ELECTRONICS Australia

August, 1970



40¢

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Units shown: RS 768US 3-head stereo tape deck • SA 53 65-watt solid state AM/FM stereo tuner-amplifier • SF 171 2-speed high-fidelity stereo record player • SB 35 3-way speaker system.

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ELECTRONICS Australia

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HOSPITAL SHOCK HAZARDS: *Dangers to patients due to broken or improper earth connections with patient monitoring systems can be minimised.* *(Page 8.)*

VHF ANTENNAS: *The construction of low-cost, simple rotatable VHF beam antennas is described on page 40 for amateurs and would-be amateurs.*

CD IGNITION: *A capacitor discharge ignition system is described by a contributor who has successfully made up several of these devices.* *(Page 47.)*

IGNITION TIMING LIGHT: *A simple instrument to permit accurate adjustment of vehicle ignition timing can be constructed at very low cost.* *(Page 89.)*

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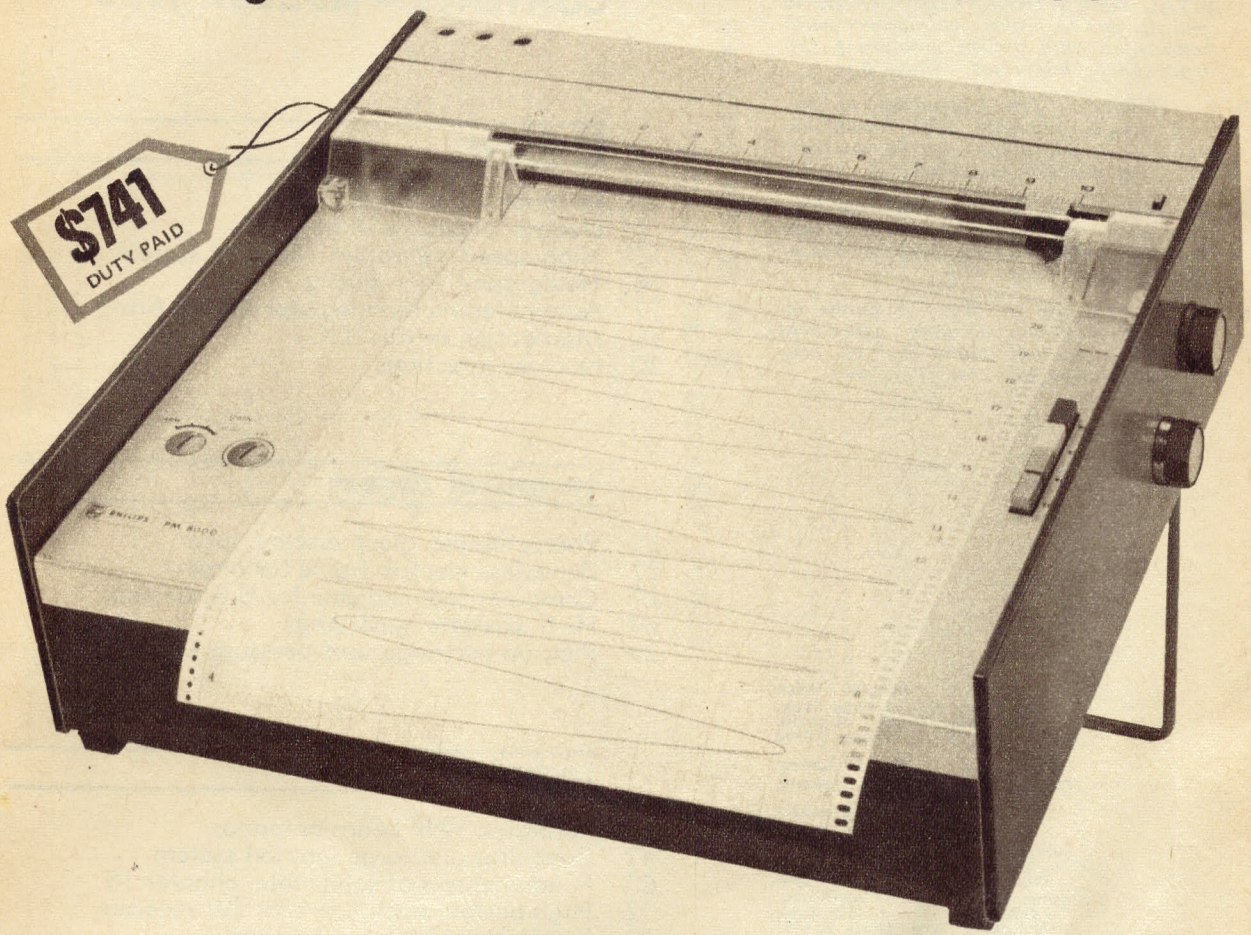
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Philips portable flat-bed recorder PM8000 priced below any other recorder in its class.



This single-function flat-bed instrument offers a low cost approach to high-accuracy recording for a broad range of scientific and analytical equipment, such as gaschromatographs, photometers and spectrometers.

Its excellent characteristics include:

- ☐ Accuracy class 0.25
- ☐ Sensitivity ImV f.s.d.
- ☐ 250 mm chart width
- ☐ Reproductibility 0.1% f.s.d.
- ☐ 0.5 to 500 mm/min chart speeds using 10 speed gearbox
- ☐ High reading accuracy
- ☐ Handles weak signals very accurately, even in presence of strong stray voltages
- ☐ Optional accessories greatly extend versatility and convenience

The new design concepts for this potentiometric strip-chart recorder have resulted in exceptionally high sensitivity and accurate recording on the 250 mm wide chart. A choice of chart speeds—both forward and reverse direction—plus a new completely clog-free disposable nylon pen, give really sharp clear readings at any angle from horizontal to vertical.

Construction is compact, rugged and cleanly styled, and a wide range of accessories enables the PM8000 to provide the exact facilities required for electrical integration, set point control or ADC. Above all, the price is well below that of any comparable recorder available today.

For complete information and specifications, contact: Philips Electrical Pty. Limited, 69-79 Clarence Street, Sydney, or your nearest Philips Office.

PHILIPS

PHILIPS test and measuring instruments

38-8921



EDITORIAL VIEWPOINT

by Neville Williams

From Japan . . .

So as not to miss this August issue, I am writing this editorial in the International Hotel at Takamatsu, overlooking Japan's inland sea.

At this point in time, the first "Electronics Australia TECHNITOUR" is about two-thirds complete and I have no doubt that the remainder of the time will flash by at a seemingly accelerated pace.

All along the route — in Hong Kong, Taiwan and throughout Japan — we have been treated not only with marked courtesy but with genuine friendliness, and one cannot resist the remark that the average somewhat off-handed Australian can learn something from these oriental people. All arrangements have dovetailed smoothly and the only anxious moments have arisen when one or another member of the party has suffered temporary internal upset, due to the unfamiliar food, water and environment.

During the early part of the tour we were able to visit the Ta Tung Company in Taipei, and the Toshiba Electrical Institute and Sony Corporation in Tokyo. Each visit was rewarding in its own particular way and our thanks are extended to the respective companies for their co-operation. En route, individual members of the party took time out to pursue their own particular interests. One group, for example, visited the Japan Amateur Radio League; another spent a fascinating afternoon at the Akihabara radio market — a sight which is incredible even when you are there! Others diverted to fulfil private business obligations.

The highlights of the tour were, however, the visits to EXPO-70, which is an enormous conglomerate of arts and sciences housed in striking architecture. One would need weeks, not days, to appreciate all that EXPO-70 has to offer, but merely to be there and to catch something of its atmosphere was an unforgettable experience.

By its very nature EXPO-70 is an expression of technology from around the world, but there is no anomaly about its setting in Japan. It is served by trains as modern — or more modern — as one finds elsewhere; by whole fleets of air-conditioned buses; by masses of cars on expressways. By busy airports: when we landed at Tokyo, we were greeted by three 747 jumbo jets!

And, everywhere, there are the marks of a modern electronic society: television in mono and colour, FM/stereo, hi-fi systems, tape recorders in every imaginable shape and size, electronic organs, piped music and so on. All this side by side with rice paddy fields, and shrines carrying the traditions of centuries. For our first party of "TECHNITOURISTS," these have indeed been memorable days.

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ON SALE
THE
FIRST MONDAY
OF EACH MONTH

On the cover

Abue, the largest elephant imported into Australia, recently put her full 4½ tons on a cardboard carton containing Philips carrier telephone equipment. She provided a novel test of the strength of a new pack designed by ACI to Philips specifications. The pack withstood weight far above requirements, and was subsequently approved by the Australian Post Office after a series of controlled tests — not involving elephants!

INSTROL HI-FI

the largest HI-FI showroom in Australia.

* NOW you can build your own JBL speaker system.

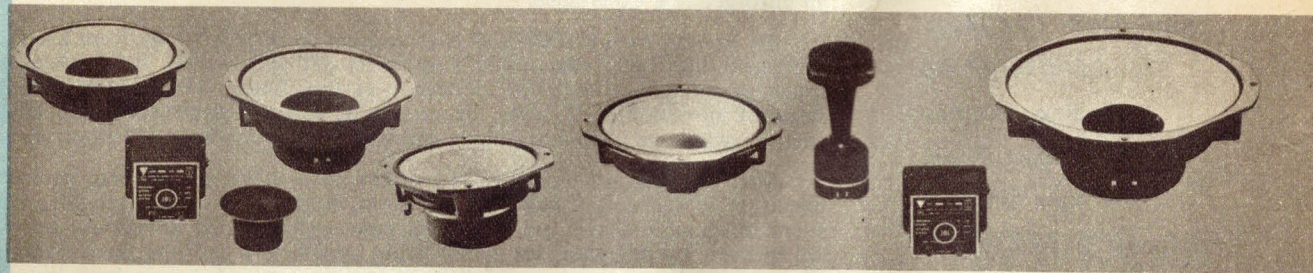
With Instrol cabinet kits and J.B.L. loudspeaker components.

JBL 032 SYSTEM

An outstanding speaker system designed for compact enclosures of 3 cu. ft or more. The 032 system comprises a D123, 12 inch low frequency loudspeaker, with heavily damped, long excursion cone assembly, 3 inch edge-wound copper ribbon voice coil and 6lb magnetic assembly. The JBL LE20, 2 inch direct radiator high frequency transducer, a unit of exceptional performance and versatility and the JBL LX2 precision dividing network, which features an H.F. attenuator and hand wound aluminium foil capacitors, individually checked to maintain accuracy to ± 1%
Frequency response 20-20,000 cps.
Impedance 8ohms.
CABINETS for JBL speaker systems are available in teak, maple or walnut finishes, and are both in kit form or built.

JBL LANCER 77 AND S11 SYSTEM

The LE10A LINEAR efficiency low frequency loudspeaker, with a 3 inch edgewound copper ribbon voice coil, lans-a-loy cone termination and a massive 10lb magnetic assembly, is normally combined with the LE20 high frequency transducer and the LX11 crossover network to make the S11 2 way speaker system. The S11 delivers smooth, full range performance and is ideally suited to our 2 cu. ft. enclosures. For more robust bass response the JBL PR10 "passive radiator" may be used in conjunction with this sytem in an airtight enclosure to effectively double the size of the speaker for greater dynamic range and smoother response well up into the mid-range.
Frequency response 30-20,000 cps.
Impedance 8-16 ohms.



JBL S1 SYSTEM

Although the LE14A 14in Bass loudspeaker has an area equal to that of many 15in speakers it may be installed in an enclosure as small as 2 cu. ft.! The large 4 inch diameter copper ribbon voice coil and massive magnetic assembly (total weight 21lbs) enable this speaker to faithfully reproduce the lowest fundamentals, even at high power levels. The JBL LE175DLH driver/horn/lens assembly consists of a compression driver, cast aluminium expotential horn and 14 element acoustic lens for 90 deg. high frequency dispersion in circular symmetry. Transition between high and low frequency transducers is controlled electronically by the JBL LX10 with variable H.F. attenuator.
Frequence response 25-20,000cps.
Power handling capacity 60 watts RMS.
Impedence 8-16 ohms.

JBL LE8T, PR8 SYSTEM

The remarkable performance of the JBL LE8T in a 1 cu. ft. enclosure cannot be matched by any other single speaker ever produced! The LE8T boasts a 2 inch edgewound copper ribbon voice coil, lans-a-loy cone termination and a 6½lb magnetic assembly. We now have available the C53 enclosure manufactured from JBL blue prints and measuring only 9in x 9in x 23in! The LE8T is ideally suited for mounting in walls or ceilings due to its shallow depth. For more prodigious base response the JBL PR8 passive radiator may be used to compliment the LE8T in airtight enclosures from 0.75 to 3 cu. ft.
Frequency response 30-18,000 cps.
Impedance 8 ohms.

CENTRE

91a York St.(between King & Market St.)

Just Released

Brand new range of:

PLAYER STANDS

and

PERSPEX COVERS

PLAYER STANDS

MODEL 35 STAND. Size 14½in x 15⅝in x 3½in. Complete with masonite base, rubber legs, fully veneered on all surfaces. Features attractive side panels raised by ¼in from player panel.

Walnut or Maple **$7.95**

Teak **$9.95**

MODEL 45 STAND. Size 17⅞in x 14⅝in x 3½in. Complete with special black surround on the base, plus a masonite safety base. Fully veneered on all surfaces. Sweeping new overseas styling.

Walnut **$8.95**

Teak **$10.95**

(Extra for player stands cut to template,75c)

PERSPEX COVERS

MODEL 315. Size 14¼in x 15¼in x 3¾in outside measurements. This sleek MOULDED cover in grey tinted perspex, is for use with the model 35 stand and any record player. Complete with attractive perspex knob.

MODEL 325. Size 14¼in x 15¼in x 4¾in outside measurements. A fabricated grey-tinted cover, ideal for record changers in conjunction with model 35 stand. Complete with attractive perspex knob.

Model 315 ..... **$8.95**

Model 325 ..... **$9.95**

MODEL 415. Size 17⅞in x 14⅝in x 3¾in outside measurements. This attractive MOULDED grey-tinted cover is for use with the model 45 stand and any record player. Complete with sleek perspex knob.

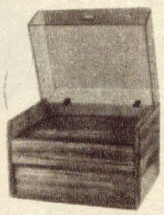
MODEL 425. Size 17⅞in x 14⅝in x 4¾in outside measurements. A fabricated grey-tinted cover, ideal for changer models in conjunction with our No. 45 stand. Complete with attractive perspex knob.

Model 415 ..... **$9.95**

Model 425 ..... **$10.95**

(Extra for covers fitted with stay-up hinger, $1.50)

COMBINED AMP/PLAYER CABINET



This model 75 cabinet combines a player stand, attractive tinted perspex cover and amplifier cabinet (4½in x 17¼in). Perspex cover comes complete with attractive perspex knob and a pair of stay-up type hinges. Cover measures 16⅝in x 14⅛in x 4⅜in inside dimensions. The cabinet comes as an easy-to-assemble kit of parts, both saving you money and facilitating transport.

Kit of parts in Maple **$25.00**

Kit of parts in Teak **$28.50**

PACKING AND REG'D POSTAGE

MODEL	N.S.W.	VIC., QLD.	TAS., N.T., S.A., N.G.	W.A.
Player stand	1.65	1.70	2.15	2.40
Perspex cover	1.65	1.75	2.25	2.55
Model 75 kit	2.75	3.05	4.20	4.90

INSTROL

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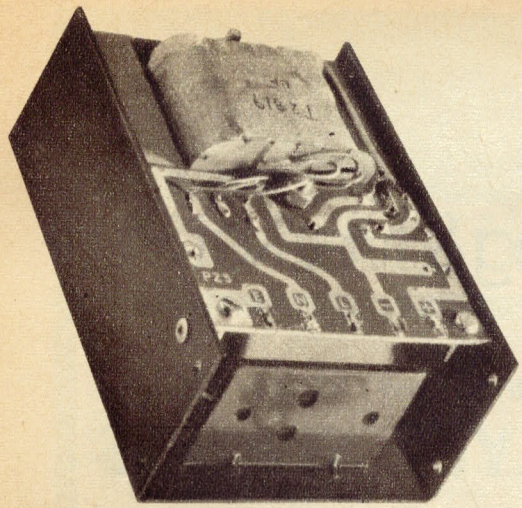
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☐ **Speaker Kits**

☐ **Player Stands and Perspex Covers**



PZ.5 and PZ.6 Power Supply Units

Two types of mains-power supply units are available for use with Sinclair high fidelity equipment. For the majority of domestic applications the PZ.5 will be found completely adequate. Where very low-efficiency loudspeakers are used, however, it will be necessary to use a PZ.6 Stabilised Power Unit. Use of the latter is also indicated where maximum outputs are required from the amplifier system under extreme operating conditions.

PZ.5
Unstabilised power supply unit recommended for two Z.30 amplifiers and Stereo 60 for all average requirements.

Specifications

Output:
30 volts/1·5 amps maximum.

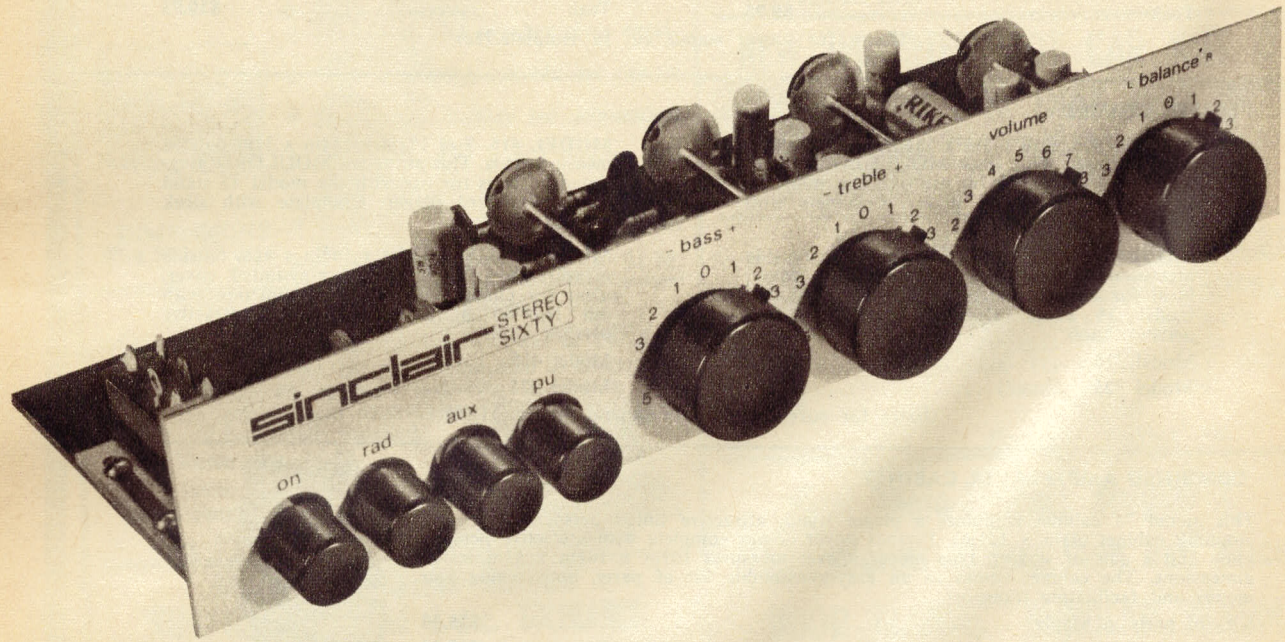
Mains input:
110-240 volts ± 20% 50/60Hz.

Size:
3·9″ × 2·8″ × 1·6″

PZ.6
Stabilised mains supply unit delivers 35 volts at 1·5 amps with ripple less than 20mV at any output up to maximum current.

Size:
3·9″ × 2·8″ × 1·6″.

SINCLAIR PRODUCTS for the ELECTRONIC CONSTRUCTOR



Stereo Sixty Pre-amplifier and control unit

Elegantly modern design with original concepts in circuitry make this pre-amp and tone control unit meet the most stringent high fidelity standards. Basically it is for use with two Z.30 amplifiers powered by a PZ.5 (or PZ.6), but it is equally satisfactory used with other good power amplifiers. Silicon epitaxial planar transistors are used throughout and a very high signal-to-noise ratio has been achieved together with excellent channel separation. The unit is very easy to mount in cabinet or modern plinth with motor and pick-up assembly.
Input selection is by means of four push buttons and accurate equalisation is provided for all the usual inputs. The tone controls are also very carefully designed and tested.

Specifications

Input sensitivities:
Radio: up to 3mV
Magnetic pick-up: 3mV
correct to R.I.A.A. curve ± 1dB
20 to 25,000Hz
Ceramic pick-up: up to 3mV
Auxiliary: up to 3mV.

Output:
250mV.

Signal-to-noise ratio:
Better than —70dB.

Channel matching:
Within 1dB.

Tone controls:
Treble +15dB to —15dB at 10kHz
Bass +15dB to —15dB at 100Hz.

Power consumption: 10mA. max.

Front panel:
Brushed aluminium with black knobs and controls.

Size:
$8\frac{1}{4}$″ × $1\frac{5}{8}$″ × $3\frac{1}{2}$″.



Z.30 Twenty watt high fidelity amplifier

This is a power amplifier of advanced design, having a fantastically low distortion level of 0·02% at maximum output and all lower outputs. As far as we know, no other high fidelity amplifier made can match this specification, no matter what the price. Nine silicon epitaxial planar transistors are employed in circuitry which enables the Z.30 to operate from any voltage from 8 to 35 without adjustment and from any power supply. Essentially a high fidelity power amplifier of the very highest standards, the gain of the Z.30 is such that it can be fed directly from a crystal pick-up enabling it to be used in an economy battery operated record player for example. The versatile Z.30 has very many applications, however, ranging from high fidelity to P.A. and laboratory work and these are fully detailed in the comprehensive manual included with the unit, which is supplied built, tested and guaranteed.

Applications
Hi-fi amplifier: car radio amplifier: record player amplifier fed directly from pick-up: intercom: electronic music and instruments: P.A.: laboratory work, etc. Full details for these and many other applications are given in the manual supplied with the Z.30.

Specifications

Power output:
15 watts R.M.S. (30 watts peak) into 8 ohms using a 35 volt supply: 20 watts R.M.S. (40 watts peak) into 3 ohms using a 30 volt supply.

Output:
Class AB.

Frequency response:
30 to 300,000Hz ± 1dB.

Distortion:
0·02% total harmonic distortion at full output into 8 ohms and at all lower output levels.

Signal-to-noise ratio:
Better than −70dB unweighted.

Input sensitivity:
250mV into 100K ohms.

Damping factor:
> 500.

Loudspeaker impedances:
3 to 15 ohms.

Power requirements:
From 8 to 35 volts d.c. (the Z.30 will operate ideally from batteries if required).

Size:
$3\frac{1}{2}'' \times 2\frac{1}{4}'' \times \frac{1}{2}''$.



IC.10 Integrated Circuit 10 watt amplifier

The Sinclair IC.10 is the world's first monolithic integrated circuit high-fidelity amplifier and pre-amp. It has 5 watts R.M.S. output (10w. peak). The circuit is a specially processed silicon chip, one-twentieth of an inch square by 0·01 inch thick, containing 13 transistors, 3 diodes and 18 resistors. This, together with its connecting pins, is bonded to the supporting heat sink which runs through the solid plastic package in which the circuit is encapsulated. The resultant product is infinitely more rugged than any amplifier ever made available before to the public. The IC.10 is a true high-fidelity amplifier possessing distinct advantages over conventional types. The most important are complete freedom from thermal runaway and very low distortion level. Thus battery operation is perfectly satisfactory. As an audio amplifier, the IC.10 requires only the addition of components such as tone and volume controls. However, it can also be used in many other applications including servo amplifiers, etc, since the circuit is d.c. coupled in both its sections. The manual provides details of an extraordinarily wide range of applications together with all necessary instructions.

Specifications

Output:
Class AB, 10 watts peak, 5 watts R.M.S. into 3 Ω with 18v. supply.

Frequency response:
5Hz to 100kHz ± 1dB.
Total harmonic distortion less than 1% at full output.

Power gain:
110dB (100,000,000,000 times) total.

Supply voltage:
8-18 volts.

Sensitivity:
5mV.
Input impedance adjustable externally up to 2·5 MΩ for above sensitivity.

Size:
1″ × 0·4″ × 0·2″.

Circuitry:
3 transistors in pre-amp; 10 (including two power types) in power amplifier. Both sections are d.c. coupled, and a high level of negative feedback is applied over all. With a transistor cut-off greater than 500MHz, the pre-amp can be used as an RF or IF stage and the whole IC.10 used as a radio receiver without the need to add further transistors.

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GE-P553

Protecting Hospitalised Patients from Electrical Hazards

Electrodes internal to the body give rise to safety problems far more complex than generally supposed, requiring changed thinking about the design and use of medical electronics equipment.

by William F. Craven

Medical practitioners are becoming concerned about the growing possibility that hospital patients connected to monitoring equipment might be electrocuted. Extremely low current levels can be lethal if allowed to flow between earth and electrodes internal to the body, especially those inserted in the heart.

Monitoring equipment itself is basically harmless but, because it makes conductive contact to the patient, it can be the key link in a life-threatening current path.

Although it is difficult to determine how many patients actually are electrocuted, because death of the very ill is often attributed to other causes, accidental deaths from electrocution have been reported in the literature since 1960[1]. Some of these accidents are caused by faulty electronic equipment, but more often they are caused by misapplication of equipment. I would like to discuss here the subtle ways electrocution can occur, and what can be done to reduce the likelihood of such catastrophes.

There has been concern about shock hazard ever since electric power came into general use in the late nineteenth century. Many investigations were conducted to establish safety standards, most of them concerned with gross effects — like pain, muscle stimulation, and tissue destruction from burning — caused by electrical current travelling through the intact skin from limb to limb. The results of these investigations, which show the effects that various current levels have on human beings, are summarised in the box below[2].

Although it varies widely from person to person, the threshold of perception is about 1mA. At this level, a faint tingling sensation is felt. At a current level of 5mA, many sensory nerves are stimulated and the sensation becomes painful, usually to the point that the subject jumps away from the source of stimulation.

Effects of 50Hz current on average humans through the trunk (one-second contact)

.001A	Threshold of perception.
.016A	"Let-go" current. Sustained muscular contraction.
.05A	Pain. Possible fainting, exhaustion, mechanical injury. Heart and respiratory functions continue.
.1 to 3A	Ventricular fibrillation. Respiratory centre intact.
>6A	Sustained myocardial contraction followed by normal heart rhythm. Temporary respiratory paralysis. Burns if current density is high.

At current levels higher than 5mA, motor nerves are stimulated and the affected muscles contract. At the so-called "let-go" current level, around 10 to 20mA, muscle fibres are kept in a constantly depolarised condition. The subject then has no ability to control his own muscle actions and he is unable to release his grip on the electrical conductor. Above the "let-go" level, electrical stimulation becomes increasingly painful and mechanical injury may result from the powerful contraction of the skeletal muscles. Despite pain and fatigue, however, the heart and respiratory functions continue.

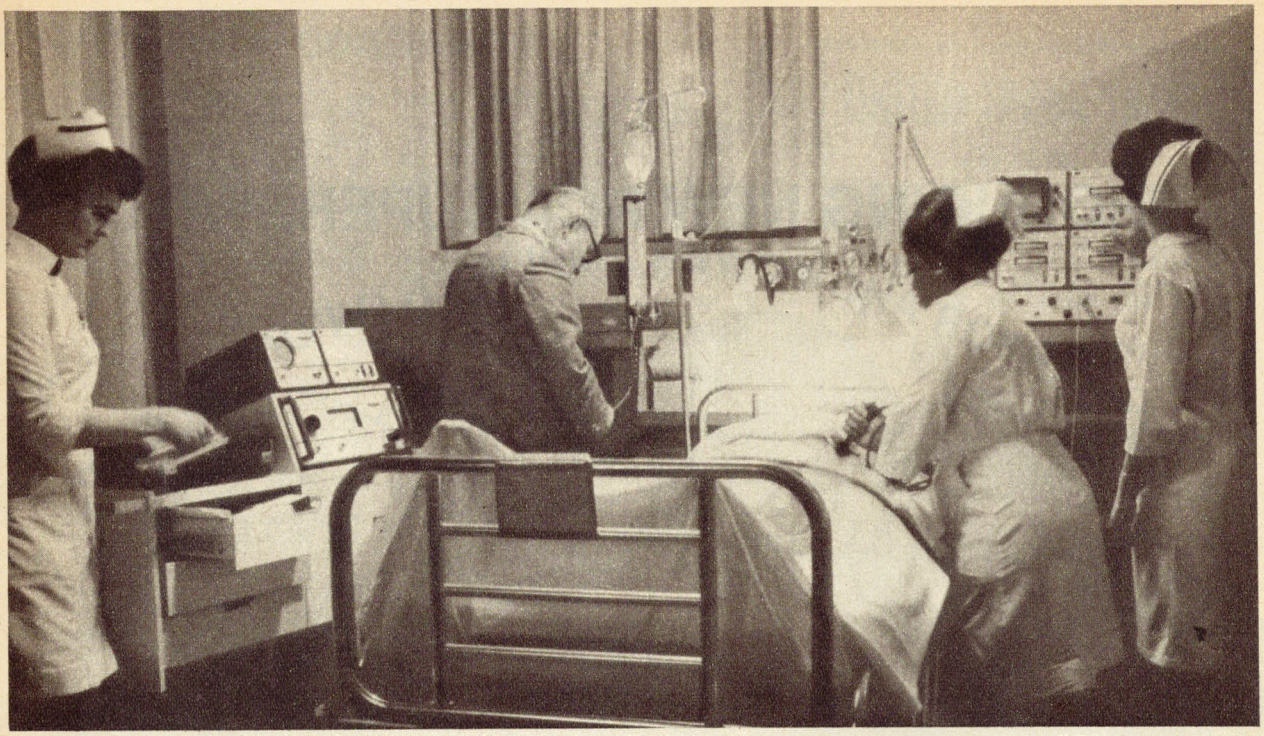
At about 100mA, other more life-threatening physiological phenomena occur. One of the more common is ventricular fibrillation, a lack of co-ordinated action among the muscle fibres of the heart. Fibrillation defeats the heart's ability to pump blood and is fatal unless corrected within minutes. At about 6A or more, though, the heart goes into sustained muscular contraction, much as skeletal muscles do at the let-go level, but when the current ceases, the heart usually reverts to its normal co-ordinated mode of operation. This phenomenon is used extensively to restore normal rhythm to fibrillating hearts, usually by applying a 1-3KV, 5mS, pulse to the chest.

Continuous high current levels of 6A or more also cause temporary respiratory paralysis and may cause serious burns if the current density is high. At current levels much above 6A, massive damage is caused by the heating effect of the current flow.

The voltages required to obtain these current levels vary widely because the contact impedance varies from person to person, depending on skin type, contact area, and on other parameters such as whether or not the skin is moist. Typically, the threshold of feeling is from 10V to 50V.

From many investigations conducted over the years 5mA has become accepted as the maximum that should be

1. "Medicine and the Law: Fatal Shock from a Cardiac Monitor," Lancet 1:872, 1960.
2. Bruner, John M. R., "Hazards of Electrical Apparatus," Anesthesiology, March-April, 1967.
3. Whalen, Robert, Stanner, McIntosh, "Electrical Hazards Associated with Cardiac Pacing," Academy of Science Annuals, New York, 1964.



Patients in intensive care wards may simultaneously come into contact with several different types of monitoring instruments and electrical appliances.

allowed to pass through a human being from external contact. Among the many tests that electrical equipment must pass to receive Underwriter Laboratories listing, is one specifying that 50Hz leakage currents from the mains to the equipment case shall be less than 5mA. That is, if a person were to touch an electrical instrument or appliance while standing barefoot on wet earth, there should be no more than 5mA flowing through his body. Nowadays, these leakage currents arise in electronic equipment primarily from capacitive coupling in RF line filters and between the primary winding and core and case of the power transformer. Resistive leakage paths have been reduced significant by modern insulation materials.

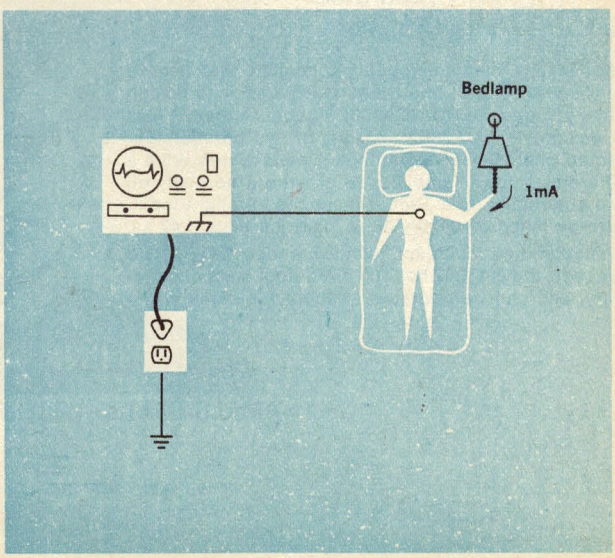
The preceding has assumed that electrical contact is made outside the body. With the improved instrumentation now available to hospitals, it is common to have electrical contacts made inside the body where fluid electrolytes substantially reduce resistance to current flow. In a modern surgical intensive care unit, for instance, a patient may have four direct connections to his heart to allow measurement of pressures in the various chambers of the heart. This patient would also, most likely, have an electrocardiograph attached externally to his body along with temperature probes, respiration sensors, and perhaps mechanical assist devices like respiration pumps and heart-lung machines. In these circumstances, there is a possibility that leakage currents might pass directly to the heart. Furthermore, not only is the resistance to current flow reduced by internal electrodes, but the current levels deemed hazardous are much smaller than externally applied hazardous current levels.

Of the many groups concerned with patient safety, most believe that current passing internally through a patient should be limited to less than 10μA. Investigators at Duke University have shown that a current as small as 20μA flowing between the right and left ventricles in the hearts of dogs can cause ventricular fibrillation[8]. Although the average current causing ventricular fibrillation in this study was 170μA, the fact remains that much smaller current can cause fibrillation. Naturally, it is difficult to perform similar experiments with humans but there is good reason to believe that the fibrillatory current may be similar. Since the minimum impedance likely to be found between two electrodes can be as low as 500 ohms, a working group of the National Fire Protection Association recommends that non-therapeutic voltages that a patient may contact should be less than 5mV.

Let us look at some of the situations that can arise in hospitals. Figure 1 shows a patient in bed with earthed monitoring equipment attached. He reaches over to turn on his bed lamp, a two-wire lamp that has a leakage current of 1mA but which still passes all present safety requirements. This 1mA can pass through his arm, then through his trunk to the earthed patient monitor with a portion going through his heart. In fact, if an earthed electrode were attached to his heart, all of the 1mA might flow through his heart, causing immediate ventricular fibrillation. The existence of this leakage path would go undetected, unless a nurse or attendant, accidentally touching both lamp and monitor, also noticed a shock. Who knows how many patients might have been electrocuted before anyone correlated a patient's sudden crisis with touching the lamp? Fortunately, when a patient is monitored, an alarm sounds if his heart starts fibrillating so resuscitation can be started immediately.

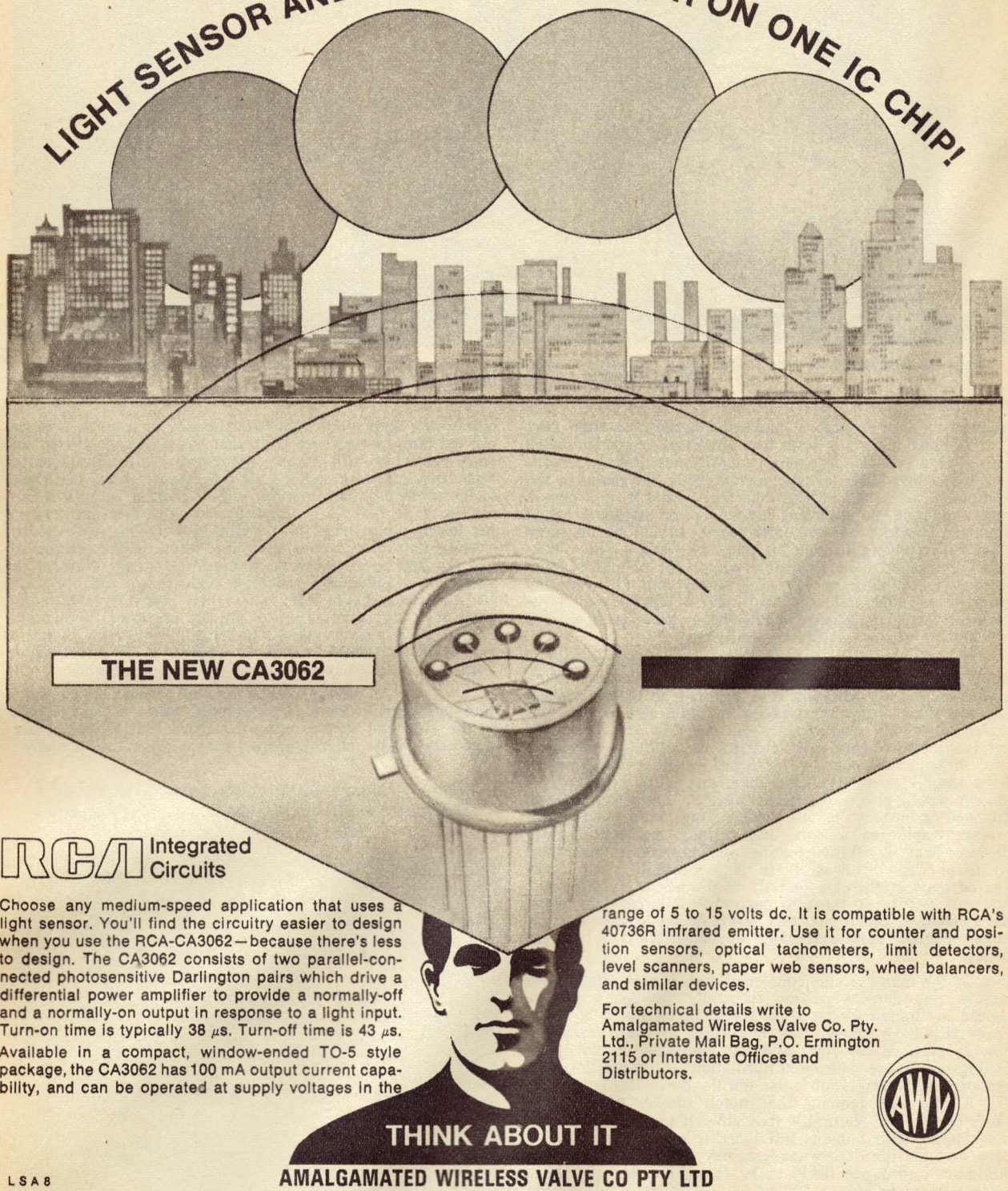
We are all aware of the hazards posed by common household appliances and power tools, where a leakage path to the case can create a shock hazard, but when we are concerned with microamperes rather than milliamperes,

Figure 1. Normally harmless leakage current in a lamp can become dangerous if a patient has internally attached electrodes.



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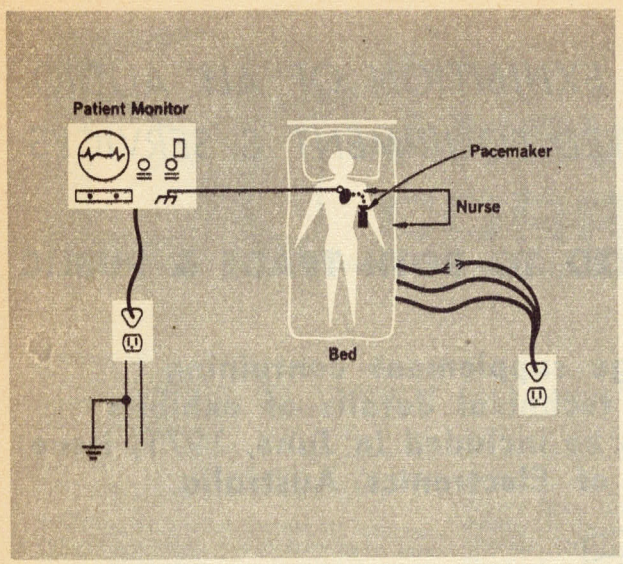


Figure 2. Broken earth wire creates hazardous environment for monitored patient. In this case, nurse unintentionally completes circuit from mains power to earth through patient.

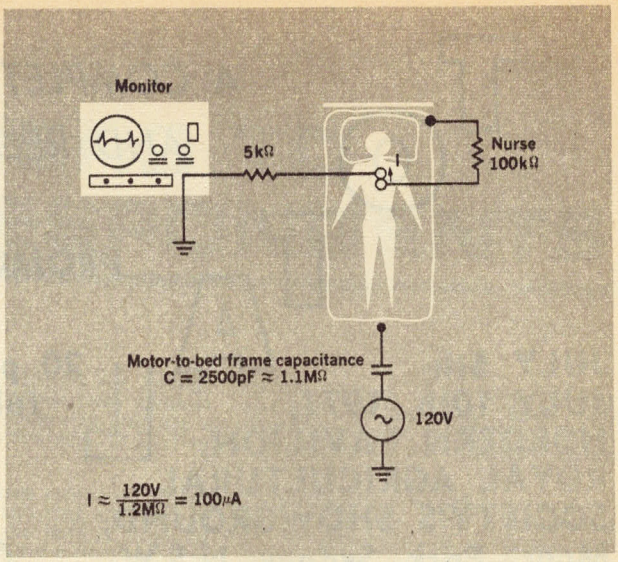


Figure 3. Equivalent circuit of situation diagrammed in figure 2.

there are many unsuspected ways that shock hazards can arise.

A more subtle situation is shown in figure 2. Here the patient is on a bed that has electric motors to raise, lower, and adjust his position. An earth wire is broken, so the metal framework may be at some potential other than earth because of capacitive coupling between motor wiring and bed frame. The patient is connected to earth through an electrocardiograph (ECG) monitor, and he has a pacemaker catheter inserted into his heart to synchronise his heart's rhythm. However, the pacemaker is battery operated and is not tied to any AC outlet. So, the patient is safe — so far.

Now suppose the nurse adjusts the wiring on the pacemaker while leaning against the metal bed frame. Obviously, she supplies an electrical path from the bed frame to the patient's heart and then to the earthed monitor, as shown in the equivalent circuit of figure 3. As much as 100μA could flow through the patient's heart and, as discussed earlier, this could cause ventricular fibrillation.

Had the bed been earthed, there would have been no problem. Equipment in hospitals, however, gets severe use, and it is usually handled by people who do not understand electricity and who do not understand the need for good earthing. The bed, which worked fine because it did not rely on the earth wire for operation, could have had a broken earth wire unnoticed for a long time. The only evidence that something might be wrong might have been excess 50Hz interference on the monitor oscilloscope. Those using the equipment probably would have assumed the problem was in the monitor or electrodes, and would likely have done nothing further.

Let us look at one more example. Figure 4 shows a patient grounded by an ECG monitor. Intercardiac blood pressure is also being monitored by a saline-filled catheter inserted through a vein into the patient's heart. The catheter transmits pressure to an external transducer that is connected to an earthed monitoring device in such a way that the saline-column is also connected to earth. The patient's heart is thus effectively tied directly to earth. No problem yet.

It so happens that the patient is in an older hospital where the intensive care unit was converted from a general ward area, requiring the installation of additional electrical outlets. As is common practice, and as permitted by most electrical codes, the earth wire for the new outlets was not connected directly to existing outlets but was routed all the way back to the power distribution panel. In this case, the ECG monitor was connected to an outlet on one earthing system and the pressure monitor was connected to the other earthing system. Still no problem.

Now, along comes the cleanup man with his vacuum cleaner. Vacuum cleaners are notoriously unsafe devices because they are prone to large amounts of residue in their

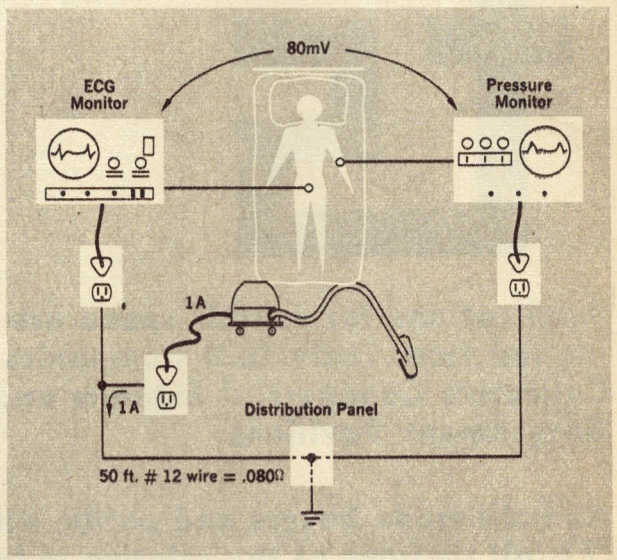


Figure 4. If all equipment near the patient is not connected to a common earth point, a hazardous situation can develop. Leakage current in the vacuum cleaner is sufficient to create a voltage dangerous to the patient.

suction motors, and they often pick up debris that may be damp. Over a period of time the motor develops resistive leakage paths from its windings to the vacuum cleaner case although a three-wire power cord prevents the case from rising to a high potential.

This particular vacuum cleaner has developed a leakage path that allows 1A to flow in the earth wire. This current flows through the earth wire in the outlet back to the power distribution panel 50 feet away. The 12-gauge ground wire has a resistance of 80 milliohms, which means there is a voltage drop of 80mV from outlet to distribution panel. So now the patient is connected between two earths that have an 80mV potential difference. Now there is a problem: if the impedance between the two grounds on the patient were much less than 8000 ohms — and it could be as low as 500 ohms — more than 10μA would flow.

Here we have an insidious situation in which the patient might have expired without anyone touching him or without his touching a lamp or anything else. The connection between plugging in the vacuum cleaner and the patient's sudden demise is far from obvious. It should be emphasised that the wiring as installed met all requirement of existing electrical codes.

The above examples show that where there is direct

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electrical access to the heart, extreme caution must be observed in attaching electrical monitoring equipment to patients. What can be done to prevent problems from occurring? One way is to prevent, where possible, electrical pathways to the heart. The new Hewlett-Packard Model 1280 B/C Pressure Tranducers, for example, have dome and diaphragm electrically isolated from the rest of the transducer to provide protection for catheterised patients.

Additional protection can be provided by limiting to less than 10μA the maximum possible current in all leads connected to the patient. Hewlett-Packard electrocardiographs and instruments for patient monitoring now have current-limiting circuits that allow no more than 10μA to flow through patient-connected leads should the patient come in contact with 115 volts, or even 230 volts. This insures that the equipment does not supply an earth path if the patient comes in contact with voltages produced by other equipment such as beds, TV sets, radios, and electric shavers. This type of monitoring equipment, by isolating the patient electrically, does not contribute to hazardous situations.

How patient isolation is achieved in this equipment is shown in the diagram of figure 5. In much the same way that signal earth is isolated from equipment in guarded digital voltmeters, patient leads are isolated from the measuring experiment. The only connection between the patient and equipment ground is through stray capacitance C1, which is approximately 95pF. During the design phase, careful attention was also paid to all other possible current leakage paths from the isolated input to the rest of the equipment. As a result, the impedance between input circuits and ground is greater than 25 megohms at 50Hz. This means that if a patient connected to a monitor using this circuitry should come in contact with 115V, no more than 4.6μA could flow through him.

To protect the patient from all sources of electrical shock, regardless of the equipment used, great care must be exercised in the installation and maintenance of equipment within his reach. One way is to connect to one common point all nearby metal surfaces and all electronic devices to which he is attached. This point, referred to as the equipotential patient reference (EPR), is then connected to the hospital earthing system. The EPR can have a potential with respect to real earth without harm to the patient because he cannot come in contact with any metal object except those tied to the EPR. It is important, however, to limit the length of earth wires connecting the equipment to the EPR and to limit possible current flow in these wires so that the potential difference between equipment and EPR is always less than 5mV.

Further improvements in an EPR system can be obtained with an isolating transformer, as shown in figure 6. Here, even if a leakage path exists in a piece of equipment from the "hot" side to "common" (the EPR), the maximum current that can flow is that permitted by stray capacitance between the isolation transformer windings and in associated wiring.

Also included in this system is a fault detector that monitors the impedance between the EPR and each side of the line. Should the impedance fall below a level that allows just a few milliamperes to flow in the EPR, a warning is set.

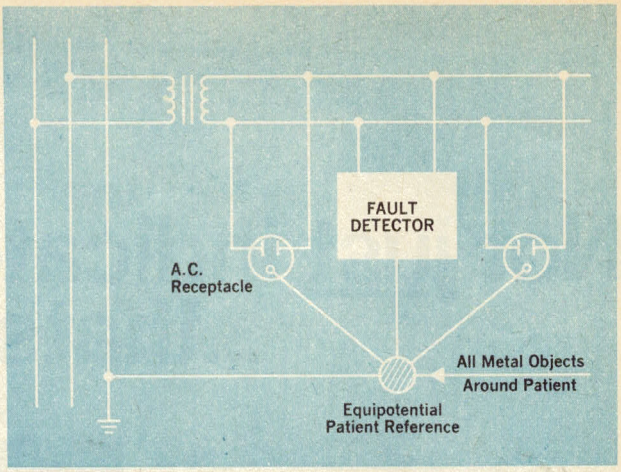


Figure 6. An isolation transformer and a single earth point provide a safe electrical enviroment if all earth leads are inspected regularly.

Nevertheless, even with the improved protection provided by an EPR, not all hazards are eliminated. If the earth wire connecting the EPR to the chassis of an attached instrument should break, stray capacitance could raise the chassis potential above earth and, since plugs get yanked out of outlets and power cords get stepped on and kicked around, breaks in earth wires occur far more often than leakage faults in transformers. If the installation were designed so that all leakage currents in the isolation transformer, wiring, and instruments were less than 10μA (designing a distribution system with less than 10μA leakage is not easy), the patient would be safe should a ground wire break. Obviously, instruments with isolated inputs provide an important safety factor here, but many installations do not have them. Hence, good earthing practice is not only essential, but frequent inspection of the electrical environment is imperative.

From the preceding, it is obvious that providing good, safe monitoring to patients in hospitals is not a simple task. The best that can be done is to reduce the risk of accidental electrocution to the lowest possible level by using a combination of isolated patient circuits and a properly installed and maintained earthing system. These provide a double barrier to electrical accidents. Failure of either one does not place the patient in immediate jeopardy as long as the other is intact. The fault would be found during the next routine inspection of the electrical environment. By making regular inspections, the probability of simultaneous failure of both safety barriers can then be reduced to an acceptably low level.

(Continued on page 189)

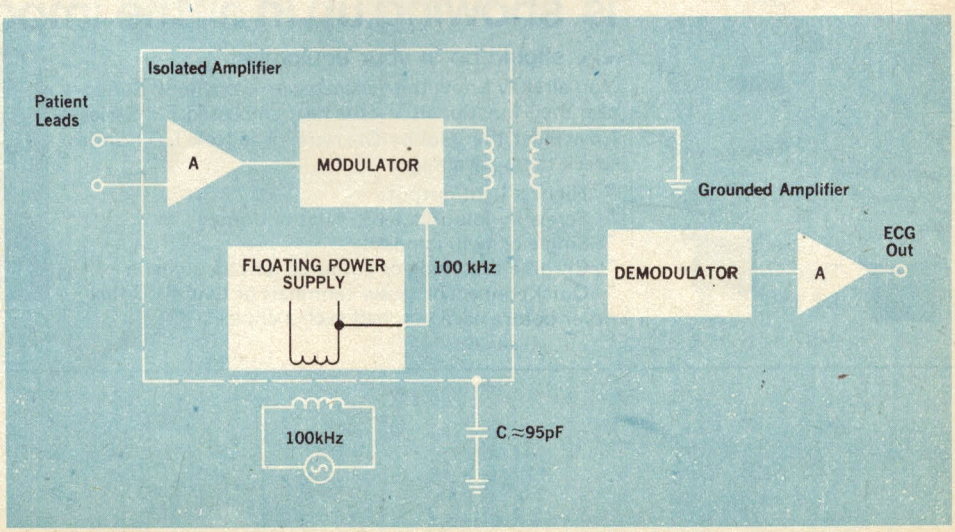
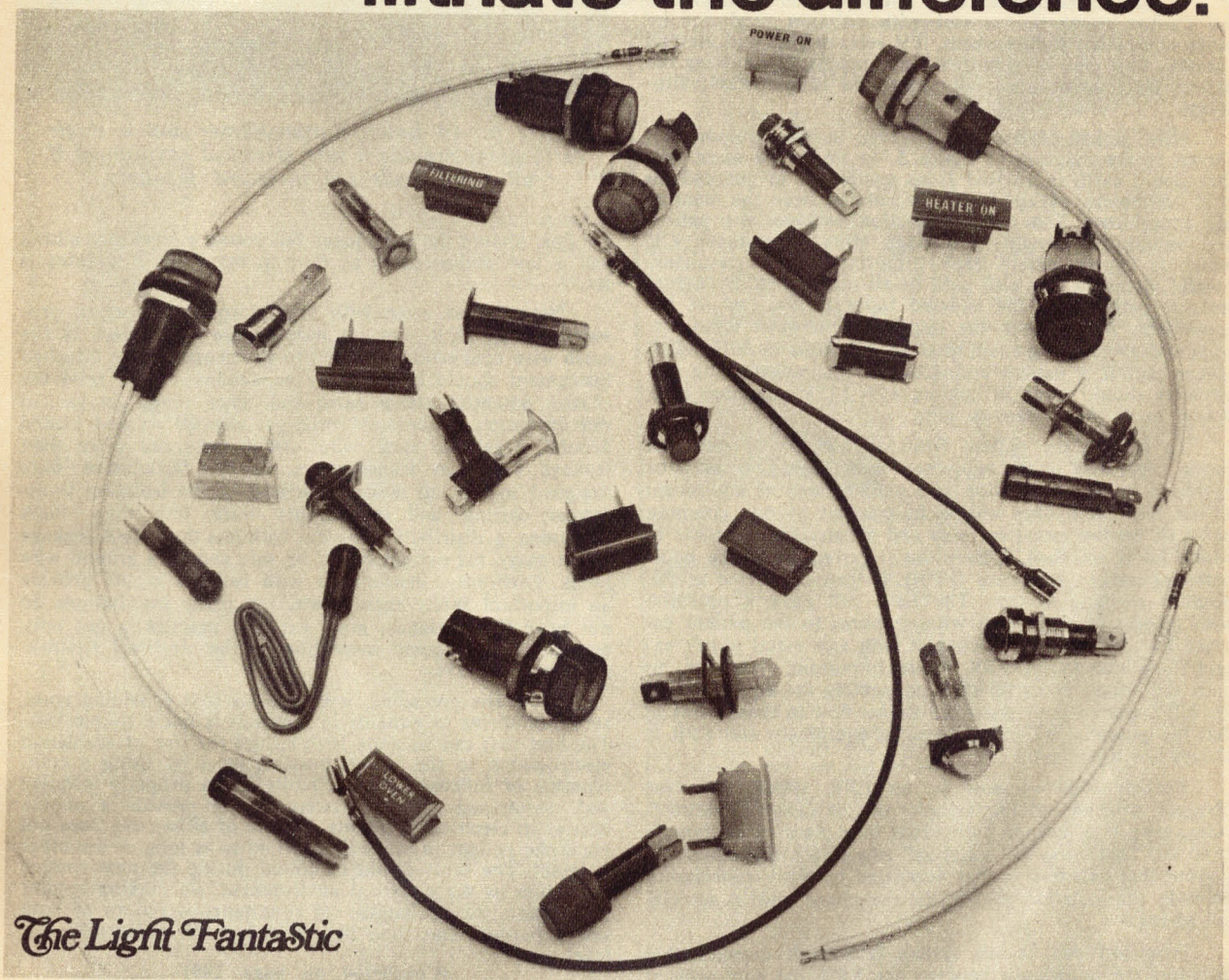
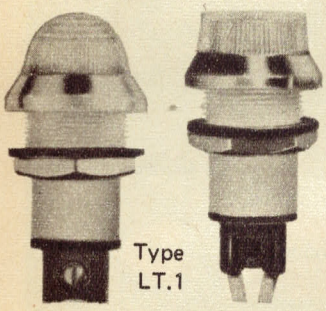


Figure 5. AC coupling to an isolated amplifier eliminates any DC connection between input and output. The input signal modulates a 100KHz carrier for coupling to external circuits. A demodulator recovers the original input waveform.

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Microfilm Storage with High-Speed Retrieval System



An automated filing system which can retrieve upon demand any one of millions of microfilmed documents within ten seconds has been developed in the U.S.A. by the Varian group.

The system, called the Varian ADCO 626 Microfilm Storage and Retrieval System, does not require a computer, and uses a specially developed film carrier.

The fast response of the system is made possible by an optical search head which can scan a file of 1,000 microfilm carriers and identify the required one in a maximum of one second. The entire system requires less than 10-second access from any number of remote points to a multi-million page master file. A high definition (1225-line) closed circuit television system is used for displaying stored information.

Recent studies have shown the cost of storing a page of information in a computer can be as high as $40, on a per-bit-stored basis. Equivalently, the new Varian ADCO 626 system costs approximately 8 cents per page, or almost 1/500th the cost, representing a significant economic breakthrough in the rapid filing and secure storage and retrieval of printed or graphic information on microfilm.

Not only does the average organisation waste 76 cents out of every dollar spent for record-making and filing operations, the studies showed, but the average cost of a single misfiled document has been calculated authoritatively to be $85. This, plus the fact most organisations misfile one per cent of all documents, can have a significant effect on profits.

Moreover, a "Dun's Review" survey of 278 manufacturers indicated 47 per cent of the firms agreed that better filing procedures and systems offered the greatest single opportunity in business operations for improvement and cost savings. The average company, further, keeps seven per cent more records than it actually has to, and uses 45 per cent of all file cabinet space to store duplicate records and file copies that have no real reference value whatsoever.

In announcing the new system, Varian said market studies showed that many organisations today are anxious to begin the task of updating their systems and automating document retrieval procedures, but have been hesistant because of the prohibitive costs of many microfilm retrieval systems that are computer-based. The ADCO 626 system was designed precisely for such organisations, Varian says.

The system operates by means of a hardwire logic/digital controller arrangement whereby the user directly addresses the optical search head by typing the number of the document he wants to be retrieved. This number directs the photodiode/light cell search head to the tray of carriers where the document has been filed, and the search head then scans the binary-notched codes on the edge of each carrier with a collimated light probe.

When the proper carrier (or carriers) has been selected, it is placed on to a high-speed miniature conveyer which takes it immediately to a high-resolution TV camera. An image of the microfilm is then transmitted to a 1,225 line TV monitor at the request station where an electrophotocopier will make hard copies.

Whether 16, 35 or 105-millimetre size, the frames are stored in their carriers according to the following filing hierarchy: 1,000 microfilm image carriers per tray; 10 trays arranged on a single level; five levels form a basic storage module and a maximum of six of these modules form a storage bank, or bay. Because each microfilm frame can contain up to 30 page-images, a single bay gives the user a nine-million-page capacity. There is a search head for each level of microfilm storage, operating independently from all the others, each with its own delivery system and TV camera.

The following is a summary of the system's main features:

Simultaneous access to documents by a number of users — even those requesting information from distant cities;

instantaneous transmission of image to any number of request stations, with hard copies available at each;

fully automatic infiling, purge or updating offered as a standard feature;

remote operation over microwave or cable links, or over existing telephone line equipment;

no computer is required for system operation — this saves extensive leasing, programming and training costs;

a basic System 626 file bank of any number of pages can be expanded modularly, in increments of 50,000 to 1.5 million pages (a single module), to accommodate every organisation's particular filing and retrieval growth requirements;

expansion of the system to multi-million or even thousand million page capacities does not affect retrieval time;

while it doesn't need a computer, the system is easily linked to any modern business computer without extensive software;

the system can make hard copies of any record at any remote terminal in 10 seconds, at a price competitive with current copy costs;

the 626 system can store in its basic configuration, up to nine million pages of documents, including all necessary hardware, in 350 sq. ft. — less than 5 per cent of the 7,500 sq. ft. required for an equivalent amount of documents in four-drawer file cabinets;

retrieval in less than two seconds of each successive frame after the first has been displayed;

indexing is by whatever system an organisation is already using — no special language or coding method is required;

no complicated peripheral equipment is required;

the system is equally economical and flexible for any type of organisation or industry;

visual verification of records being retrieved is provided by digital tube readouts on the operator's console;

a "browsing" mode is included to let users casually scan groups of documents, stopping whenever they wish to make hard copies of specific pages;

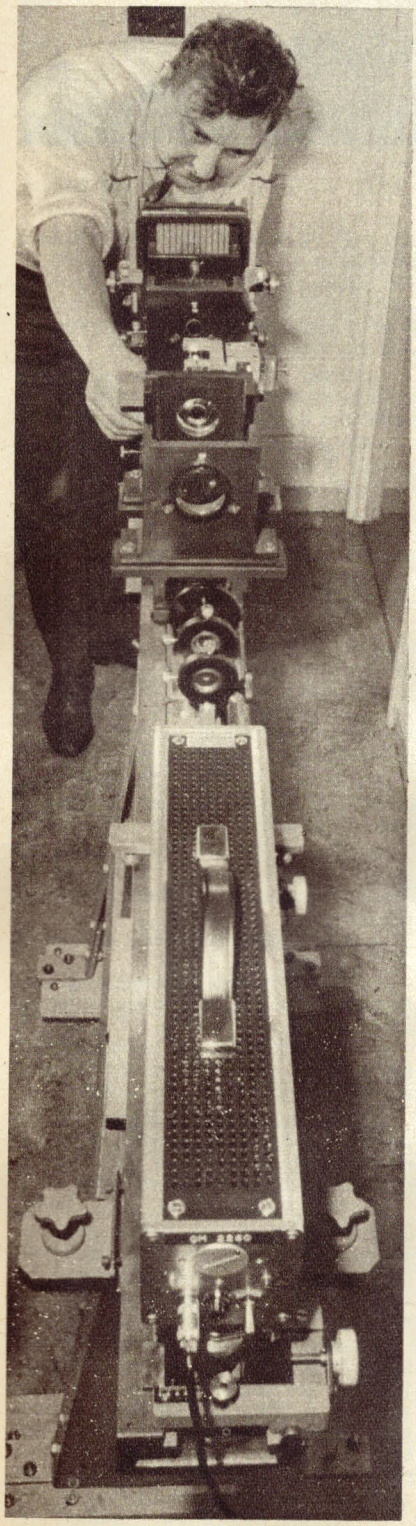
the film surface or the index coding is never handled; the system operates anywhere, needs no special air conditioning or flooring, and is powered by standard 220V AC line current; totally secure, pilfer-proof document storage.

Industries expected to be attracted to the ADCO 626 system are insurance, banks, government agencies, State agencies such as motor vehicle departments, law enforcement agencies, credit card companies, hospitals and companies which store and refer frequently to large volumes of maps, charts and drawings, and other documentation.

HOLOGRAPHY IN INDUSTRY

In the past few years, articles have been published regularly in "Electronics Australia" on holography, the technique of reconstructing three-dimensional images from a photographic plate made with the light from lasers. Continuing research has resulted in the development of techniques that are now being exploited by industry.

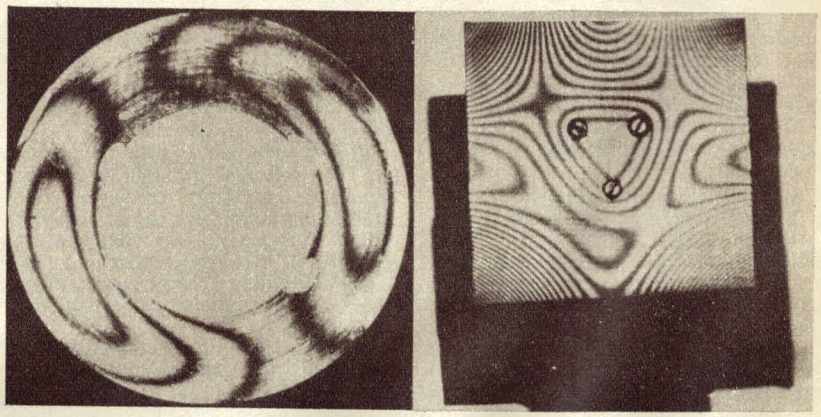
By Ron Brown



It is, for example, possible to use holography to see vibration patterns of such things as high speed turbine blades, piezo-electric transducers and structures of many kinds. It is also possible to measure extremely small changes of shape of structure when it is loaded, or to compare components as they come off the production line with a three-dimensional image of a perfect component. Any errors show up immediately in the form of an easily identifiable light pattern.

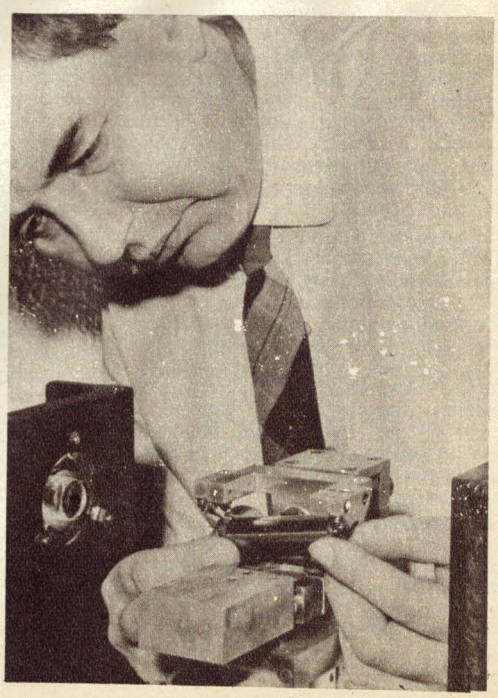
One of the applications of holography is to check high precision motor car cylinders against the reconstructed image of a master cylinder. The hologram is recorded by shining a laser beam on to the interior walls of the cylinder and when it has been developed it is replaced in its holder and illuminated. This produces a three-dimensional image of the cylinder which superimposes itself exactly on each production line cylinder where it replaces the master cylinder. With an imperfect cylinder, the residual differences between the two images produce interference fringes. Errors in the shape of the production line cylinder can be detected and measured by observing the shape and position of the interference fringes. The fringe pattern can be regarded as a contour map in which the contour interval is an error of 1.8 micrometres in the radial direction. This cylinder measuring technique is now being developed in collaboration with a leading British motorcar components manufacturer.

A slightly different technique is used to check vibrating objects such as turbine blades. These blades and many other components show mode patterns that vary with frequency when they are vibrated. At any one frequency some parts of the components are stationary and other parts vibrate vigorously. If a hologram of such a vibrating body is made with a long exposure time the sta-



ABOVE LEFT: Comparison of diesel injection pump cyclinder bores. The view down the cylinder bore shows contour fringes representing the difference between a perfect master cylinder and one whose axis is curved.

ABOVE RIGHT: Pattern of fringes over a square plate attached to a piezo-electric crystal vibrating at 1052Hz.



LEFT: The complete apparatus used for examining cylinder bores by holography.

RIGHT: The master cylinder being inserted into its mount.

tionary parts will produce a normal hologram image, but the vibrating parts will be recorded in many different conflicting positions and will be "washed out" by destructive interference in the finished hologram. When the hologram is later illuminated the stationary parts appear bright and the vibrating parts appear much darker, and are covered in a fringe pattern contouring the equal amplitudes of vibration. In this way the positions of the nodes and antinodes are clearly visible.

The National Physical Laboratory in the U.K. has invented an important extension of this technique which makes use of the stroboscopic effect to freeze the vibrating patterns. The idea here is to place a hologram of the test object in exactly the same position it was in during the recording process. The test object itself also remains in its original position and is viewed through the hologram plate so that the object and its three-dimensional image coincide. This produces the normal pattern of interference fringes. The position of these fringes does, of course, depend upon the relative positions of the object and its image: any slight movement of the object relative to its image causes the fringes to move. This means that if the object is vibrated its periodic movement will cause the fringes to sweep backwards and forwards across its surface at the vibratory frequency. If the laser used to illuminate the object and the hologram is pulsed on and off at the frequency of vibration the movement will appear to be arrested in the classic stroboscopic manner. The distortion of different points on the surface at that particular vibratory frequency can then be observed directly, and the effects of varying the frequency can be observed by simply turning the frequency control knob of the oscillator producing the vibratory frequency. Vibration analysis carried out in this way has a very high sensitivity because the interference fringes are effectively contour lines spaced at intervals of one-half wave-length of the laser light.

Fringe patterns viewed stroboscopically allow the vibration modes to be examined over the full frequency range. A particularly attractive feature of the technique is that cine records can be made which, when run at normal speed, show the changes in the behaviour of the components as the frequency of vibration is varied. Among other things the very damaging sharp resonance conditions which are difficult to study by any other technique show up very well.

The basic technique for observing vibrating surfaces has been used in the design of high-powered sonar tranducers for underwater operation. Similar vibration studies are being applied to the blades of jet engine turbines. Also under investigation are holographic techniques for measuring accurately the droplet size of medical sprays from aerosol cans. Fingerprint identification by holography is also being actively investigated.

(This article, and the accompanying photographs, are reproduced from "New Technology," No. 37 (February, 1970), published by the U.K.'s Ministry of Technology, by arrangement with the Editor.)

Automated Meteorology System for U.K. Army



A prototype of the control console to be used in the automated meteorological system. This uses program-directed entry techniques to guide the operator through all the steps necessary to make sounding, and displays results as they are provided by the computer.

Artillery regiments in the British Army are to have automated meteorological systems which will provide them with data on prevailing atmospheric conditions in the shortest possible time.

The new Artillery Meterological System (AMETS) will be a completely self-contained, mobile upper air station built to rugged military standards. It will produce instant meteorological messages by automatic processing of the data from a tracking radar and radiosonde complex. A single AMETS will normally provide all meteorological data needed in the area of one army division.

Current methods of obtaining meteorological information in the upper air are based on the use of a hydrogen filled balloon carrying a radar reflector and radiosonde. Height, and the direction and rate of horizontal movement are obtained continuously from a tracking radar as the balloon rises, while atmospheric pressure, temperature and humidity are transmitted back to the ground from the radiosonde.

AMETS uses a similar radiosonde but with a temperature sensor only. The outputs from radiosonde and radar are fed into a computer which can then calculate the required meteorological information from the radiosonde and radar outputs, a measurement of surface pressure, and from average humidity figures which can be provided for the particular zone of operation.

Up to now, systems providing artillery meteorological data have used a combination of instrumented and manual methods. The attendant problems of operator training and the possibility of errors that can easily occur under battle conditions have emphasised the need for an automated system. Typically, manual calculations can take about one hour to complete after the radiosonde has reached the required altitude but the use of computer methods to process the data in AMETS can result in the meteorological message being available less than two minutes after the radiosonde has reached the given altitude.

Computer methods allow the control of the whole system to be greatly simplified and soundings to take place more often than is currently possible. In rapidly changing weather conditions, soundings can be taken as frequently as necessary. By using the technique of program-directed entry, the operator is reminded at each step what data the system needs and, if any item is omitted, a visual warning will be given before balloon launch. There is also a comprehensive set of self-checking routines which enable the operator controlling the sounding to check that all parts of the system are operational.

GEC-Elliott Space and Weapon Systems, who will supply the data processing sub-system, will also be system research and development (R and D) authority and prime contractor for the complete project. Plessey Radar Limited, together with Plessey Radio Systems Division, both parts of the Plessey Elec ronics Group, will be the R and D authority for the tracking radar and radarsonde sub-systems respectively and will also be responsible for the supply of this equipment. The companies have carried out a feasibility study to define the total requirements of the project and the new contract will cover final development and production of a quantity of systems sufficient to equip the British Army. System presentations have been made to a number of overseas military authorities, including NATO, and AMETS is expected to have considerable export potential.

U.K. METRICATION TIMETABLE

The recently appointed Australian Metrication Board will have to decide on the timetable to be used in Australia. The plan adopted for the introduction of metric in Britain was outlined earlier this year to representatives of U.S. government and industry by the Chairman of the British Metrication Board, Lord Ritchie-Calder. The following extracts from his address deal mainly with the proposed timetable for U.K. metrication.

In Britain there is no "if" about going metric. By 1975, we shall have achieved what 200 years ago — July 1790—Jefferson proposed for the New United States — a rational system of measurement. It has always struck me as ironical that Quincy Adams, who was personally convinced of the virtues of the metric system should, as Secretary of State in 1821, have advised Congress not to adopt it "because it would be hazardous to deviate from the practice of Great Britain." I say "ironical" because the excuse of British industrialists dragging their feet a century later was that they did not want to deviate from the practice of their biggest customer, the United States.

I find the loyalty of the United States to the old imperial system rather touching, especially in the Space Age when the calculations and instrumentation needed to get men to the moon are in the scientific number-language of metric. (I should love to see the computer calculating the number of barleycorns to the moon and back. As you no doubt know the foot was standardised all those centuries ago as "thirty-six barleycorns taken from the middle of the ear.") But the astronauts when they come back to earth splash down in so many fathoms — and the fathom is the length of a Vikings's embrace — and so many yards from point zero. The yard, of course, was the distance from the tip of the nose to the outstretched finger of King Edgar, the Anglo-Saxon king a thousand years ago. The astronauts have been gathered up and carried off into quarantine to be debugged, decontaminated, debriefed and demetricated so that they can step out into a pound-foot-gallon country.

Learning metric is simple. It is **unlearning** imperial that is difficult. And that is where our younger generation is lucky.

The contemporary phase of British metrication can be dated from the report of The Committee on Weights and Measures Legislation (Hodgson Committee) set up by the President of the Board of Trade which reported in 1950. The Committee resolved the perennial debate by coming down on the side of metric as "a better system of weights and measures than imperial" and recommending that the Government "should take steps, in concert with the Commonwealth and the U.S.A., in favour of the complete adoption of the metric system over a period of about 20 years." In 1965, the Federation of British Industry wrote to Ministers formally stating that the large majority of its members was in favour of the metric system. This was endorsed by the Government and the F.B.I.'s successor-organisation, the Confederation of British Industry, has energetically promoted the change-over.

The British Standards Institution has had, and will continue to have, a crucial role. Metrication is meaningless for industry unless it is embodied in codes of industrial standards, acceptable in Britain and, so far as possible, abroad. The B.S.I. is a typically British partnership between Government and business subscribers embodying, like metrication policy, a national program and the voluntary principle. The B.S.I., having actively promoted metrication, put in hand a systematic examination and revision of over 4,000 standards so that the pace of change throughout the economy would not be impeded by lack of essential metric materials and components. At the same time, the Institution prepared and published, in consultation with interests concerned, agreed metrication time-tables for four major industries. Those time-tables, in turn, were dependent on the production of B.S.I. metric standards by which they could become operable.

The Royal Society, in the tradition of British science, took a leading role even when "imperial" was paramount in promoting an internationally coherent system, consistent with scientific precision. It held two conferences on metrication in schools and later published booklets embodying the recommendations and conclusions.

Government departments, by requiring metric specifications in publicly financed projects and in direct contracts, are decisively influencing the progress of going metric. In the nationalised industry sector, substantial progress has been made in planning the change. The Central Electricity Generating Board, for example, has published its program for the change-over, issued a comprehensive metric manual, and organised training programs in conjunction with the Electricity Supply Industry Training Board.

The construction industry, with an order-book of $US11.2 thousand million a year, and involving over 1 million operatives and 80,000 contracting firms, many of them small and most of them dependent on casual labour, might have seemed an intractable problem. Through the initiative of the leaders of the industry and the positive metric policy of the Ministry of Public Building and Works, the construction industry has become a pace-maker in metrication. To assist on-site labour the Construction Industry Training Board produced a substantial range of program information and of training material.

Many Trade Associations, by their own volition, made plans and began the change-over before the Board came into existence. Productivity Councils have prepared the ground. Chambers of Commerce in all parts of the country have promoted discussion. One of the gratifying discoveries of the Board was to find how matter-of-factly metrication had been examined by the farming organisations, without serious misgivings.

The pharmaceutical industry and the pharmacists who began planning as far back as 1945, had changed over to the use of metric units by March 1969. Without any fuss or bother, the traditional grains and scruples disappeared. This is an excellent example of the metric go-between. The industry by its packaging and the dispenser handling the prescriptions could make the conversion with no trouble to the medical profession or to the public. The ease with which the change has been made is a reflection of the wisdom and thoroughness of the planning which preceded it. To the general public it just appeared to happen.

During 1970 substantial progress will be made in many sectors of the economy. The British Standards Institution expects that all important standards relating to construction, industrial materials, engineering components and equipment will be available. This is an essential stage to an orderly advance within these sectors. In education too substantial progress can already be foreseen, the change to metric in examinations being a powerful stimulus.

Freight transport has set the beginning of 1972 as the target date. The road speed levels will be in kilometres per hour in 1973, and prior to that a beginning will be made in erecting new road signs incorporating distances in kilometres.

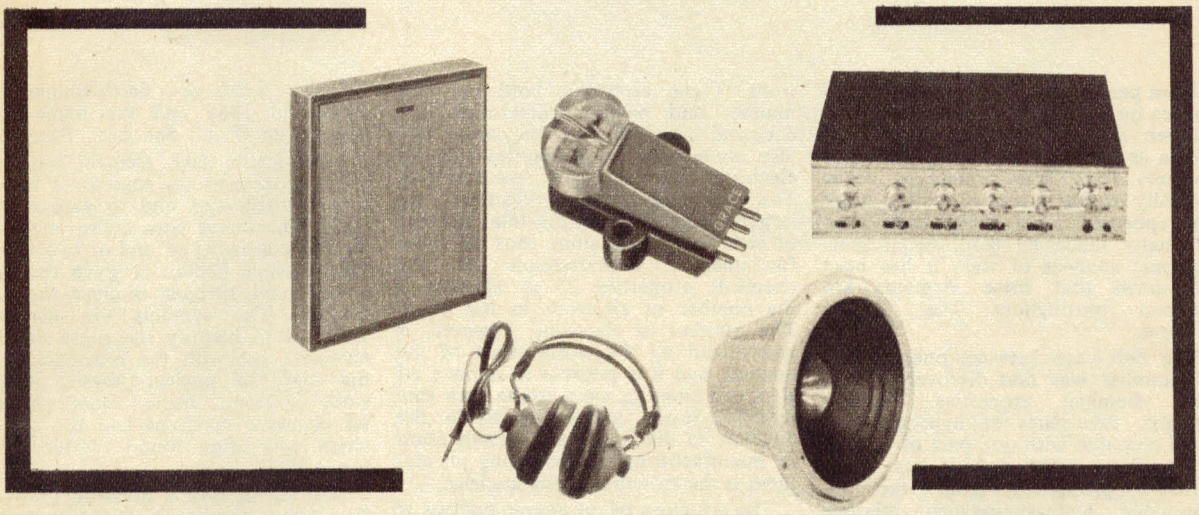
The measurement of land in metric will begin in 1970, with dual dimensioning in preparation for the full change-over in 1971 when land measurement will be wholly metric. Forestry will take a further year to achieve the complete change-over. Farming as a whole seems likely to begin to go metric in 1972, a change which should be substantially completed in 1973.

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(Continued on page 190)

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NUCLEAR REACTIONS

In the two previous issues, we have presented articles on particle accelerators and detectors, used by physicists to investigate the structure of atoms. This latest article discusses what scientists have discovered about the nucleus, which forms the heart of the atom, and some of the researches they have been able to conduct, using this knowledge.

By L. C. Debnam

Most people today know that all substances on the Earth are made up of a number of fundamental substances known as **elements.** Ninety one of these elements have been found to occur naturally on Earth and a number more (14 reported up to 1969) have been artificially made by man. From spectroscopic analysis of stars it has been determined that these elements are common throughout the known universe.

The difference between one element and another was first discovered from their chemical properties. As an example, two parts of hydrogen (H) could combine with one part of oxygen (O) to form water, which has vastly different properties from the inflammable hydrogen-oxygen mixture of which it is made. Although two parts of hydrogen combine with one part of oxygen to form H_2O, if an attempt is made to combine magnesium (Mg) and oxygen it is found that only one part of each is required to form a compound MgO (magnesium oxide). Similarly hydrochloric acid, HCl is formed from one part hydrogen and one part of chlorine (Cl). Compounds such as HO, Mg_2O, H_2Cl will not normally form.

The smallest particle of an element that can exist and still retain the properties of the element is an **atom.** It was once thought that the atom was a solid sphere which could not be broken (atomos = indivisible) but it is now known to be mainly composed of empty space — and to be far from indivisible.

An atom is made up of a central core, or nucleus, which contains most of the mass, and at relatively fixed distances out from the nucleus are electrons. These electrons, both by their number and position, determine the chemical properties of the atom and also some physical properties such as electrical and thermal conductivity. The positions of these electrons are largely determined by the total number of electrons in the atom, thus the main fundamental consideration of the chemical properties of an element is the number of electrons in the atom. The number of electrons, however, is determined by the composition of the nucleus, and it is possible to remove all electrons from an atom (some very easily) but much harder to divide the nucleus, so that the main consideration in manufacturing or describing an element is the structure of the nucleus.

The structure of an atomic nucleus is largely unknown. However, it is known that the main constituents are particles of approximately equal mass known as **protons** and **neutrons.** A proton is positively charged, with the same size charge as the negatively charged electron, and neutrons have no electric charge. A normal atom is electrically neutral, i.e., there is no detectable electric charge a short distance from it, and for this to occur the total positive charge and the total negative charge must be equal so that they cancel.

This means that in a normal atom the number of electrons (hence the positions of the electrons and the chemical properties of the atom) is decided by the number of protons in the nucleus. The number of protons in the nucleus is known as the **atomic number** of the element and ranges from 1 (for hydrogen) to 104 (for Kurchatovium) for the known elements. (Element number 104 was reported to have been manufactured at the Soviet Atomic Energy Research Establishment at Drbna in 1966 and the name is at present unofficial. See Box, Page 23.)

Historically, each element has been given a name as (or sometimes before) it was discovered and to ease writing these names have been abbreviated to a symbol consisting of one or two letters. For example helium is given the symbol He and nitrogen is given the symbol N. The symbols are generally sufficient to identify the more familiar elements but with the introduction of the study of nuclear physics (i.e., a study of atomic nuclei) many unfamiliar elements occurred and the symbol alone was often found frustrating to use.

Because of this, a notation based on the atomic number of the element was introduced. In this notation the chemical symbol for the element is still used when it is known, and the atomic number is written as a small pre-subscript to the symbol. Helium, which has atomic number "2," is thus written as $_2$He and nitrogen, atomic number "7," is written as $_7$N. With this notation it is possible to identify an element even though the symbol is unknown. For example if in a reaction an element is predicted to occur with an atomic number of 68, the element may be written as "$_{68}$E1" (as no element has the symbol E1, which here means "element") and later the appropriate symbol and name may be found in a table, and the correct notation, $_{68}$Er (erbium) substituted.

In 1912 Joseph John Thomson discovered that natural neon was composed of two different types of atoms. Each atom reacted chemically in the same manner (i.e., each has the same atomic number, 10) but the masses of the atoms were different. These different types of neon were called **isotopes of neon** and it was eventually found that all elements have isotopes. The different isotopes of an element do not generally matter in chemical reactions, but in physical studies the mass is important so a system of differentiating between isotopes had to be devised.

The difference in mass of different isotopes of an element was found to be due to the number of neutrons in the nucleus. The simplest example is the element hydrogen. In "normal" hydrogen the nucleus consists of a single proton, but two other types of hydrogen exist in nature. The atom of one of these was found to have a mass twice the mass of "normal" hydrogen and was named "heavy" hydrogen, or "deuterium." "Heavy water" is simply

TABLE I—Typical Fusion and Fission Reactions

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{139}_{56}Ba + {}^{68}_{36}Kr + 11\,{}^{1}_{0}n$$

mass (amu)	235·12	1·009	138·92	85·94	11·099

$$^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He$$

mass (amu)	2·016	2·016	4·012

ordinary water H_2O where the hydrogen is in the form of deuterium. The third isotope of hydrogen discovered has an atomic mass three times the atomic mass of normal hydrogen and has been given the name "tritium."

These three isotopes of hydrogen have different masses because there are neutrons in the nuclei of deuterium and tritium but none in the nucleus of normal hydrogen. The normal hydrogen nucleus contains only a proton (one particle) and is written as ${}_1{}^1H$, where the pre-superscript indicates the number of nucleons (a general name covering both protons and neutrons) in the nucleus. The deuterium nucleus contains one proton and one neutron, and is written as ${}_1{}^2H$, and similarly the tritium nucleus contains one proton and two neutrons and is written as ${}_1{}^3H$. The number of neutrons in the nucleus may be determined by subtracting the lower number from the upper number. This upper number is an approximate measure of the atomic weight of an isotope. For example an atom of ${}_{92}{}^{238}U$ (uranium-238) has a mass approximately 238 times the mass of a hydrogen atom.

As the typesetting of small numbers as subscripts and superscripts is time-consuming and sometimes quite impractical an alternate form is often used to designate the different isotopes. An example of this is given above where uranium with 238 nucleons in the nucleus is written as uranium-238.

Most elements as found in nature consist of a mixture of isotopes. Natural neon consists of approximately 9.21% of neon-22, 0.28% of neon-21 and 90.5% of neon-20 which gives an average mass of 20.2 times the mass of a hydrogen atom. This number is the number found listed in chemical tables as the "atomic weight." (More correctly atomic weights are compared with carbon, the atomic weight of which was set arbitrarily at 12, thus in the tables the atomic weight of hydrogen is 1.008.)

The number of isotopes of an element found in nature varies considerably over the range of elements. For example only one isotope of beryllium, beryllium-9, occurs naturally whereas tin occurs as eleven isotopes ranging from tin-112 to tin-124. Many isotopes have been manufactured in nuclear reactors and more than 1200 isotopes of the 104 elements are known.

The isotopes which occur naturally are generally "stable" isotopes, whereas the man-made isotopes are usually unstable—i.e., they are radioactive and decay by a nuclear fission process.

One well known example of a naturally occurring unstable element is radium-226, the nucleus of which spontaneously "splits" into two parts to form radon and helium as in the following reaction,

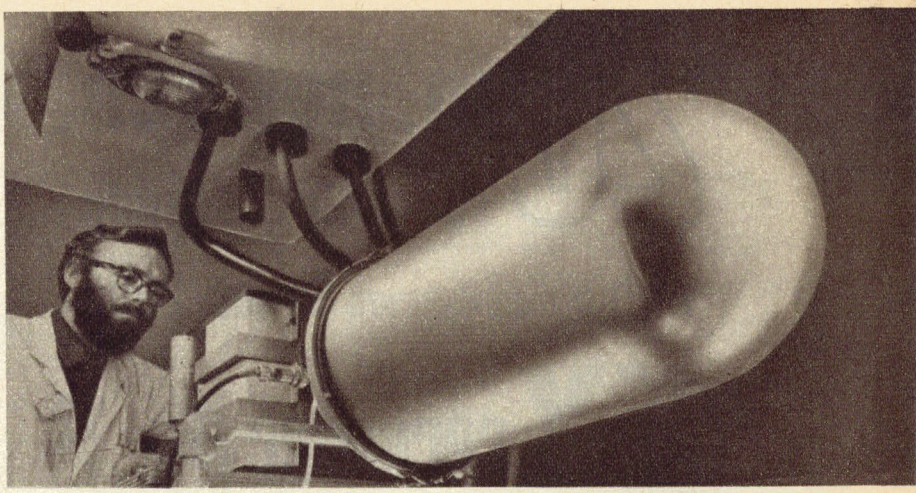
$$ {}_{88}{}^{226}Ra \rightarrow {}_{86}{}^{222}Rn + {}_{2}{}^{4}He \qquad [1] $$

The helium nucleus is a common result of the fission process (i.e., the splitting of the nucleus) which occurs with radioactive elements. This was given the name "alpha particle" before its true nature was known, and is still referred to by this name. A second particle is often found to occur as a result of nuclear fission. This is referred to as a "beta particle" and is now known to be an electron. Radiocarbon (carbon-14) emits beta particles to change to nitrogen-14 by the process

$$ {}_{6}{}^{14}C \rightarrow {}_{7}{}^{14}N + {}_{-1}{}^{0}e \qquad [2] $$

where the "-1" on the electron charge shows that the charge is negative.

Although electrons may be emitted from the nuclei of radioactive isotopes



This impressive device is a 14MeV neutron generator used by the Activation Analysis Unit of Britian's Atomic Energy Research Establishment, Harwell. Part of the unit's work is concerned with neutron activation analysis methods and applications.

TABLE 2

Element-forming nuclear reactions

ν = neutrino

Q = energy

${}_1{}^1H + {}_1{}^1H \rightarrow {}_1{}^2H + \nu + Q$	1
${}_1{}^1H + {}_1{}^2H \rightarrow {}_2{}^3He + Q$	2
${}_2{}^3He + {}_2{}^3He \rightarrow {}_2{}^4He + 2{}_1{}^1H + Q$	3
${}_1{}^2H + {}_1{}^2H \rightarrow {}_2{}^4He + Q$	4
$3{}_2{}^4He \rightarrow {}_6{}^{12}C + Q$	5
${}_6{}^{12}C + {}_6{}^{12}C \rightarrow {}_1{}^1H + {}_{11}{}^{23}Na + Q$	6
${}_6{}^{12}C + {}_6{}^{12}C \rightarrow {}_2{}^4He + {}_{10}{}^{20}Ne + Q$	7
${}_6{}^{12}C + {}_1{}^1H \rightarrow {}_7{}^{13}N + Q$	8
${}_7{}^{13}N \rightarrow {}_6{}^{13}C + {}_1{}^0e + \nu + Q$	9
(spontaneous fission)	
${}_6{}^{13}C + {}_2{}^4He \rightarrow {}_8{}^{16}O + {}_0{}^1n + Q$	10

TABLE 3

Some neutron reactions, showing how elements are built up by successive neutron capture, starting with ^{23}Na. The reactions in which no neutron is added are self-initiated fission reactions, i.e., the element on the left of the equation is radioactive.

$${}_{11}{}^{23}Na + {}_0{}^1n \rightarrow {}_{11}{}^{24}Na$$

$${}_{11}{}^{24}Na \rightarrow {}_{12}{}^{24}Mg + {}_{-1}{}^0e$$

$${}_{12}{}^{24}Mg + {}_0{}^1n \rightarrow {}_{12}{}^{25}Mg$$

$${}_{12}{}^{25}Mg + {}_0{}^1n \rightarrow {}_{12}{}^{26}Mg$$

$${}_{12}{}^{26}Mg + {}_0{}^1n \rightarrow {}_{12}{}^{27}Mg$$

$${}_{12}{}^{27}Mg \rightarrow {}_{13}{}^{27}Al + {}_{-1}{}^0e$$

et cetera

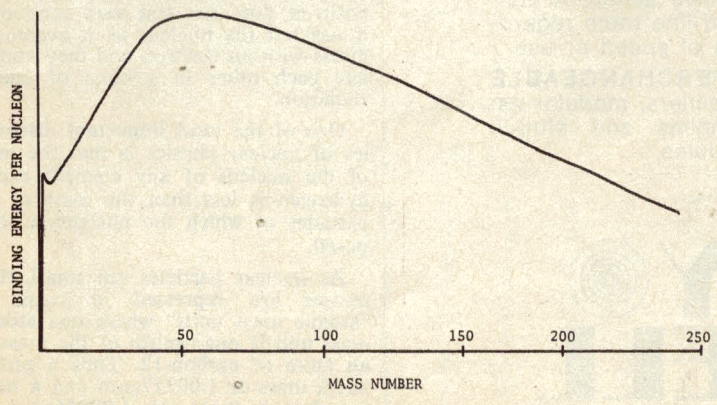
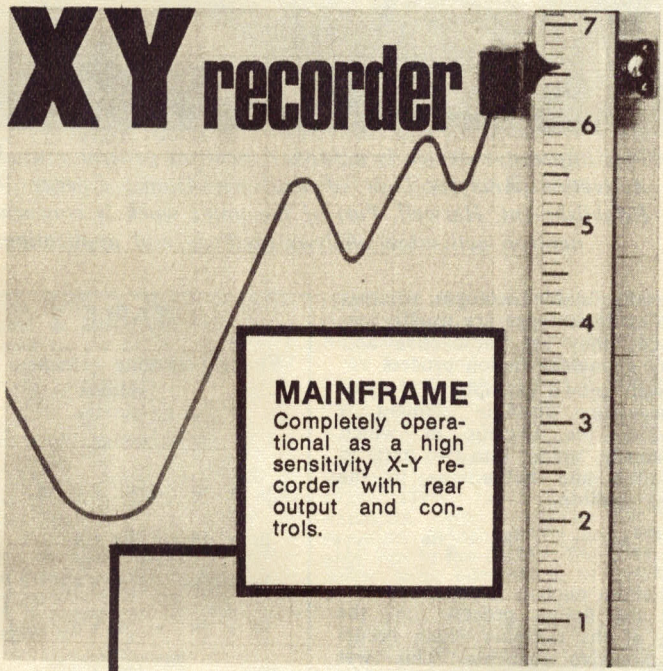


Figure 1. Graph of binding energy per nucleon as a function of mass number.

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it does not appear that there are any electrons, or electrons identifiable as such, present in the nucleus. Investigations of such reactions show that the reason for an electron being emitted is that one of the neutrons in the nucleus has changed form, having become a proton and an electron. The electron is ejected from the nucleus by the large amount of energy which is evolved in this transformation. Thus, although it does not appear to be possible to manufacture a neutron by combining a proton and an electron, the neutron may break down into these units.

The reactions (1) and (2) illustrate two conservation laws which occur in nuclear physics. These are **conservation of charge** and **conservation of nucleons**; in each reaction the total charge and total number of nucleons remains unchanged. In reaction (2) the number of proton charges is 6 before the fission occurs and (7—1 = 6) after the reaction. As the electron is not a nucleon it has a nucleon number of zero.

The mass of an electron is extremely small by everyday standards, and the masses of protons and neutrons, although small, are much larger. The mass of a proton is 1836.1 times that of an electron, whereas the mass of a neutron is 1838.6 times that of an electron. The total mass of a neutron is thus equal to the mass of a proton plus the mass of 2½ electrons, but only one proton and one electron are formed by the fission of a neutron, the remaining mass being converted into energy which overcomes the electrostatic attraction of the proton and electron and causes them to fly apart.

There is one other particle of major importance which is found to occur in radioactive isotopes. This particle has the same mass as an electron but with a positive charge and is known as a positron. This particle occurs, for example, when silicon-27 changes to aluminium-27 in the process

$$^{27}_{14}Si \rightarrow {}^{27}_{13}Al + {}^{0}_{1}e \quad \text{(positron)} \quad [3]$$

The production of positrons is assumed to be by disintegration of a proton into a neutron and a positron, but as the mass of neutron + positron is greater than the mass of the proton, energy must be supplied for this reaction to occur. This reaction only occurs in the nucleus and is observable in many artificially made isotopes. A positron does not last very long once it has left the nucleus as it eventually meets with an electron and they annihilate each other in a burst of energy radiation.

One of the most important discoveries of nuclear physics is that the mass of the nucleus of any element except hydrogen is less than the mass of the particles of which the nucleus is composed.

As nuclear particles are small, their masses are expressed in terms of "atomic mass units" where one atomic mass unit is one-twelfth of the mass of an atom of carbon-12. Thus a proton has a mass of 1.00727amu and a neutron has a mass of 1.00866amu. It would therefore be expected that a helium-4 nucleus, containing two protons and two neutrons would have a mass of 4.03186amu — but it is found by

measurement to have a mass of only 4.0115amu, so that 0.02amu is missing

This "mass defect" is generally accounted for by assuming that the missing mass is in the form of energy binding the nucleus together. Such energy is required, as otherwise the protons would fly apart by electrostatic repulsion.

The mass defect is also referred to as "binding energy" and is effectively a measure of the stability of the nucleus. If a nucleus has a high binding energy for each nucleon, it is more stable, i.e., less likely to break apart, than if it has a low amount of binding energy for each nucleon.

These forces are obtained from gravitational attraction. If two hydrogen atoms attract each other by their mutual gravitational forces, together they exert even greater forces on other hydrogen atoms. Eventually a large mass of material may be collected together to form an object the size of our Sun, which contains approximately 10^{57} nucleons.

The pressures arising from such a large accumulation of matter can generate temperatures up to 100 million degrees celsius, and at these temperatures fusion reactions can occur.

In a graph of binding energy per nucleon against mass number (figure 1), it is seen that the maximum occurs at about mass number 50-60, which corresponds to chromium and nickel in the periodic table, indicating that the most stable elements are these. The most stable element is chromium-53 closely followed by nickel-60 and zinc-64, which are all found in the same part of the periodic table of elements.

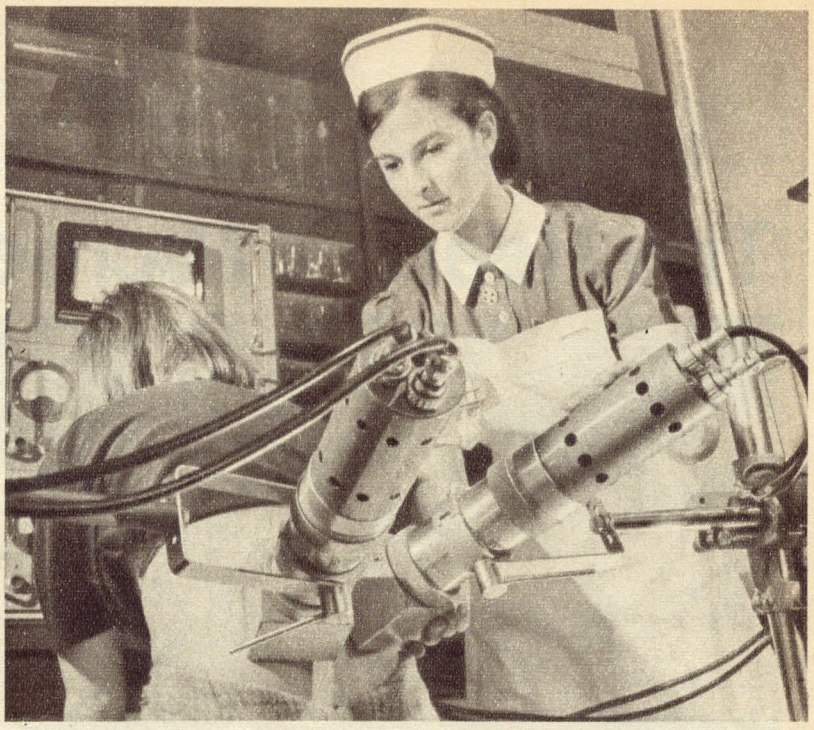
Nearly all elements after lead (element number 82) are unstable and break apart by radioactive decay (spontaneous fission), but may exist for millions of years before doing so. The average lifetimes of many of these elements have been determined and are used for geological dating purposes.

Another consequence of the mass defect is the production of energy from induced nuclear reactions. Two such reactions, with nuclear masses, are given in the accompanying panel (table 1). The first is a typical reaction which occurs in fission devices such as a nuclear pile or atomic bomb, where a uranium-235 nucleus is "split" by addition of an extra neutron to form by-products of krypton, barium and extra-neutrons. The missing 0.17amu is converted into energy released by the reaction.

The second reaction shown is a typical fusion reaction, as occurs in the "hydrogen bomb" or the sun where 0.02amu is released as energy with each reaction. Mass-for-mass, the second reaction produces about 6 times as much energy as the fission reaction shown.

The main disadvantage of the second type of reaction on earth is that enormous temperatures are required to initiate it, and the hydrogen bomb uses an "atomic bomb" (fission device) as a detonator to obtain these temperatures.

Because of the high temperature requirements (nearly ten million degrees C) the fusion reaction has not yet been commercially achieved for power production, but is known to be the energy source of stars. The fusion reactions which occur in stars is now thought to be the process by which the chemical elements were first created in the universe.



Radioisotopes have been widely used in medicine for many years. Probably their best known application is in the treatment of cancer patients, but isotopes whose radiation is not strong enough to be harmful to humans in small doses are used in other treatments and diagnoses. Iodine-131 is typically used in thyroid cases for checking the performance of kidneys. In this picture, taken at the Royal Edinburgh Infirmary, the patient has been given an intravenous injection of iodine-131 in a form which concentrates in the kidneys. The two scintillation counters measure the build up of activity, and two recorders plot graphs to show the concentration of the iodine-131 and its excretion.

Spectral analysis of stars and interstellar gas shows that 90 per cent of the universe is hydrogen, the simplest element. However, a fusion reaction cannot occur with hydrogen alone and other forces are initially required.

The reactions which are most likely to occur are shown in Table II. In this table a small uncharged particle, the neutrino, is seen to occur. This particle is a common by-product of nuclear reactions and is extremely penetrating due to its small size and lack of charge.

The first reaction which is likely to occur is the fusion of two hydrogen nuclei to form deuterium, with a liberation of energy, represented as Q in the table.

One atom of deuterium (hydrogen-2) may combine with one atom of hydrogen-1 to form helium-3, again with liberation of energy, and either the third or fourth reaction may produce helium-4 (normal helium).

Other reactions can occur building up short-lived isotopes up to beryllium-8, which break down spontaneously to form helium-4, and when sufficient of this is present carbon-12 can be formed.

At this stage the nuclear reactions themselves have raised the temperatures to the order of 600 million degrees and two carbon-12 atoms can react to form sodium or neon.

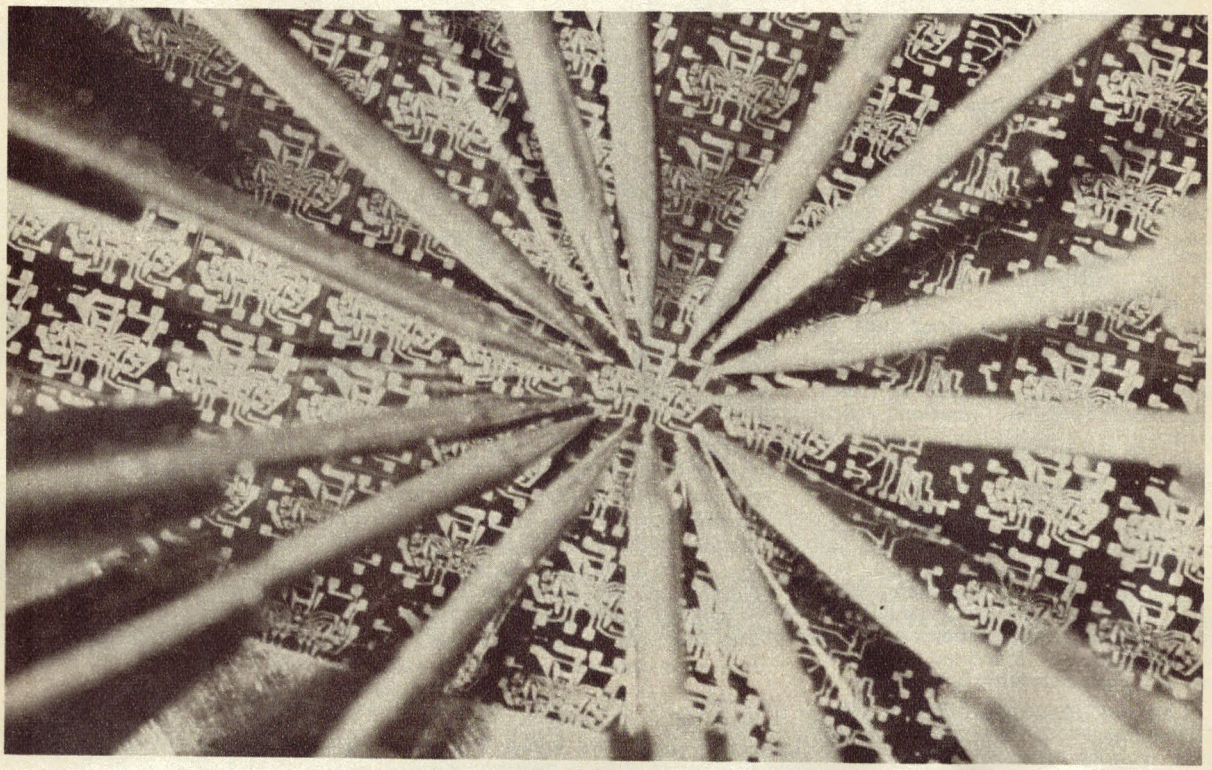
The carbon-12 can also react with hydrogen to form carbon-13 via nitrogen-13, which is required for the neutron producing reaction shown as number 10 in the table.

Neutrons are essential to produce the heavier atoms, and reactions producing elements up to bismuth (atomic number 83) are formed. Some of these reactions are shown in table III. It should be noted however that not all stable isotopes of all these elements are formed and many years may elapse between the time that any one nucleus captures a neutron and the time that it captures the next neutron. During this time most of the redioactive isotopes of the element decay by spontaneous fission, such "by-passed" isotopes exist in smaller abundances than the more easily created ones.

The elements heavier than iron are generally harder to manufacture than the lighter ones, as energy has to be added to form them, and generally the processes involved are not known although many are theoretically possible.

Elements from bismuth to uranium have been formed in the laboratory by the addition of neutrons to the nuclei of lighter elements, but, as mentioned earlier, all of these are radioactive. As all of the naturally occuring isotopes in this range are also radioactive it appears that stable elements cannot generally be formed with more than 84 protons in the nucleus (lead). ■

The Heart of Microelectronics



Plessey Silicon Microelectronic and Integrated Circuit devices offer major advantages to the equipment designer in terms of increased reliability and reduction in equipment size.

They are available in various forms of encapsulation from small TO18 to 40 lead flatpack.

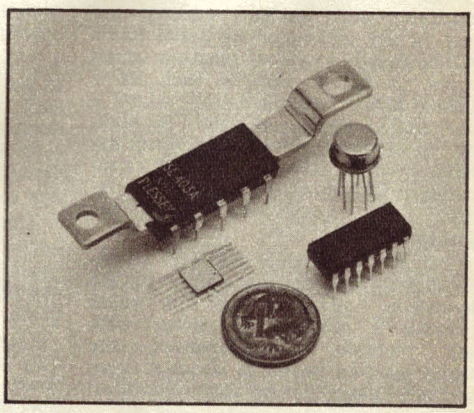
Available in the range are digital and linear devices, general purpose logic and an engineered range for S.S.B. communication equipment.

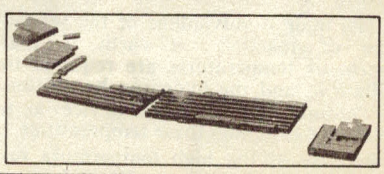
Of extreme interest is the wide range of MOS (metal oxide silicon) and MOSAIC (metal-oxide-silicon array integrated circuit) which possess a high degree of noise immunity, low input capacitance, high input impedance and have inbuilt input protection. Also available are Quad 10 bit, 16 bit, 56 bit and 100 bit static shift registers, analogue switches, multiplexers and logic circuits.

For consumer products there is the 2 watt and 3 watt I.C. Audio Amplifier also the F.M. discriminator and color demodulator for P.A.L. and NTSC T.V. Systems.

New devices are continually being developed.

Above: Automatic testing of high speed logic circuits in part of Plessey's sophisticated SIC production facility. Actual size of the circuits is 0.075 x 0.060 inch; in this photograph they are magnified approximately ten times.





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AD16

TECHNICAL DIGEST

Photochromic glass display tube has long memory

A cathode ray tube for computer graphics displays which can retain an image for long periods without a complex faceplate grid has been developed in the U.S.A. by Corning Glass Works. The new CRT uses a faceplate of photochromic glass, and a phosphor which emits ultra-violet light.

About six years ago, researchers at Corning Glass Works developed a form of photochromic glass that could change colour radically and rapidly when properly irradiated, and was free of fatigue effects when cycled repeatedly through its colour changes. Even then, it was the work of but a moment to think of dozens of possible applications. Today, one may buy photochromic spectacles that are like normal glasses indoors but become sunglasses when worn outdoors; some new office buildings have photochromic windows.

Now, one of the more complex potential applications of photochromic glass — as a medium for short-term storage — has been realised. Corning has built a computer graphics display system that uses a cathode-ray tube with a photochromic faceplate. This CRT can display data traced out just once by a computer, and hold it for 15 minutes without fading, while it is being displayed, without the complex and expensive faceplate grid in most storage tubes.

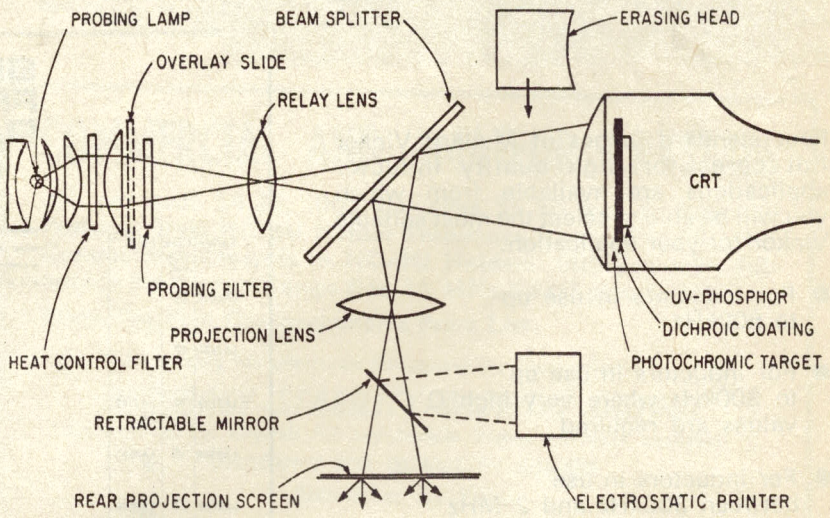
The time limitation for holding the image results from the internal scanning which is required to display the image, as explained later. When the system is switched off, and the scanning discontinued, the image can be retained for up to several days, provided it has not been already seriously weakened by scanning.

The CRT in Corning's new unit is a 5in tube with a phosphor which radiates ultraviolet light. Placed over it is a 2in x 3in faceplate made of photochromic optical fibres. This is backed by a dichroic film that transmits ultraviolet, but reflects the green light used for internal scanning and the red light used for rapid image erasure. The fibre construction of the faceplate reduces dispersion of the ultraviolet light by funneling it directly forward, so that only one fibre is affected at any instant by the radiation from a spot on the phosphor. The optical fibres becomes darkened, and therefore opaque to visible light, where irradiated by ultraviolet light.

To prevent ambient light from darkening the fibres randomly or bleaching the image too rapidly, the CRT is enclosed in the machine. Its image is made visible by a probing beam is material to the projected display, thus relieving the computer of the task of generating it.

A retractable mirror that can move into the path of the probing beam between the splitter and the projection screen reflects the light into an electrostatic printing unit for a hard copy of the display image.

Eventually, the image on the CRT decays by itself. The reason is that the probing beam's effect on the photochromic glass, although minor, isn't zero; also, photochromic glass is subject to thermal bleaching except when it is



The CRT used in the photochromic tube is basically conventional but has a phosphor which radiates ultra-violet light and a photochromic faceplate. The probing optics project the faceplate image to the viewing screen.

green light, whose wavelength is too long to darken the photochromic glass and too short to bleach it appreciably. This probing beam passes through a beam splitter and through the photochromic face plate to the dichroic film, which reflects it back to the splitter. On its second encounter the splitter reflects the beam, now carrying the image from the faceplate, to a 9in x 12in rear-projection screen on which the image is focused.

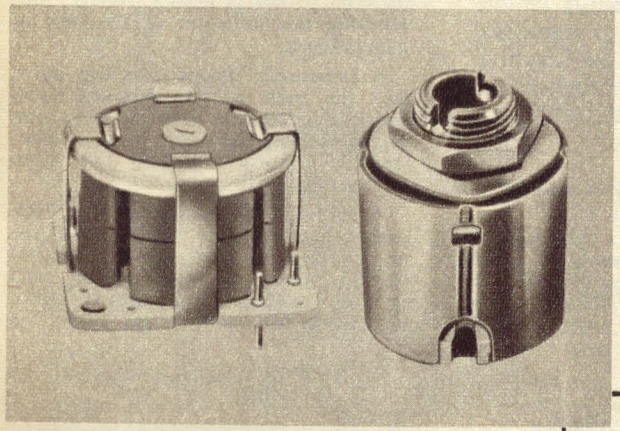
A lantern slide carrying reference axes, a map, or other background material can be inserted in the focusing optics of the probing beam to add this cooled to cryogenic temperatures. To destroy the image without waiting for its natural decay, a red light source is moved in front of the faceplate, blocking the probing beam, and bleaching the image in a matter of seconds.

Up to 64 lines of 72 characters each can be displayed on the unit; it also can carry plots, diagrams, and the like. However, as with conventional storage tubes, the whole screen must be erased when any part of it is erased. Therefore, it cannot show a dynamic, or moving, image, as can some conventional displays. ("Electronics," 13/4/70.)

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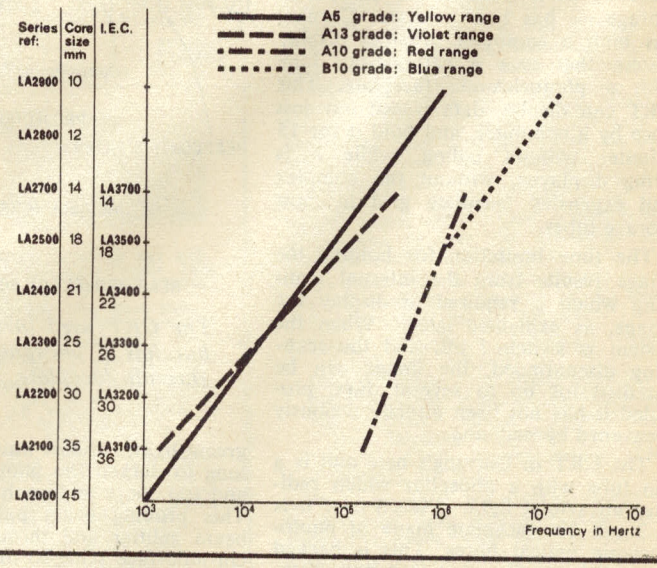
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M 233

DIGEST

DRIVERLESS ELECTRIC TRAINS FOR AIRPORT PASSENGERS

Driverless, trackless battery powered electric trains operating at Houston Intercontinental Airport, Texas, have solved many problems in providing reliable, economic and effective in-terminal transport for airline passengers.

Four such trains are in use at present.

These can handle more than 200 passengers in a peak 10-minute period. Design of the system is such that capacity can be increased to 600 passengers in the same time without major changes or additions to equipment. The trains provide free rapid underground transport between the two airport terminals and parking lot escalators. Maximum walking time for any passenger is not more than 3 minutes. Distance between terminal buildings is 1,400ft and trains make about 40 round trips in 8 hours at between 4 and 8 m.p.h.

Each train is powered by two 36V lead traction batteries which can be changed by one man in only 90 seconds, allowing continuous train operation without stops for battery charging. Advanced electronic controls are employed and all train functions are entirely automatic. Guidance is by embedded signal wires which also provide coded signals for preprogrammed stops along the route. Stops are made to within two inch positional accuracy.

Passenger safety and comfort were the principal factors in design of the trains. An optical scanner will cause an unscheduled stop should it "see" an object in the path of the train. Safety edges on the elevator-type car doors prevent injury. Contact with passengers automatically reopens the doors and movement of the train is prevented until doors are completely closed. Each stop is announced automatically by an inbuilt speaker system. An electronic monitor sends malfunction alerts to a central control station attendant who mans a rail-road type panel map and controls. All these functions, as well as traction, are powered by the lead traction battery installation carried on the train.

A lead battery power system was chosen in preference to an AC mains supply for several reasons:

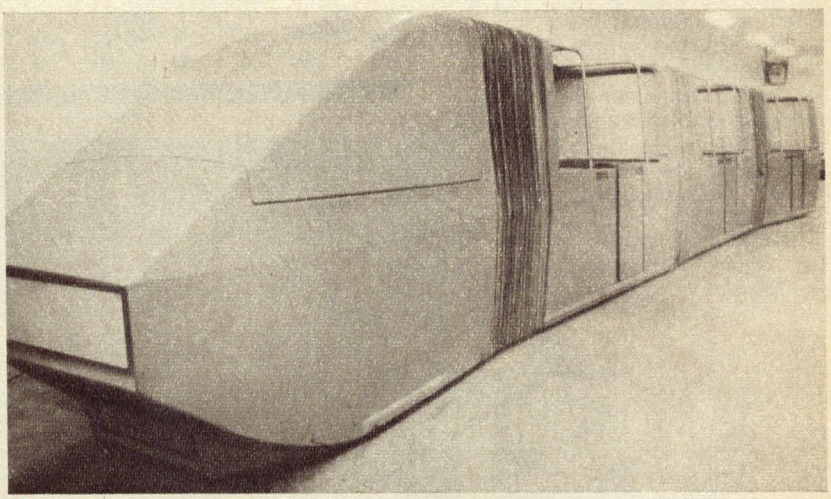
Initial cost. The cost for pantograph or third rail systems would have been about $3 million. The cost for the lead battery powered system was only $500,000.

Comfort. In the air-conditioned tunnel, frictional problems, lubricant odours, and arcing at splices would cause discomfort to passengers as well as an additional load on the air handling equipment.

Economy. Power losses in pantograph or third rail systems, operating at low voltages, are substantial and would contribute to higher operating costs.

Safety and reliability. Overhead conductors or a third rail system would be a potential safety hazard and would impose design limitations on the system. On-board power is independent of central station power if interruption should occur, and passengers can be returned to point of origin safely. Guidance signals are safeguarded against mains failure.

Similar battery electric trains should find wide use in future. As aircraft and airports grow larger, passenger clearance within terminals is fast becoming a vital factor in airport administration. Many other possible applications exist, such as amusement parks, industrial complexes, shopping centres, universities and metropolitan shuttles. ("Lead Battery Power," April, 1970.)



Computerised Medicine for U.K. Doctors

Britain's first real time computerised patient record system will go into operation within the next two months, providing a direct on-line link from the doctor's surgery to a central computer.

The Department of Computer Science at Essex University, under the guidance of Dr Keith Bowden, has co-operated with Guy's Hospital, London, to develop this pilot scheme, which will serve two large group practices.

At each practice there will be a Marconi-Elliott Videodata 4,000 visual display unit forming the communication link between the doctor and the computer.

At the moment there are several other similar schemes being developed along very similar lines. During February this year, I.B.M. carried out a feasibility study with Exeter University by placing an I.B.M. 2260 display terminal in a doctor's surgery at Exeter. This was connected to an I.B.M. 360/40 computer.

Both systems make use of specially developed software to speed up a doctor's access to his patient's records. Instead of leafing through wads of paperwork, the doctor can quickly call up any part of the patient's record on the visual display unit.

Another important feature of this system is the diagnostic facility. With the ever increasing documentation of illnesses and tests, it is often difficult for the doctor to remember all the necessary tests. Now, if he suspects a certain disease, he can ask the computer to display a diagnostic check list.

In about 12 months this facility will be expanded to include differential diagnosis, where the doctor can feed in all the symptoms and the computer will immediately send back a list of possible illnesses and suggested treatments. The doctor can then select the correct diagnosis and treatment — or if they do not satisfy him, he can send his patient on to a specialist.

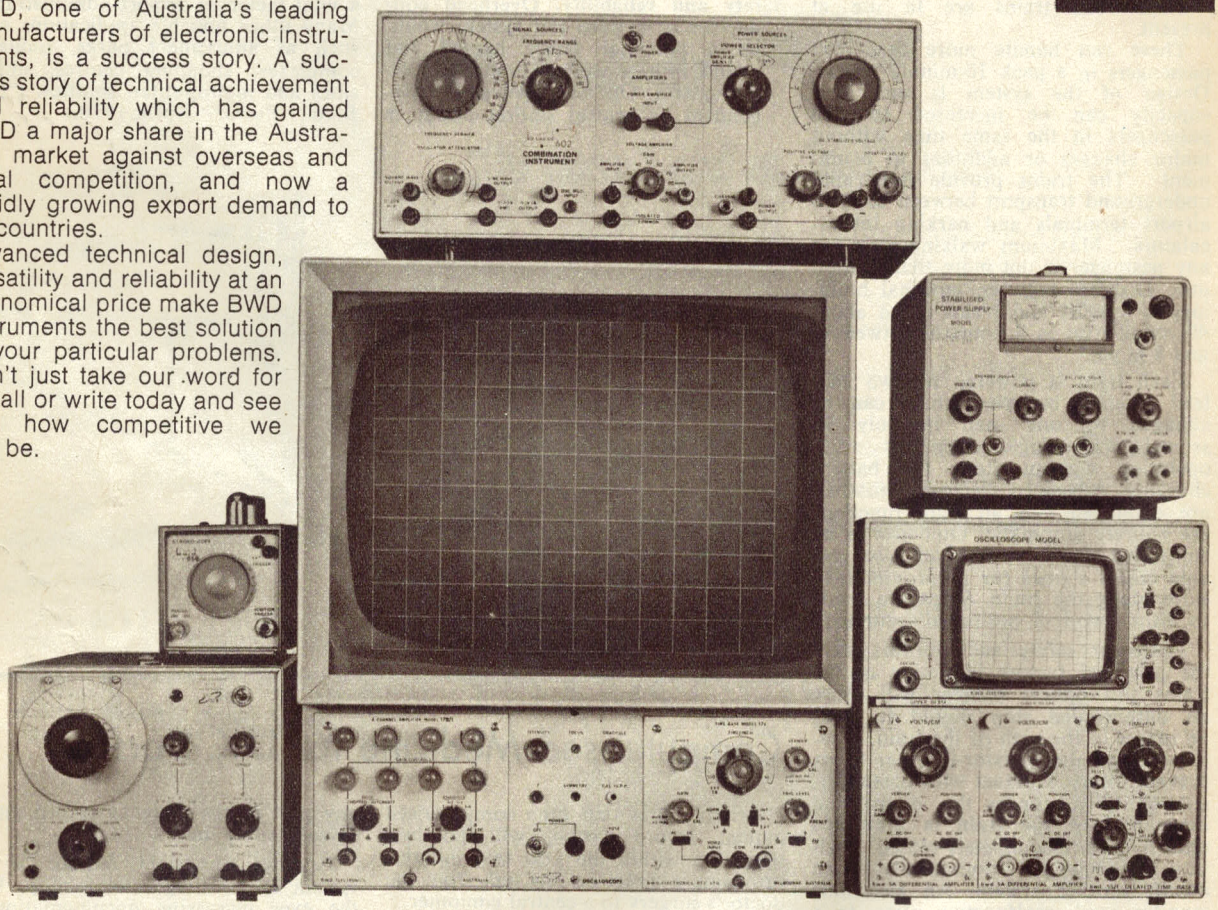
On the thorny question of the privacy of the system, Dr Bowden commented that the patients' records are frequently left lying around in doctors' surgeries and cars. The computer system would use identification codes, and even the simplest system would be more confidential than the currently used paper system. ("Electronics Weekly," 13/5/70).

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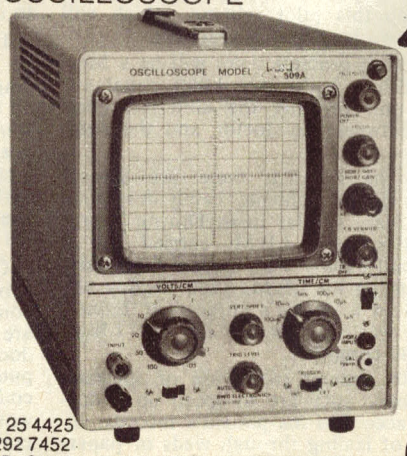
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DIGEST

HI-FI CASSETTES — WILL THEY SUPERSEDE DISCS?

So far recordings on tape cassettes have been regarded as a convenient form of recorded music for those not particularly concerned with high quality reproduction. Recent developments in the U.S.A. seem likely to make the cassette attractive to the more discriminating listener.

Reporting on the developments in the May, 1970, issue of "Audio," well-known audio writer Edward Tatnall Canby had this to say: Advent, a very busy young (recording) company these days, has brought together two major recent developments long since hailed in "Audio" — the Dolby noise reduction system, and that fabulous black Dupont Crolyn chromium dioxide tape which is still officially non-existent in audio but is appearing all over the place unofficially, short of the consumer market.

Present cassette dogma is positive: the system, for all its convenience and compactness, is, with its 1-7/8ips speed and tiny narrow tape, strictly not for hi-fi. Tonal range is punk to so-so. Dynamic range is limited. Distortion and mechanical wow and flutter are mostly too high for serious hi-fi listening. (Try a piano.) Worst of all, juggling of recording parameters results in entirely too much hiss, which is omnipresent and apparently as unavoidable as record scratch in 78rpm disc days. The cassette, then, is mainly for ultra-convenient speech recording and for not-so-hi-fi. The audiophile isn't touching it.

Curiously, manufacturers in these circumstances cannot afford to build solid quality into existing cassette players, as they do, for instance, into the better automatic disc players. Serious listeners simply will not pay for it. And thus flimsy equipment leads to more flimsy sound. A vicious circle indeed.

It is this sort of dogma which the Advent people undertook to refute by example. How astonishing to hear them state, matter-of-factly, that the cassette can remove the quality limitations inherent in the state-of-the-art **disc** recording! The limitations, they say, aren't in the cassette at all. On the contrary, the cassette at last opens up new horizons for technical improvement.

We heard the evidence via a series of A-B tests in which familiar recordings were deftly compared, in conventional disc format, via standard commercial cassettes and in the specially made state-of-the-art cassettes, produced (like disc recordings) from tapes copied from recording-company masters. Time after time, the new cassette sound easily equalled, or even surpassed, the best disc sound in vital respects. Frequency range and low distortion. Dynamic range. Wow and flutter. And, most important, low background noise. Velvet silence! Who has ever heard **that** from a cassette! These had it.

No one factor was responsible and this was Advent's intent. This was a careful adding-up of many virtues, out of painstaking efforts to improve **all** aspects of cassette performance within the standard parameters. But Crolyn and Dolby were clearly the big news. At the very slow speed Crolyn gives perhaps a 6dB advantage in noise over top-quality iron-oxide tape and in easily wider tonal range — hence a cleaner, more satisfactory signal.

The Dolby circuit drops the noise level in a different fashion, by 10 or 15 dB without the slightest observable effect on the musical signal. A carefully chosen commercial cassette player, a production model, took care of the wow and flutter.

To answer an inevitable question — how about mass production? — Advent sent out a Dolby-treated tape for commercial processing on to non-Crolyn BASF tape, via high-speed duplication equipment exactly as in a standard production cassette. Even so, played back through the Dolby circuit the sound was markedly better than that of the very same recording played normally from a commercial cassette release. And the noise improvement was fantastic. Cassette advancement must be many-faceted but even one major element can tip our scales heavily towards a change of thinking. ■

SONY PICKUP USES PRESSURE WAVES

A high-quality gramophone pick-up cartridge based on entirely new principles has been developed by the Sony Corporation, Japan. The cartridge was described by John Borwick in the May, 1970 issue of "The Gramophone."

Sometimes a new audio product comes along that stirs the imagination by its audacious use of principles that are miles away from conventional and seemingly entrenched designs.

A good example is the new pickup cartridge invented by Hirotake Kawakami of the Sony Corporation of Japan. This has the audacity (there is no other word for it) to convert the vibrations of the stylus into acoustic signals, pick them up on twin microphones, amplify them and produce stereo signals at the cartridge output pins.

The inventor claims all the sought-after properties for a top-quality cartridge including very high compliance, smooth frequency response, low intermodulation distortion and high trackability.

The general arrangement as sketched in figure 1 and figure 2 shows the way in which the fairly conventional stylus shaft transmits stereo signals via V-arms to a yoke bar, as is done with some crystal and ceramic pickups. The ends of the yoke are attached to the apex of a pair of funnel-shaped "bellows" which the inventor has called canaliculi (little canals).

Acoustic waves travel down these cones, which are said to act as acoustic transformers. Pascal's Law states that pressure applied anywhere to an enclosed body of fluid or air produces an equal pressure per unit area over the whole surface. Thus, the cones provide a mechanical impedance transformation proportional to the ratio of the end area. In the Sony pickup, an impedance conversion of about 25:1 is achieved, which is said to reduce the effective compliance to about 20×10^{-6} cm/dyne.

Terminating the wide ends of the cones are the diaphragms of tiny electret capacitor transducers (microphones). These generate electrical signals which pass through field effect transistor pre-amplifiers. ■

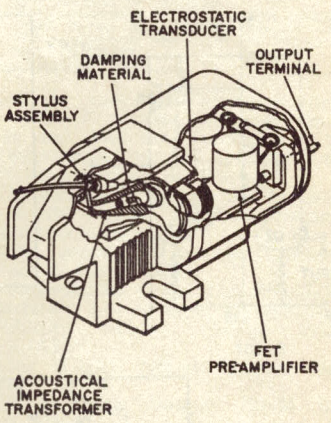
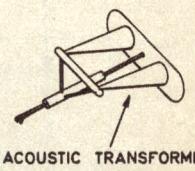
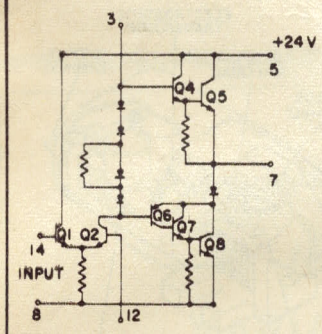


Figure 1. Cutaway sketch of the cartridge. RIGHT: Figure 2. The stylus cantilever arrangement.

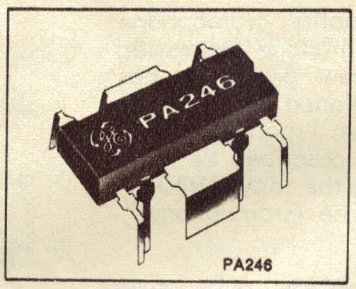


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PA246 is a monolithic power amplifier designed to deliver 5 watts of continuous power to a 16-ohm load. This integrated circuit will operate from a wide range of supply voltages, up to 37 volts, and can drive a wide range of loads with up to 1.25 amp peaks. This new package contains two heat sink tabs and eight leads in a staggered arrangement.
Primarily designed for use in audio equipment, the PA246 can also be used as a voltage supply regulator, servo motor drive, relay and lamp driver, operational amplifier booster and in many more applications.
For 2 watt applications, take advantage of the versatile PA237.
PA237 is a complete audio amplifier capable of delivering up to 2 watts of continuous low distortion output power to a speaker load. This monolithic IC is ideal for tape recording equipment, radio and television sound systems, and sound cinema projectors.
There are provisions for application of external feedback, and adjustment for gain and distortion. The PA237 will operate over a supply range of 9-27V, with a frequency response well beyond normal audio frequencies.
For 1 watt applications, use the PA234 IC which operates with a minimum of external components.
PA234 audio amplifier delivers one watt of continuous power to a speaker load from a 22-volt supply. Low cost and simplification of design afforded by the reduced number of external components make the PA234 a most economical one-watt audio amplifier. In addition, a 1.5 to 2.0 watts power capability version of this type is also available.
Applications range from phonographs and radio receivers to television sound systems.

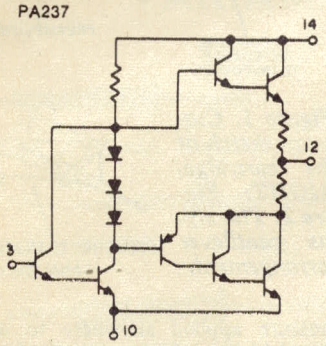
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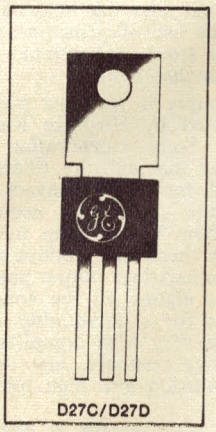
PA237



PA246



PA234


D27C/D27D

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SCIENTIFIC AND INDUSTRIAL NEWS

Programming in schools

A simplified programming system, developed at Monash University, is being used in computer training in about 250 Victorian schools. It is estimated that about 20,000 students will receive at least some computer instruction. The system, called Minitran, allows high school students to write elementary computer programs at the end of their first lesson. During an introductory programming course, the average student will submit about 50 computer runs. The cost of running student exercises using Minitran is only about 10c per run, compared with about $2 a run using conventional programs.

With the Minitran system, students are instructed in their own classrooms by their own teachers. They prepare their programs during class or at home, using specially designed cards. Into these cards they can punch information, using something as simple as a bent paper clip.

Laser lighthouse

A helium-neon gas laser is being installed in the Captain Cook Memorial Tower at Point Danger (on the Queensland-N.S.W. border) to replace the Fingal Light, which is over 100 years old. It is said to be the first such installation on the Australian coast, and is expected to give much better penetration of rain and haze than a conventional light. The tower is being built with the approval of the Department of Shipping and Transport using a laser supplied by Laser Electronics Pty. Ltd.

Radioactive shipment

A radioactive cobalt source, said to be the most powerful produced in Australia for medical purposes, was shipped from Sydney to Perth recently to power a new anti-cancer unit at the Royal Perth Hospital. The cobalt-60 source was produced by the Australian Atomic Energy Commission at Lucas Heights, near Sydney, and was bought by Watson Victor Ltd., who installed the radiation equipment at Perth. The 11b radioactive isotope travelled the 2,500 miles in a special steel, lead and tungsten container weighing 2½ tons and worth $7,000. When the cobalt was inside the container, radiation measured a yard away was less than that given off by a luminous watch.

No hazard from TV receivers

No hazard arises from X-ray emission from black-and-white television sets in use in Australia or from the colour television sets already available for experimental purposes. This was shown in a series of tests conducted recently by the X-ray and radium laboratory of the Commonwealth Department of Health and the Australian Broadcasting Control Board in association. None of the wide range of makes and ages of monochrome receivers tested had a level of X-ray emission greater than 1/25 of the internationally agreed level for such receivers, and none of the colour receivers had an X-ray emission greater than 1/10 of that level.

The instruments used in the tests were of sufficient sensitivity to measure the radiation from a radioactive luminous watch. The level of X-radiation from black-and-white TV receivers was well below the radiation from the watch. (Joint Press statement by the Commonwealth Minister for Health, Dr A. J. Forbes, and the Postmaster-General, Mr Alan S. Hulme.)

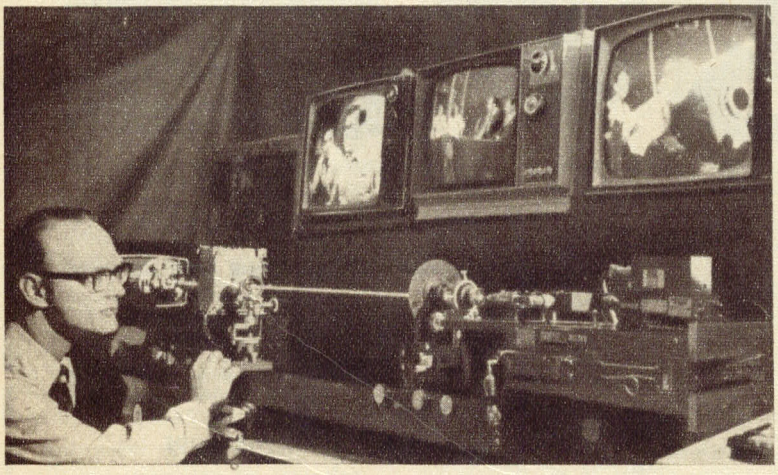
ITU administrative meeting

The Administrative Council of the International Telecommunication Union (ITU) met for its 25th session in Geneva from May 24 to June 11, 1970. In addition to dealing with administrative questions relating to the staff and finances of the Union (the budget approved for 1971 was 35.5 million Swiss francs), the Council reached the following decisions:

That the World Administrative Radio Conference for Space Telecommunications, due to open in Geneva on June 7, 1971, will last for six weeks.

That the next ITU Plenipotentiary Conference will be

Laser communication system



The laser beam communication experiment set up in the Lockheed laboratores, with the laser (foreground) and three of the TV receivers displaying pictures received over the laser link.

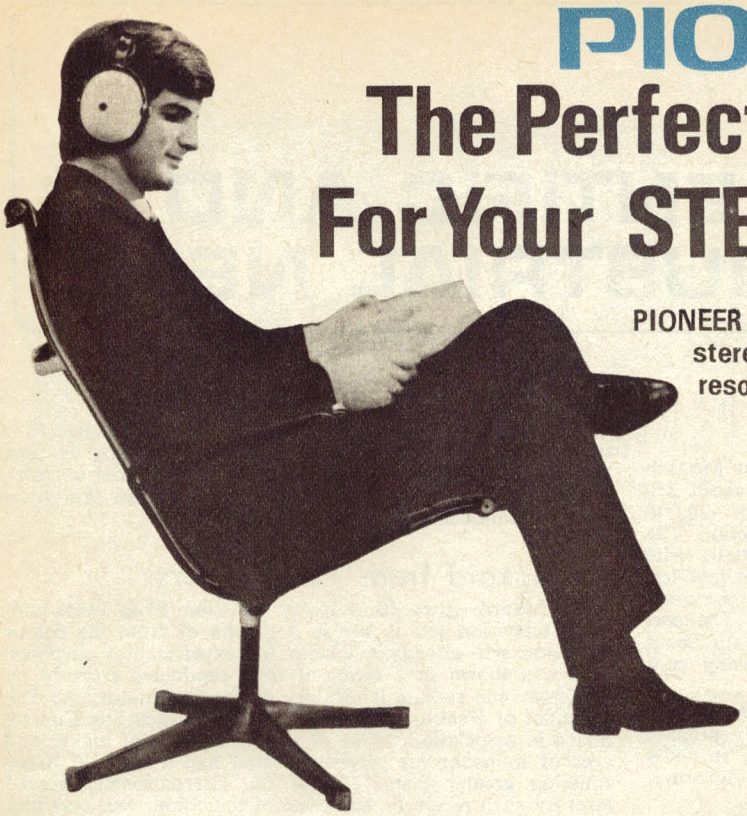
A method of transmitting 1GHz bandwidth signals over a laser beam has been developed at the Lockheed Missiles and Space Co. research laboratories, Palo Alto, Calif., U.S.A. Over 70 television channels could be transmitted by means of a single laser beam using the Lockheed microwave subcarrier method. The company said that the method holds particular promise for relaying messages between satellites.

The input information is frequency modulated on to a microwave subcarrier, which then modulates the intensity of the laser beam using a wideband "optical modulator" designed by Lockheed scientists. At the receiver, the laser beam is focused on a photodetector to recover the microwave signal, which is then demodulated to reproduce the original intput signals.

Lockheed demonstrated the system by transmitting simultaneously over a green lasser beam six local TV channels, a computer display link and an FM music channel.

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held in Geneva, starting on September 14, 1973;

That the next World Administrative Radio Conference for Maritime Services will be held at the beginning of 1974 to establish, on the basis of SSB operation, a new frequency allotment plan for HF radiotelephone coast stations and amend the associated provisions of the Radio Regulations;

That, in future, May 17 will be celebrated as World Telecommunication Day, and that in 1971 the celebrations should be organised around the theme "Telecommunications and Space," but member countries should be free to choose another topic if they desire.

The Council also decided that a new computer should be leased and be in operation by January 1, 1973. International public tenders will be invited for the supply of the new computer.

A world telecommunication exhibition, "Telecom 71" will be organised in Geneva from June 17 to 27, 1971. It will be held in the Palais des Expositions where the World Administrative Radio Conference for Space Telecommunications will be in session at that time. The ITU has entrusted the practical organisation of the exhibition to "Orgexpo," 16 Quai de l'Ecole de Medecine, Geneva, Switzerland.

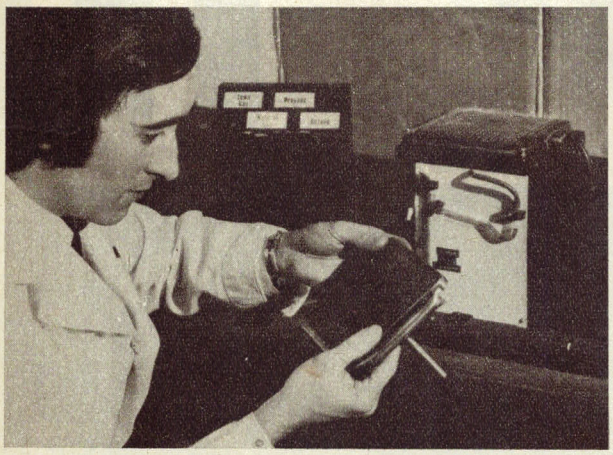
Temperature scale

Australia has adopted the International Practical Temperature Scale of 1968, IPTS-68. In IPTS-68, the scale has been extended down to within a few degrees of absolute zero, and is defined by a total of 11 points. The changes from the previous IPTS-48 are generally small, and are significant only in measurements of high precision. In the vicinity of room temperature, the values are decreased by about .008°. From 100°C to about 900°C, the values are a fraction of a degree higher. At 1,000°C, the increase is 1.24° rising to 9.3° at 3,000°C. (C.S.I.R.O. Division of Physics, University Grounds, City Road, Chippendale, N.S.W. 2008.)

Foam metal in gas burner

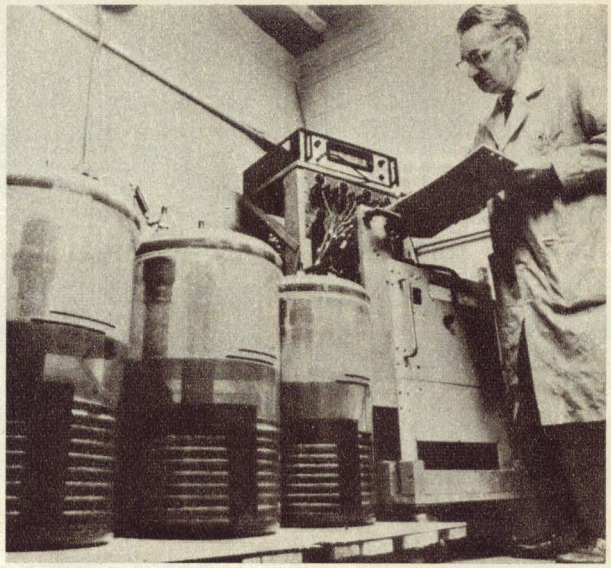
The Dunlop Co. Ltd., in the U.K., has developed a process to produce a foam metal, called "Retimet" (for reticulated metal). The metal is deposited on a sheet of foam rubber in a process similar to electro-plating; the rubber is then burnt off in a furnace to leave the mesh-like material. One application of the material is to use its controlled porosity in the development of a new type of burner for natural gas.

Based on an invention by British Petroleum Ltd., the burner consists of two perforated plates, the top one of Retimet and the other of corrosion-resistant steel. Gas is fed into the network of passages formed by the mating of the plates, and diffuses through the porous foam metal top at low velocity. It mixes with air passing through the burner to give an even and stable flame over the whole area of the burner. The burner has proved capable of operating with natural gas, propane, butane, and town gas without modification, only adjustment of pressure being required. With sufficient draught, it will operate in any position, even upside down!



A technician in the Dunlop laboratories tests the new burner using natural gas, propane, butane, and town gas.

Cylindrical cells



A battery of cylindrical lead-acid cells is checked during a series of tests conducted by Western Electric. Designed by Bell Telephones in the U.S.A., the cells use circular grids stacked one on top of the other instead of the conventional arrangement of rectangular grids. The circular grids are designed to grow evenly during service and are expected to considerably prolong the life of the cells. (See "Electronics Australia," July, 1970.)

Electromagnetic log

A new electromagnetic ship's log has been specified by the Royal Navy for surface and underwater vessels. The equipment comprises three major items — a rodmeter, the hull fitting, and a speed and distance unit. The elliptical, aluminium-bronze rodmeter projects three feet downwards through the hull. At its outer end it carries a speed sensing element in the form of a coil embedded in a glass fibre shell. The coil, fed with a 60Hz current, produces a flux which is cut by the water when there is relative motion between the ship and the water. A voltage proportional to the relative velocity is developed across two bronze electrodes mounted one on each side of the glass fibre shell, and fed to the speed and distance unit. This provides both local and remote indications. (Aeronautical and General Instruments Ltd., Croydon, Surrey, England.)

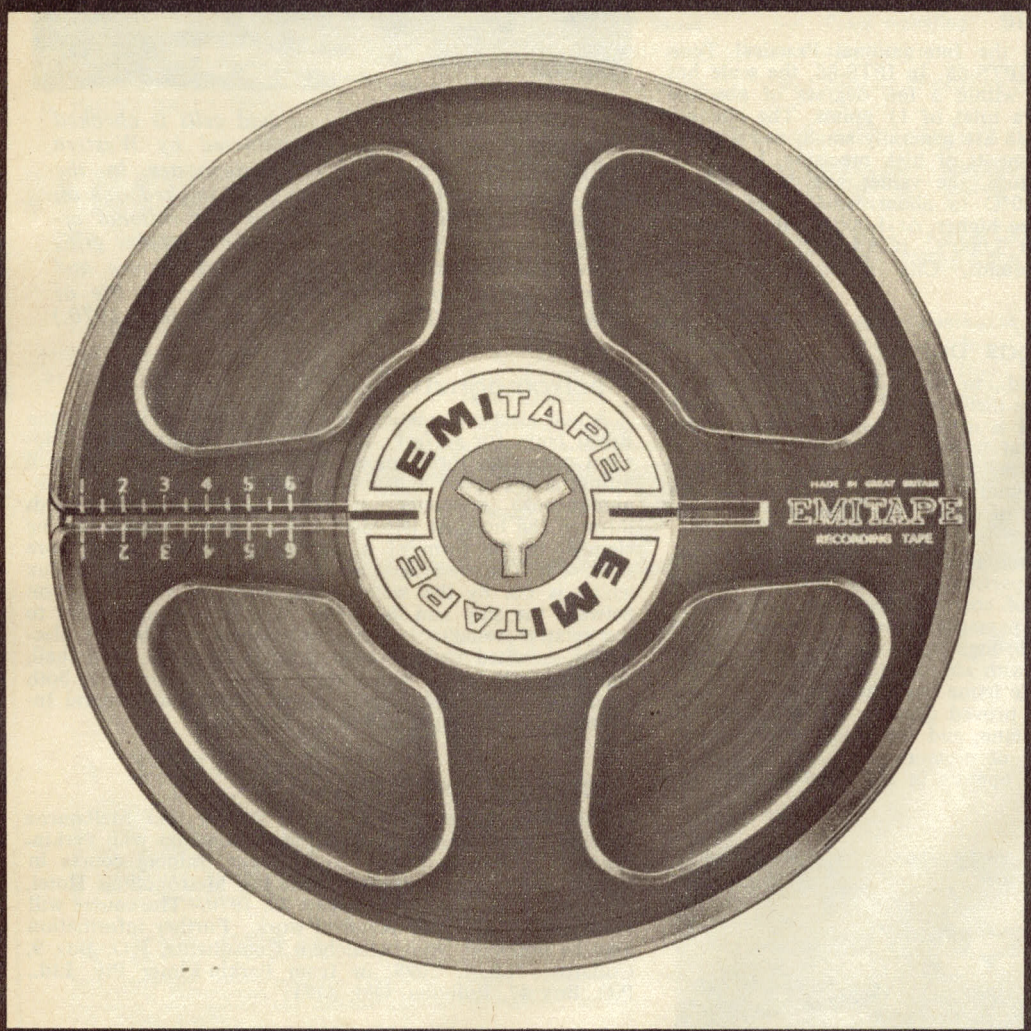
Atomic absorption course

Following successful courses in Sydney and Melbourne recently, Analchem Consultants, in conjunction with Perkin-Elmer Pty. Ltd., will hold a three-day training course in atomic absorption spectroscopy at the Metropolitan Hotel, Brisbane, commencing on August 24, 1970. The course will cover both theory and practical work. Further information may be obtained from Analchem Consultants, P.O. Box 9, Collaroy, N.S.W. 2098, or from Perkin-Elmer Pty. Ltd., P.O. Box 47, Bulimba, Qld. 4171.

Weather satellite

The first of the second-generation weather satellites designed for operational use by the Environmental Science Services Administration (ESSA) has been checked out by the National Aeronautics and Space Administration (NASA) and turned over for operational duty. Improved TIROS Operational Satellite-1 (ITOS-1) was launched by NASA on January 23, 1970, and given an exhaustive five-month engineering checkout. Operational coverage from weather satellites will be more than doubled with the use of ITOS-1 due to its ability to take day and night cloud cover pictures. The 682lb spacecraft is in a near-polar orbit ranging between 890 and 918 miles altitude and is inclined 78 degrees (retrograde) to the equator. It orbits the earth every 115 minutes.

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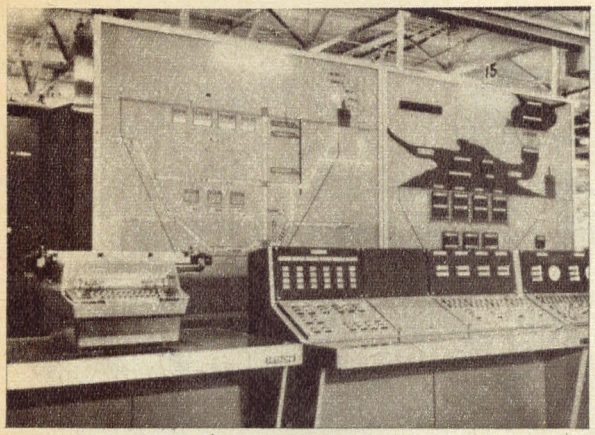


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Computer controls dams



The Hitachi dam control system features a control computer, graphic display panels and a data printer.

A computer system for simultaneously controlling the operation of two Japanese dams has been completed by Hitachi Ltd. The on-line system, which incorporates a HIDIC-100 control computer, will be installed at the Matsubara Dam on the Chikugo River in Kyushu. Linked with the operational controls at the Shimouke Dam located 6KM upstream, the system will automatically control the level, flow and discharge of water at the two dams. The computer will also record operational data and compile daily reports on the dams. The system, the first of its kind in Japan, is expected to bring a considerable reduction in manpower and help prevent floods and other water hazards.

Computers for universities

A 1904A computer ordered by the University of Newcastle, N.S.W., from International Computers Ltd. (I.C.L.) of the U.K., is expected to be fully operational by January, 1971. The machine will classify, catalogue and control the movement of the 15,000 books in the university's library. It will also help in student training, research and administrative duties. Communication with the computer will eventually be possible from 16 terminals located in various department throughout the campus.

The University of New England, Armidale, N.S.W., will also use an I.C.L. computer to process its business and statistical records, library files, and for research and teaching. Mobile teletypewriters located in various departments will allow users to communicate directly with the central processor and its store of information.

Magnetic tape cleaner

An automatic magnetic tape cleaner, developed in the U.K., removes oxide or wear particles from computer tapes. If left, these particles prevent the oxide surface of the tape from making intimate contact with the read/write head and are said to be responsible for 90 per cent of tape errors. Cleaning is effected by the shear action of tungsten carbide blades, followed by wiping with silicone-impregnated tissue. Different blades, positioned at the appropriate rake angle, are used for forward and reverse tape passes to deal with loose, adhered and embedded particles. The wiping tissues are advanced automatically to present a clean surface on each pass of the tape. (Precision Data Co. Ltd., Angel Road Works, London N.18, England).

Dry foam extinguisher

The U.K. Atomic Energy Authority has developed a dry powder fire extinguisher which gives a solid-based foam cover in the presence of a fire. The major constituent is perlite, a natural complex aluminium silicate of volcanic origin. It contains about five per cent combined water which vapourises when heated. On heating to about 900 degrees C, the perlite softens and is expanded by its own steam to give a foamy product of 4 to 20 times increased volume. When applied to a fire, ground perlite coalesces as a stable viscous foam with considerable thermal resistance which excludes air from the fire.

The U.K.A.E.A. has licensed J. Kerr & Co. (Manchester) Ltd., Ashcroft Road, Kirkby Industrial Estate, Liverpool L33 7TS, Lancs., England, to market perlite-based fire extinguishing powders.

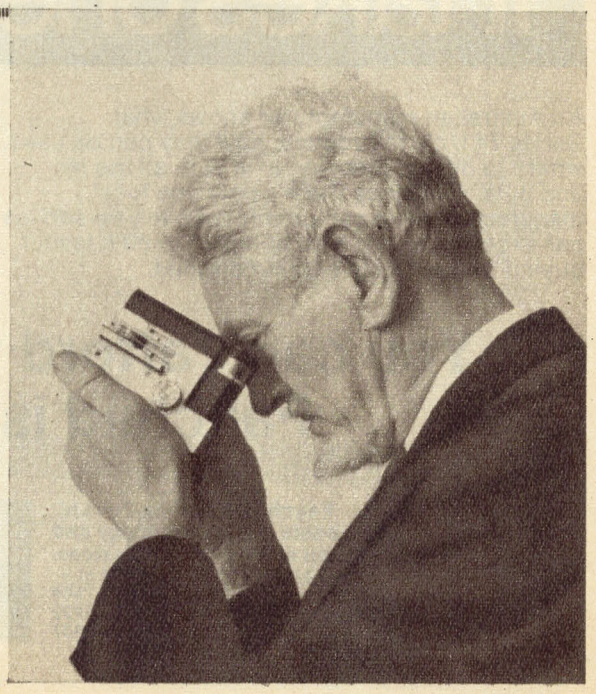
Underground radio

Westinghouse research engineers in the U.S.A. are trying to develop a radio system to locate miners and to communicate with them in emergencies in mines. Wire communications are easily disrupted by mining accidents, and radio has been little tried because the earth absorbs too much energy at the frequencies used in conventional radio systems. Scientists at the Westinghouse georesearch laboratory in Colorado have found that if the radio waves are sufficiently low in frequency,

Microscopy system

Among the winners of the 1970 Council of Industrial Design Awards in the U.K. was the McArthur microscope, which introduces a new system of microscopy. Measuring only 4in x 2¼in, it is capable of magnifications from 30x to 1500x, and covers the same specimen area with the same detail as a conventional microscope. The radical difference is the light path: light enters the instrument from the top, passes through a conventional condenser to the specimen, and then through the objective lens beneath. It is then reflected through 90° along a light tube at the base of the instrument, before being reflected again through 90° to pass upwards through the eyepiece to the eye.

Advantages claimed for the instrument include: the specimen is always in focus whatever the thickness of the slide; the image in the eyepiece is erect rather than inverted; a satisfactory examination can be made at the highest magnification even under extreme vibration; the objective lens is simply pushed in or out to change it; each microscope can easily be adapted to a multitude of specialist uses. (The McArthur Microscope, Landbeach, Cambridge, England.)



Dr John McArthur, the designer, demonstrates the new microscope.



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they can be made to pass through the ground without losing effectiveness. The researchers are now working on the development of antenna design, power and frequency limitations, methods of circumventing radio noise generated by mining equipment, and identifying and fulfilling safety requirements.

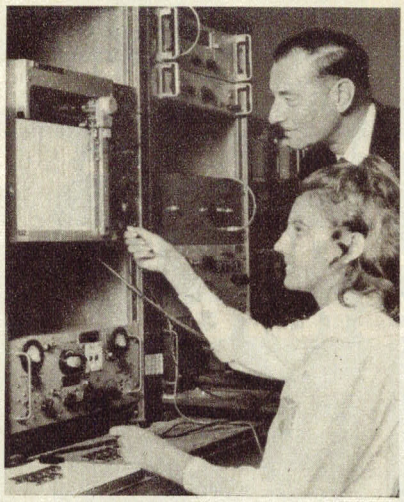
Telephone announcements

The P.M.G.'s Department has ordered magnetic drum announcement equipment from Plessey Electronics to the value of over $300,000 for its public telephone recorded announcement service. The order is for 65 12-channel automatic announcing units for short announcements and for 16 variable message recorders for longer messages. Brief subscriber courtesy information services, such as details of non-working and disconnected lines and other fault conditions, can be provided by the 12-channel equipment. The other equipment will be used for general information of up to three minutes duration, including sporting results, weather, and stock exchange reports.

TV traffic surveillance

Television cameras will be used to supervise Melbourne's Westgate Bridge when it is opened to traffic. A closed-circuit surveillance system that will provide high-quality pictures at night will be installed by Philips Electrical Pty. Ltd. who won the contract to provide all the communications facilities for the bridge. The bridge, to be longer than Sydney's Harbour Bridge, will require extensive communications, costing about $250,000 and including two-way radio connections with patrol cars.

Crystals for Qantas



A quartz crystal is tested on a special machine at Mobile Communications to determine its frequency/temperature characteristic from minus 55 to plus 70 degrees. Mobile Communications, of Melbourne, has completed a $22,000 contract for the supply of quartz crystals to Qantas Airways Ltd. to meet the needs of a new three-phase world-wide plan for the reallocation of aeronautical communication channels.

Rare earths in electronics

The rare earths are becoming an important mineral resource for the electronics industry, according to Thomas A. Wilson, manager of the chemicals division of Molybdenum Corporation of America. Reporting the results of an informal survey, he pointed out that these little-understood elements (particularly yttrium, lanthanum, cerium, praseodymium, neodymium, samerium, gadolinium, and ytterbium) are showing up in more and more components, including capacitors, thermistors, and in synthetic garnets and other ferrites.

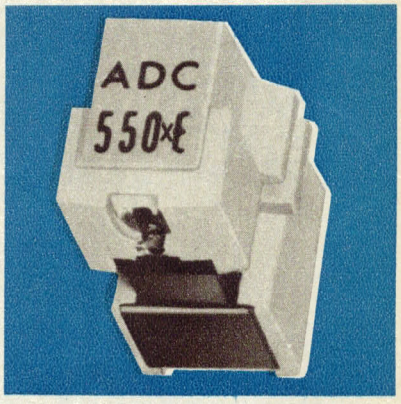
The rare earths are no longer considered rare (some are as plentiful as mercury and lead, and there is more of the rarest, thulium, than silver or gold) and do not always occur as earths (oxides). The 15 elements occupy a single place in the periodic table between barium (at. no. 56) and hafnium (at. no. 72). It is only recently that they have been available as alloys and compounds of the individual elements. Spurred on by such applications as the use of europium in colour TV tube phosphors, purified and separated rare earth chemicals have become less expensive and more readily available commercially over the last decade.

Taking ceramic capacitors as a field of active development and future promise, Wilson pointed out that doping titanates with very small amounts of cerium or lanthanum oxide increases the capacitance (in many cases), reduces its temperature coefficient, and reduces the effects of aging. Adding up to 40 per cent of neodymium oxide to capacitor ceramics and calcining has been recognised for some time as an efficient and effective method of producing NPO and negative temperature coefficient units. Recent work indicates that even greater concentrations of these oxides, particularly neodymium and lanthanum, will give capacitors with a wide range of coefficients and exhibiting a high order of dependability.

Showing great promise for miniturisation are the extremely high dielectric constants exhibited by pure rare earth compounds. Single crystals of lanthanum, cerium, praseodymium and neodymium fluorides, for example, can be sliced into capacitor bodies with dielectric constants of the order of one million.

Of interest in the development of monolithic ICs is the action of an aluminium/cerium oxide interface. When layers of metallic Al and CeO are vacuum-deposited to form a capacitor, the capacitance is independent of the thickness of the dielectric which can be only a few hundred Angstroms thick. It has been suggested, Wilson pointed out, that this results from an electrolytic action, raising the possibility of depositing a completely solid-state electrolytic capacitor directly on to an IC substrate. ■

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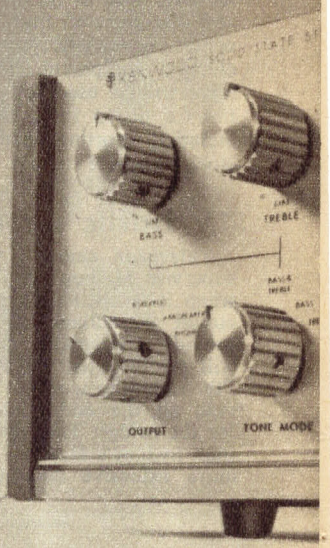
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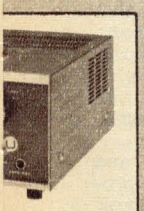
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ROTATABLE VHF BEAM ANTENNAS

This article is written especially for those amateurs or would-be amateurs who have never got round to putting up a rotating VHF beam because of the time, the money and the effort involved. This one imposes very small demands on any of the three rather scarce commodities.

By Neville Williams

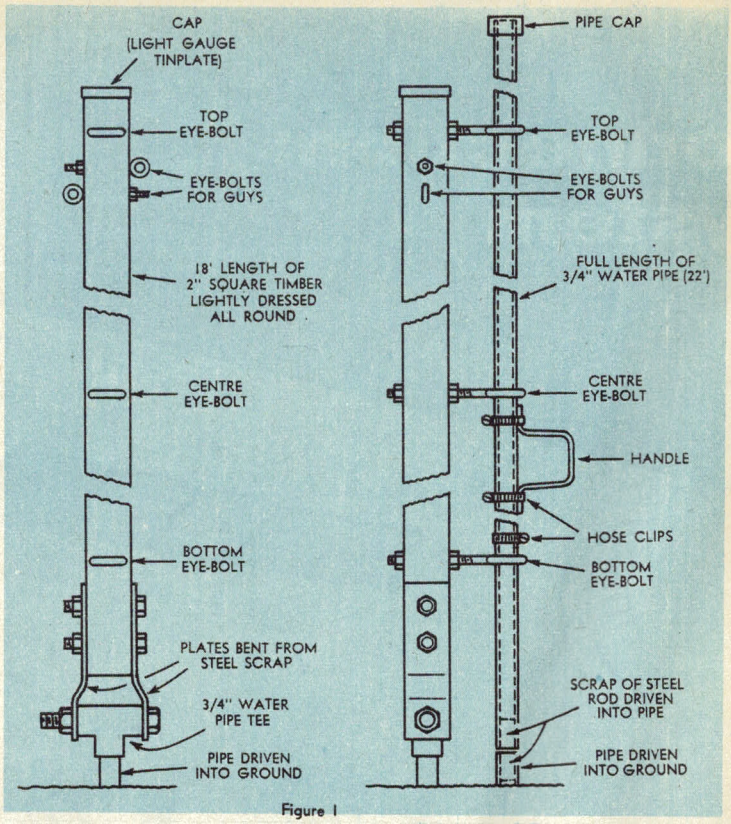


Figure 1

Neither expensive nor difficult to construct, this rotatable antenna mast can typically carry arrays for 432, 144 and 52MHz, one above the other.

The amateur who desires to become active on the VHF bands normally begins to think about erecting a rotating beam.

When he thinks about such a beam, he envisages a tower not less than 40 feet high, surmounted by a nest of arrays covering two or three bands, with a choice of polarisation — the whole lot driven by a remotely controlled motor.

But while such a system would undoubtedly be nice to have, it is likely to involve so much planning, so much work, and so much expense that, for many amateurs, it is fated to remain a dream for some time in the vague future.

Fortunately, it is possible to get by quite well with something much more modest and, to adapt an old saying, a small beam in the yard is worth something twice the size in the imagination! The system described here is only 22 feet high, but it will carry simple arrays for 52, 146 and 432MHz, it will rotate and it can be erected in not too many hours of spare time, for the expenditure of not too many dollars.

As shown in figure 1, the basis of the antenna is a spar of 2x2-inch straight-grained oregon, 18 feet long. Anything lighter will be too light; anything heavier will cost a lot more and be harder to handle. Hardwood is cheaper but again a lot heavier. Have the timber yard "skim dress" the spar or dress it yourself, making sure that not too much wood is removed in the process. In our case, the spar was skim dressed to 1¾ inch square and cost $3.55 delivered to the door.

Check over the spar for cracks or knot holes and fill them with putty or plastic wood. Apply one or two coats of primer and/or undercoat and finish with outdoor gloss white enamel — not forgetting the two ends. As an added precaution against moisture penetration, a cap can be bent up from a scrap of jam tim, fixed to what will be the top of the spar, and painted to match.

Probably the simplest and easiest way to handle a not-too-heavy antenna system is to have it pivoted at the bottom so that it can be "walked up" and as easily walked down again for maintenance and modifications. This assumes that there will be space in your backyard into which you can lower a 22ft antenna system. In most cases, it should not be too much of a problem.

The diagram suggests a simple method of arranging a bottom pivot.

From any source you can think of, get two pieces of scrap steel measuring about 7 x 1¾ inches and of not less than 16 gauge. Kink them outwards so that, when bolted to the foot of the spar, they will have 2½ inches clearance between them. Quarter-inch bolts will be ample to attach them to the mast but the bottom pivot bolt can be of about 3/8-inch diameter.

The bottom fixed pivot can be an ordinary "tee" on top of a short length of water pipe, driven into the ground. About 18 inches of pipe should be ample and, if the ground is not too hard, the assembly can be driven home in one piece. Pack the Tee with a piece of conduit if you want the bolt to be a snug fit, but whether it is or not doesn't matter all that much. Don't forget, however, to paint the steel plates and boltheads to inhibit rust.

The spar must naturally be guyed to hold it upright and it is possible to use proper stranded guys (ex disposals, if you have such), galvanised wire from clothes hoists, or plain galvanised fencing wire obtained from a hardware supplier. It is conventional to break up the guys into random lengths by inserting egg insulators but this probably doesn't matter a great deal if they are running downwards from a point well below a horizontal beam.

Three guys 120 degrees apart will support the spar but try to plan things so that the guys will run down to a stout fence, some point on an adjacent building, or down through a shrub to a ground spike. No one relishes walking into a wire guy when mowing the lawn! If a guy has to be exposed, it may be necessary to attach a batten to it, or to slip a length of plastic hose over it, both to make it more obvious and to minimise damage if someone does inadvertently walk into it. In our case, to attach the guys to the mast, we used a couple of plated eyebolts, obtained from a hardware store, with shanks long enough to pass through its 1¾-inch dimension.

The other matter to consider is that you will want to rotate the beam, preferably from within the ham shack. If your ideas do not run to pulleys or other such devices, it should be mounted adjacent to a window or door, where it can be reached easily.

Having provided a spar, pivot and guys, one can take the next step of providing something to rotate and to carry the antenna arrays. This "something" can be a standard 22ft length of ¾-inch galvanised water pipe, again obtained from the local hardware store. This will cost about $2.75. Fairly obviously, such a length of pipe is going to leave

about 4 feet protruding above the spar to carry the antennas.

To provide a "bearing" for the pipe, we used three somewhat larger eyebolts, which could be made a slip fit over the pipe by opening the eye a little and shaping with a round file. We chose eyebolts with the longest shank, and obtained extra nuts and washers, so that the pipe could be stood out as far as possible from the spar, thus providing room for any pulley that might be added later for mechanical rotation.

To carry the vertical thrust of the pipe, the simplest course is to drive another short length of pipe into the ground, at just the right distance from the base of the spar. Push a piece of conduit or steel rod down the pipe leaving a couple of inches protruding. The rotating pipe can drop over this. If you are going to rotate the pipe by hand, don't worry about thrust washers, etc. A little friction will help to prevent the array from swinging around in the wind.

It is worthwhile, by the way, installing an ordinary automotive hose clip just clear of the bottom eye bolt. When you want to walk the beam down, the circlip will prevent the pipe from sliding through the eye bolts as the spar lays over. The arrangement assumes that the pipe will be on the high side of the spar when this is done.

The diagram also shows a handle bent up from a scrap of flat steel and clamped to the rotating pipe by a couple of hose clips. This handle can be used to turn the pipe but it will also serve as a stop to prevent the pipe from touring through a full rotation. Such precaution is necessary or you will run the risk of "winding up" the antenna cables and tearing them adrift. The handle can be positioned so that it inhibits orientation in a direction from which contacts are least expected.

At this point, therefore, you have a secure, rotatable antenna mast, 22ft high, with about 4ft at the top clear for VHF arrays.

And the cost: Almost certainly less than $10, a few hours of non-arduous work, and not a great deal of planning!

When it comes to constructing the actual arrays, there are at least three different approaches open to the oddment-minded amateur.

TANK WHIP ANTENNAS, obtained from disposals sources. These are of steel, light and strong but very hard. They can be cut with a hacksaw, if you don't mind ruining blades in the process but the better approach is to cut a v.-groove around them with a file and break them. They are normally sprayed a dull green but a rub with a file will reveal a layer of copper plating which will take solder well.

BRASS TUBING: This is a handy material if you happen to live within travelling distance of a merchant who handles it. Large diameter tubing can be used as a boom, while the elements can be made from smaller diameter tubing. Tubing of diameter 3/16in, ¼in and 5/16in will usually slide one into the other, while ordinary 1/8in brazing rod will slip into the 3/16 o.d. tubing. Elements can be built up, tapering from larger diameter in the centre to brazing rod at the tips, the junctions being soldered with the aid of a plumber's iron and a gas ring or gas torch. The elements can be passed through the boom and, again, soldered in place.

ALUMINIUM ALLOY TUBING: This is lighter and cheaper than brass but, again, one needs to be handy to a source of supply. For many, a more convenient source of alloy tubing will be from damaged or even new television arrays. These have the additional advantage that they carry assembly hardware which can be removed and re-attached to provide the dimensions required for an amateur VHF beam.

Ideally, these materials should not be mixed. Brass, copper and soldering techniques go hand-in-hand.

Aluminium alloy involves welding or riveting, and alloy or plated steel hardware.

Commercial practice is to observe the compatibility of metals. If the rules are ignored, electrolysis effects will hasten corrosion and lead to customer dissatisfaction.

For the amateur, however, who may find himself with metal oddments on hand at little or no cost, it is not unreasonable to bend the rules. Corrosion or no corrosion, the chances are that a simple antenna built from incompatible materials will still do the job for as long as it is likely to be required. This should be true, at least, in those areas where salt spray or industrial atmospheric pollution does not present an additional hazard.

One point we would make, however, is that a beam built from oddment materials should be given a liberal coat of synthetic "aluminium" paint to inhibit corrosion as far as possible.

But more than that, it will improve the appearance of the beam no end. It is amazing what a good coat of aluminium paint will do for a beam built from second-hand oddments!

VHF arrays for the amateur bands can be constructed to a variety of configurations, involving both the number and arrangement of elements and the method of antenna feed. Amateur handbooks contain many suggested designs and individual constructors will probably find that one or other of these designs happens best to suit the materials (and cables) to hand. Such considerations influenced our own choice, although we feel that the suggested configurations should come fairly close to what many amateurs will find it convenient to adopt.

We settled for a 2-element 52MHz array, mounted horizontally just clear of the wooden spar. A 2-element design will give the basic gain and directivity one expects from a VHF beam and, while extra elements would add a diminishing quota of performance, they

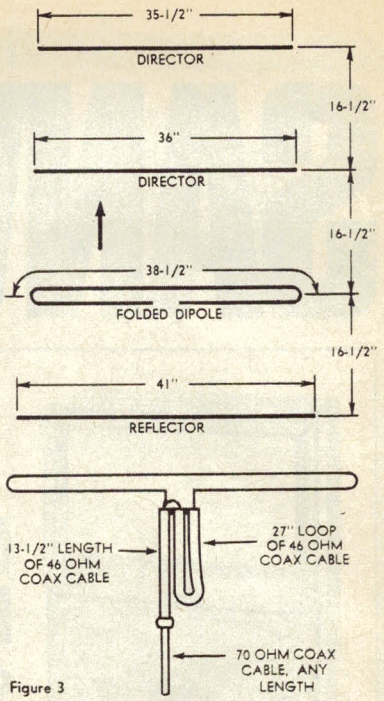


Figure 3

A 4-element array for 144MHz. A folded dipole is suggested for wider bandwidth. A rather more elaborate feed system is necessary to achieve symmetry and a reasonable impedance match.

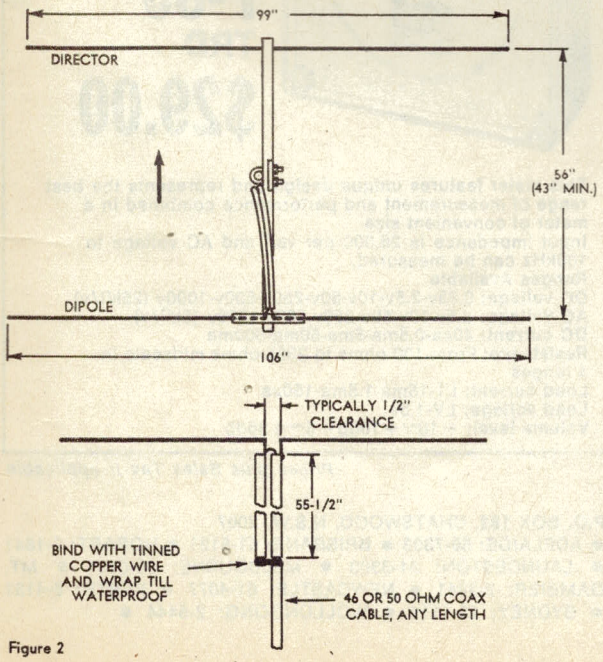


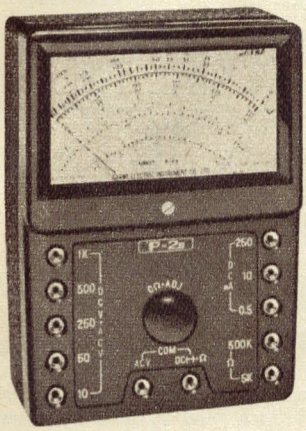
Figure 2

Essential details of a 2-element wide-spaced array for 52MHz. The stub provides a symmetrical feed for the two halves of the dipole.

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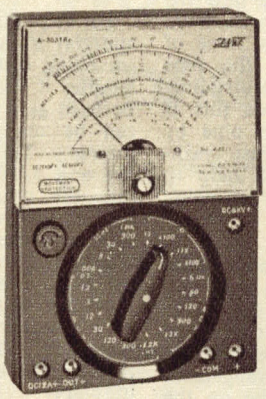
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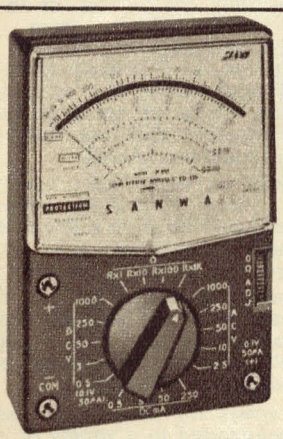
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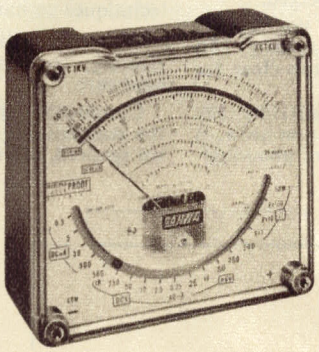
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would also add their quota of constructional complication.

For the 144MHz band, we suggest a 4-element array, more practical because the natural dimensions of a higher frequency beam are much smaller. The 144MHz beam can be clamped above the 52MHz array, near the top of the rotating pipe.

Those interested in covering the 432MHz band can substitute a reducing union for the cap at the top of the pipe and add a short length of ½-inch water pipe to carry the 432MHz beam above the 144MHz array.

For constructors who want vertically polarised arrays, the most obvious course would be to screw a "Tee" to the top of the rotating pipe, with short lengths of pipe to either side, carrying 52 and 144MHz beams mounted vertically rather than horizontally. Separation would have to be arranged, of course, to ensure that the tips of the larger array did not foul the supporting guys or other structures. The feed cables could be brought to the centre pipe and secured, in the normal way, so that they will rotate with it over at least part of the downward journey.

Figure 2 shows typical dimensions for a 2-element beam for the 52MHz band. The boom, the director and the driven dipole can be of any likely and convenient diameters, selected from the materials already mentioned. Elements for this type of beam are usually about 3/8 inch diameter and the boom ¾ inch to 1 inch.

If operation were contemplated on one frequency only, it would be logical to optimise the beam for that frequency. For the prototype array, however, we envisaged operation anywhere within the band and therefore based the dipole calculations on the centre frequency of 53MHz. Allowing the usual 5 per cent reduction for end effect this gave a figure of 106 inches overall. The dipole needs to be broken in the centre, of course, for connection to the feed cable.

Normally, a parasitic director is cut to about 95 per cent of the length of the dipole. However, since it must serve as a director at the highest frequency at which the array is likely to operate, there is good reason to reduce its length a trifle more to, say, 99 inches.

The spacing between the elements can logically be set to one-quarter wavelength, equal to 56in. If boom length is a problem, it can be reduced to one-fifth wavelength, or 43 inches, without unduly affecting the general characteristics or impedance of the driven element.

The impedance at the centre of the dipole can be expected to approximate 50 ohms and it may therefore be fed directly with a length of coaxial cable having a characteristic impedance in the region 45 to 55 ohms. The table in the centre of our June 1970 issue should assist in identifying cable suitable for the purpose.

Undoubtedly, the simplest approach is to connect the outer braiding of the cable to one element of the dipole and the centre conductor to the other, ignoring the fact that the system will be non-symmetrical, with some disturbance to the normal radiation pattern.

Symmetry can be restored by connecting a balancing stub adjacent to the antenna feedpoint, as indicated in figure 2. The stub should be a quarter-wave long at the operating frequency, with no allowance for cable characteristics, since only the outer braiding is used to secure the balance condition. Care must be taken to see that there is no contact between the braiding at the top, although good contact must be established at the quarter-wave point.

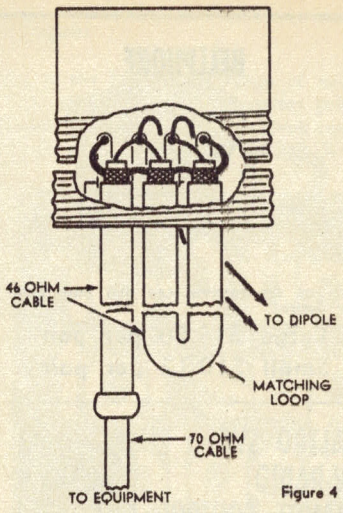


Figure 4

With a coat of paint and strapped to the mast, no one would ever recognise an aluminium pill tin for what it is. It is one way of housing and weatherproofing the feed system for the 144MHz beam in figure 3.

With new cable, a quick touch with a soldering iron on the braid can establish a soldered connection but, with old cable and tarnished braiding, heat may have to be applied for so long that the internal insulation may tend to flow and render the effort finally and completely abortive. With old cables, it is often better to avoid heating altogether; clean the braiding with glass paper, bind firmly and neatly with tinned copper wire and then wrap with plastic tape in such a way as to exclude moisture from the joint.

Incidentally, the top of the cable should also be wrapped or otherwise treated to prevent rainwater from seeping down inside.

Figure 3 shows typical dimensions for a 4-element array for the 144MHz band. In this case the folded dipole is specified to provide greater bandwidth than could be expected from a simple dipole. It is intended to resonate on 145MHz, which is not the centre of the band, but the centre of that portion of the band which is most used. The dimensions, by the way, should be measured along the conductor between the centre of the hairpins or the centre of the junctions at each end.

The tubing from which the dipole is made can be of any convenient diameter but, for the intended impedance relationships to hold, the broken and the unbroken elements should be similar, whether they are of the same diameter overall or made up from tapered segments. The spacing between them is not critical, provided that it is small compared with a quarter wavelength.

Since the parasitic reflector must function as such at the lowest likely frequency, it is logical to base the calculation on 144MHz; this gives a length overall of 41 inches. Conversely, since the directors must operate, as such, at the high end of the band, it is usual and logical to calculate them for progressively higher figures of frequency. This gives 36 inches (147MHz) for the director adjacent to the dipole, and 35¼ inches (148MHz) for the director at the front of the array.

Suggested spacing between all elements is 16¼ inches, representing a nominal 0.2 wavelength.

In a 4-element array of this general configuration, a simple dipole would exhibit a centre impedance of about 30 ohms — a figure which cannot be directly matched by any readily available transmission cable. Folding the dipole multiplies this by 4 to 120 ohms, which still presents something of a matching problem.

Various methods of matching impedances are available but the one suggested in figure 3 seemed best to suit our requirements.

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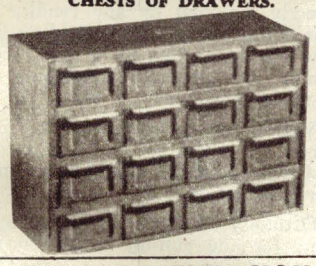
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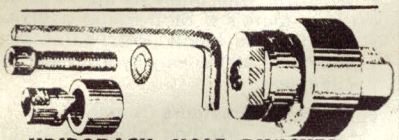
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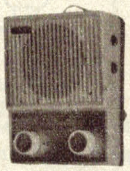
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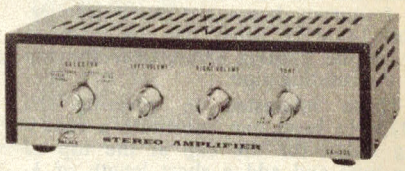
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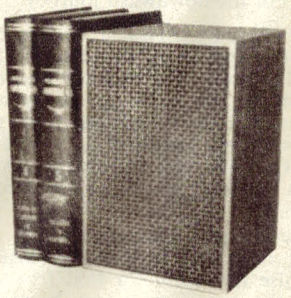
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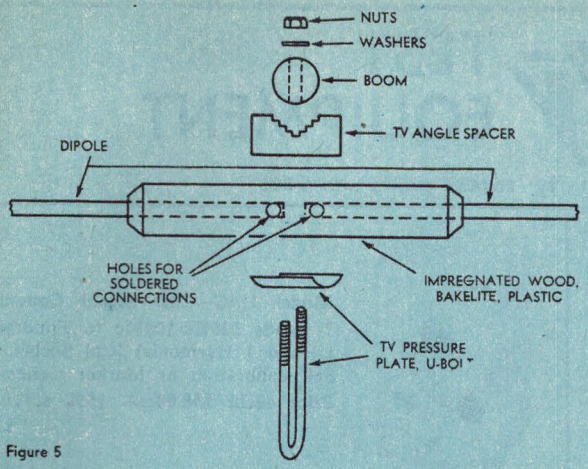


Figure 5

One way around a difficult problem — supporting and insulating the two halves of an ordinary dipole.

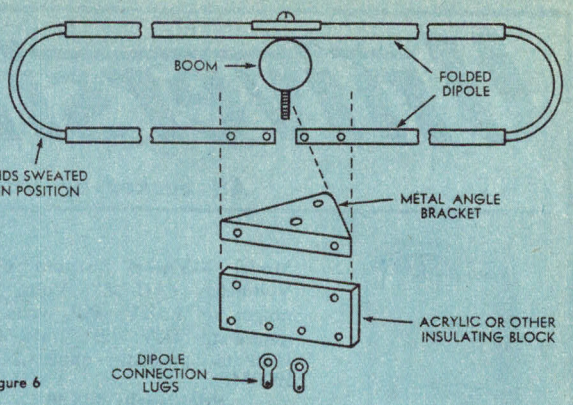


Figure 6

A way around another difficult problem — supporting and insulating the lower portion of a folded dipole.

Contriving antenna arrays from oddment materials is always a test for ingenuity. Here's an easy way to fix a brass or copper clad element to an alloy boom.

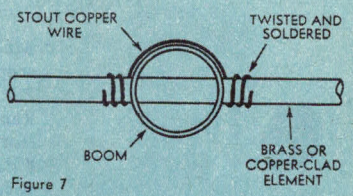


Figure 7

ment, and this can be of any practical length. Adjacent to the antenna, it is spliced to a short length of 46-ohm cable (50-ohm would do) conductor-to-conductor and braid-to-braid. The splice will need to be carefully made, carefully insulated and rendered strong and waterproof by generous taping.

Allowing for the velocity factor of the 46-ohm cable, a 13¼-inch length will function as a quarter-wave transformer. The ratio and nominal impedances at the lower junction, 70/46, call for 46/30 at the antenna end. While this end could conceivably connect directly to the centre of a 30-ohm dipole, as already mentioned, it needs to be multiplied by four, if connected to a folded dipole. A half-wave loop of the same 46-ohm cable, connected as in figure 3, will provide the necessary impedance step-up as well as achieving symmetry in the antenna feed.

Figure 4 illustrates a handy way to arrange the junction adjacent to the folded dipole. We obtained an aluminium pill tin with screw-top lid and an internal gasket seal. An ordinary small tagstrip was mounted inside the lid and holes drilled alongside it for three coaxial cables on one side and two smaller leads on the other, connecting to the two halves of the dipole. The braids were unstranded, twisted and soldered together, as shown, and soldered also to the two tagstrip mounting feet. The insulated lugs provided junction points for the inner connectors.

When completed, the body of the tin was screwed firmly in place, acting now as the lid, and the whole assembly clamped to the mast, cable down, with an ordinary TV clamping strap.

It is not wise, of course, to allow coaxial cables simply to hang from a unit like this or from antenna connection points. The cables should be taped to the rotating member and clamped firmly with hose clips, at a couple of points. Lower down, they can be fixed to the wooden spar, leaving ample slack to ensure that no strain is imposed when the antenna is rotated.

As already mentioned, those contriving arrays from TV antennas can usually adapt existing clips, brackets and insulating blocks to the new role. Those working with other materials may have to show a little more ingenuity.

Figure 5 shows one method of supporting the two halves of a dipole made from brass or copper-clad steel. Obtain from 6 to 10 inches of very close-grained impregnated wood, bakelite, perspex, etc., and drill holes into each end which will be a snug fit for the proposed elements. The holes should nearly (but not quite) meet in the centre. Drill two other holes, as shown, to meet the first two at right-angles.

Burnish the ends of the brass or copper-clad elements and push them into the respective ends of the supporting block. Apply a smear of non-corrosive flux through the side holes and flow solder on to the tips of the elements, to provide a contact and also lock them firmly in place. While the solder is molten, push in a length of stout copper wire, or a threaded bass bolt, to which the feedline can later be connected.

Figure 6 suggests a method of mounting a folded dipole on to a boom. A bolt passes right through the top element and through the boom, becoming one of two bolts which hold an angle bracket in position beneath the boom. To this angle bracket is bolted a block of insulating material, drilled to support the open ends of the folded dipole. If there is any fear of the upper element being unduly weakened by the bolt passing through it, it can be secured instead by a clip passed around and sweated to it, or simply reinforced with a short length of slightly larger diameter tube slipped over it and sweated.

Rather than try to bend the tubing to form the ends of the folded dipole, it is usually easier to bend loops from a piece of brazing rod and, after adjusting them to secure the required dimensions, sweat them in place.

It might also be observed that while it is good practice to use the best material available to insulate and support the centres of a dipole or folded dipole, there is no need to make a fetish of it, because of the relatively low impedance of a dipole at its centre point.

And, finally, figure 7 shows a simple trick for fixing a brass or copper-clad element into an alloy boom. Polish the centre of the element and push it through a closely fitting hole in the boom. Take a short length of stout copper wire, polish it and twist it tightly around the element on one side, up over the boom and round the element on the other side. Flow solder to lock the element and copper wire firmly together.

And don't forget our earlier word of advice. If you mix metals like this in the interests of economy, give the finished unit a liberal coat of aluminium paint. It will help retard corrosion and improve its appearance no end. ■

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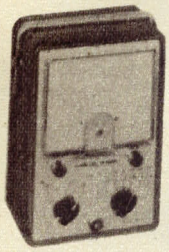
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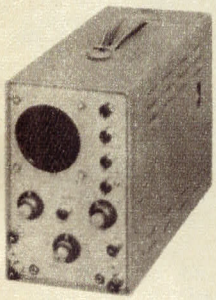
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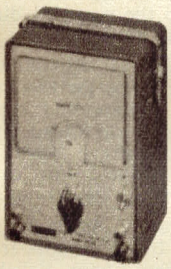
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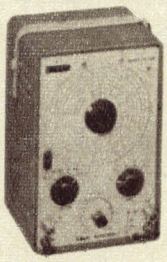
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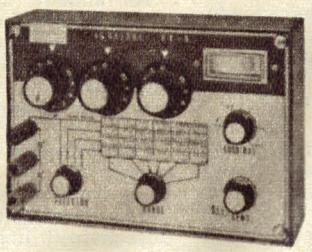
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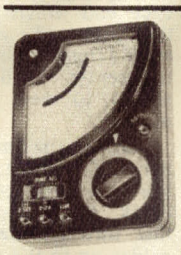
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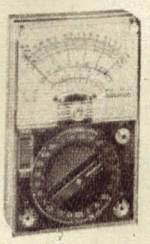
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A Capacitor Discharge Ignition System

The recent upsurge of interest in capacitor discharge ignitions systems has resulted in many requests from readers for full constructional details. This article, submitted by a Victorian reader, is based on the experience gained in building a number of such units and testing them on a variety of vehicles. It gives full constructional details which any moderately experienced reader should be able to follow.

By A. J. FRASER

Modern petroleum manufacturing techniques have resulted in fuels capable of knock-free operation, up to extremely high speeds in the well-designed internal combustion engine. These higher compressions have been coupled, in the modern engine, with high-revving, short-stroke designs which have reached and, in a lot of cases, exceeded the capabilities of the Kettering ignition systems used.

In the past, many attempts have been made to improve the original Kettering design by the addition of dual-contact distributors, sports coils, dual coil and spark-plug systems, special-type spark plugs, transistor ignition systems, etc., but have all resulted in either increased mechanical complexity, short service life of components, a reduced electrical efficiency, or combinations of these troubles.

Early in the career of the spark ignition engine, another method of providing the spark was devised. This method was termed a "Capacitive Discharge Ignition" system. CDI, while obviously superior in performance to the Kettering system, was not a practical proposition. The "state of the electronic art" at the time of its conception resulted in a very bulky unit with a poor reliability.

The advent of the transistor, and ferrite materials, brought the solution to the high voltage supply section of the system, but it was not until the development of the silicon-controlled rectifier, (SCR), that CDI became a practical reality in both size and reliability.

An average six cylinder engine consumes approximately 2 watts of spark power at the idle. Yet, to provide a reasonable high-speed performance, an input power of around 40 watts is required by a typical 12 volt version of a modern Kettering system. The transistor-assisted version provides an improved high-speed performance by simply increasing this wasteful input power to approximately 80 watts.

All this power waste is necessary with the normal system due to the manner in which the spark energy is stored until required. This storage takes the form of a magnetic field built up around the core of a pulse transformer (ignition coil). The sudden collapse of this field when the distributor points open and interrupt the primary current produces the high-voltage spark pulse when its lines of flux cut through the many turns of the secondary winding.

As the primary of this pulse transformer has an inductance, the primary current, and hence the magnetic field, takes a finite time to reach a high enough magnitude to be of any use. At high engine revs this time becomes significant in comparison with the spark repetition rate, and does not permit the magnetic field to reach full strength. Thus the normal output of 25KV at the idle, or around 30KV for a transistor assisted system, falls off rapidly as the speed rises. As well as this fall in peak voltage, the power delivered in each spark also falls rapidly, thus reducing combustion efficiency at the higher speeds.

The CDI system proposed in this article will maintain its output relatively constant up to quite high speeds. In fact it will fall by only 2 to 3 per cent even at 6,000rpm on a 6-cylinder engine, thus preserving combustion efficiency for a livelier and more economical performance in the medium and high-speed range.

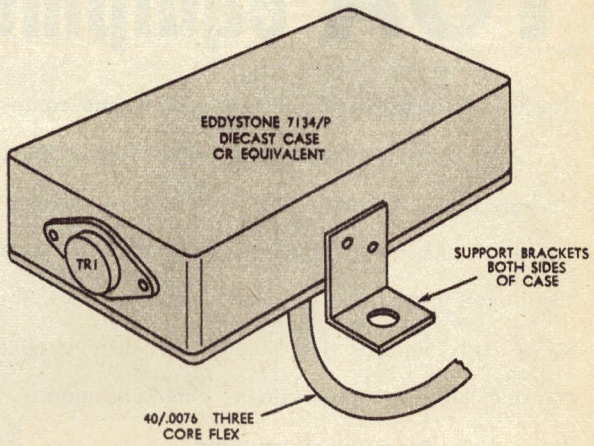
In the CDI system, the energy is provided as a high voltage stored in a capacitor, which has the considerable advantage of not consuming further power once full charge has been reached. This increase in efficiency is not fully realised in practice, in order to keep the design simple. However, even though the converter section of CDI is allowed to continue running after full charge has been provided, the power input at the idle is less than 12 watts, while the spark power is increased by almost 100 per cent over the normal Kettering system.

The spark voltage pulse is produced by a rising magnetic field with CDI and therefore unless voltage polarity, or coil primary connections, are reversed an incorrect polarity of spark will be produced from a normal coil. In this CDI, voltage polarity reversal is used for negative chassis vehicles, and coil reversal for positive chassis.

In theory the lowest voltage breakdown of a spark gap is obtained where the hottest electrode is used as the cathode. (Provided the temperature difference between these electrodes is great enough to make a significant difference in the electron valence bond strength.) The centre electrode of the spark plug is the hottest and therefore should be used as the cathode.

By the use of a high applied voltage (400V) from a low impedance power limited source, a capacitor, the rise of this magnetic field can be made almost explosively fast, and will therefore produce a high voltage in the secondary winding very close in amplitude to the applied voltage times the pri/sec turns ratio.

The complete CDI system was housed in a commercially available die-cast aluminium case. The brackets shown are designed to permit air circulation around all sides of the case.



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Most normal ignition coils fall in the 90/1 to 100/1 turns ratio range. Some high performance "Sports" coils even run as high as 120/1. Therefore, depending on the coil employed, spark voltages up to 48KV can be obtained with this CDI. However, voltages over 40KV are not advisable due to possible coil insulation failure in the event of a spark plug lead coming off at high speed. Use of sports coils are thus not recommended with CDI.

The considerably faster rise time, (approx. 15uSecs), of CDI enables firing of quite badly fouled spark-plugs with a resultant greatly extended life between plug cleanings or replacements. The higher spark voltage available also enables firing of petrol/air mixtures at greater pressures, thereby extending the lower limit of speed in top gear before misfiring, and thus "transmission snatch," commences.

The higher power delivered in each spark provides a more stable flame front in the combustion chamber. This brings about an improvement in fuel economy and a broader tolerance to lower octane fuels without "pinking." This broader tolerance to fuels also applies to the petrol/air mixture ratios, and results in easier starting even under "flooded" engine conditions.

Many exaggerated claims have been, are being, and will undoubtedly continue to be made about improvements in performance and economy with CDI. These claims probably result from the fitting of CDI to a vehicle already on the last legs of its normal ignition system and 50 per cent of the claimed improvements would have been achieved by an electrical tune-up anyway. However, this only serves to highlight the lengthened period of trouble-free service to be expected with CDI.

Over a number of test cases with CDI fitted to a variety of cars, in good condition, the following facts emerged:

Average fuel economy improvement worked out at 5%. The worst figure being 2% and the best case slightly under 10%.

The drivers of manual transmission vehicles all reported they felt the car was smoother and more pleasant to drive. Most of the smaller cars were a little livelier throughout their speed range and quite definitely more flexible at low speeds.

All drivers reported they found cold starting a little easier, and flooded starting vastly improved. Also where a manual choke control was fitted, much less use of it was needed.

Most drivers of automatic transmission vehicles reported they felt little if any improvement in smoothness or performance, although the driver of smaller engined vehicles did feel there was some improvement in their high speed performance.

However, there are other advantages: The distributor points should last the life of the engine; spark plug life will be extended; starting will be easier; improved fuel/air combustion with less use of the choke will extend top overhaul periods; and quicker starting and lower ignition current will extend battery and generator/alternator life. If these advantages, plus some improvement in economy and engine performance appeal as an attractive proposition, then the cost, time, skill and effort needed to make and fit a CDT can be justified.

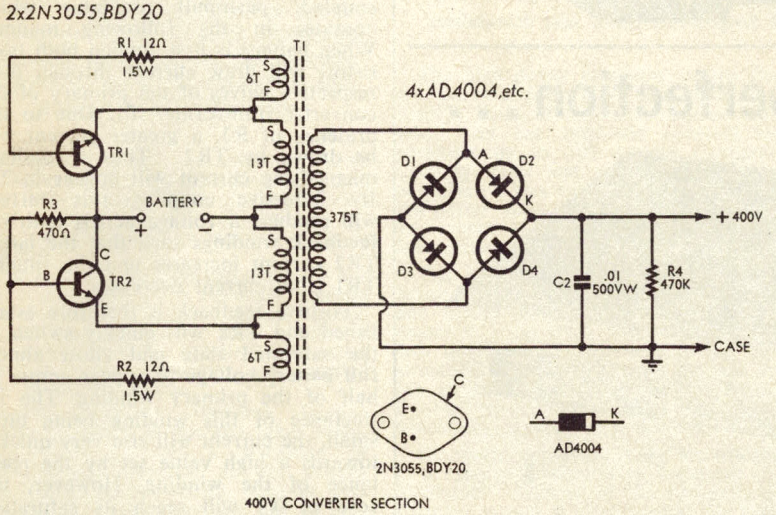
In early 1964 the author became interested in the CDI concept and decided to attempt design of a unit using readily available, local components. Almost coinciding with the decision, a suitable SCR, the type C20D, was released as an economy line, thus lowering the cost of the unit by quite a respectable amount. The main snag was finding a suitable capacitor for the charge storage. A value of 1ufd, 400V, was needed. A few, rather scarce French and German imported units were scrounged to provide a small enough capacitor to fit in the early CDIs. The subsequent release of polycarbonate and similar types, rated at 1uF, 400V, appeared to offer a better proposition, and the polycarbonate types have been used in all models to date, with complete satisfaction.

(Editorial comment: Although the polycarbonate type capacitor has been extensively used in the past for CDI systems, long term experience suggests that they are not sufficiently reliable when used in this role. Foremost among these who question their suitability are the capacitor manufacturers themselves, who point out that these capacitors were never intended for an application of this kind. The main problem appears to be continuous requirement to deliver the heavy discharge pulses demanded in this application. At least one manufacturer, Plessey-Ducon, has developed an oil filled paper dielectric capacitor specially for this application. Type number 5S10A, it is rated at 1uF, 1000V. Although larger and more expensive, it would appear to be a logical choice where maximum reliability is required.)

The early units used the ASZ15 transistor in the inverter section, but the cheaper NPN silicon 2N3055 transistor is now a more economical choice.

The main drawback in using the 2N3055 occurs when the CDI is built for use on a negative chassis system. The collector (case) of the transistor is then at the full 12v positive of the battery active, and is thus subject to possible short circuit by dropped tools etc., amd more prone to corrosion attack. In a positive chassis system the transistors are mounted directly on the CDI case, at chassis potential, and thus removed from these hazards.

With negative chassis systems it



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1 Printed wiring board type 70/cd1.
1 6-pin socket.
1 6-pin plug.

CAPACITORS

1 400uF 16V electrolytic.
1 0.01uF 500V disc ceramic.
1 1uF 400V (see text).
1 0.15uF 100V plastic or paper.

RESISTORS

2 12 ohm 1.5 watt wire wound.
1 470 ohm ½ watt.
1 470K ½ watt.
1 2.2K 1 watt.
1 22K ½ watt (see text).
1 100 ohm 1.5 watt wire wound.

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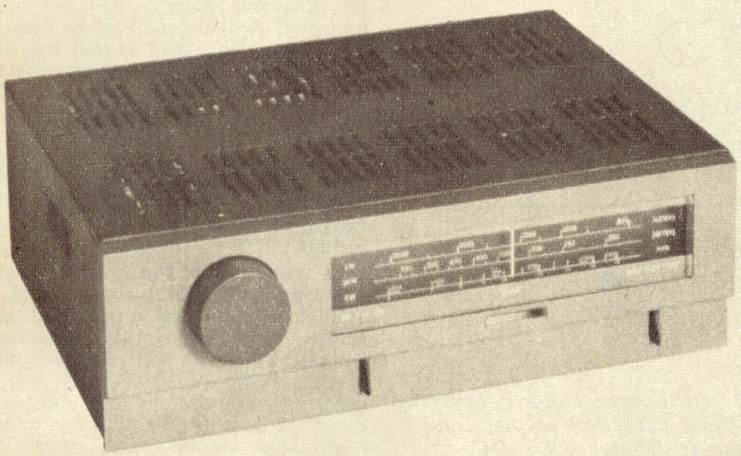
2 2N3055 or equivalent with insulating kits if necessary. (See text ref. ASZ15s.)
5 AD4004 or equiv.
1 OA202 or equiv.
1 C20D or equiv.
2 Mullard FX2242 core sections.
1 Mullard DT2180 single section Delrin former.
1 Mullard DT2155 clamping nut.
Small quantity of 22, 26 and 28 B&S gauge enamelled copper wire.

SUNDRIES

Length of 40/.0076, 3 core, power cord; grommet for power flex entry; one 4 lug tag strip; small quantity 23/.0076 insulated wire; silicone grease or heat-sink compound; flat-black paint, an assortment of screws, nuts, washers, solder, etc.; scraps of extruded aluminium for mounts.

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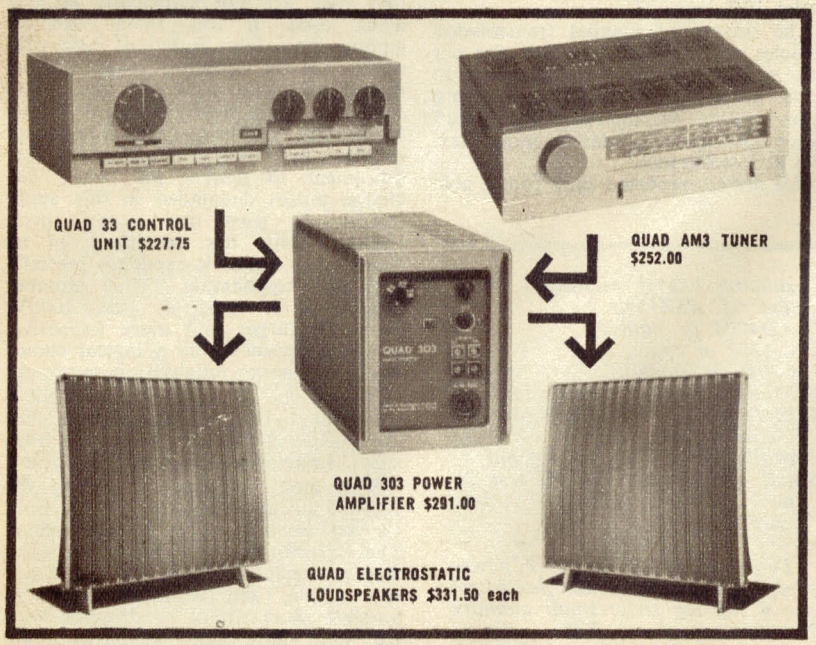
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Tuning range: Medium Wave: 510-1620kHz (588-185 m). Short Wave 1: 2.2 — 6.6Mhz (136-45 m). Short Wave 2: 5. — 18.5MHz (52 — 16.2 m). **Output Level:** 100mV (Nominal for 30% modulation). **Filter Rejection frequency;** 10kHz. Dimensions: Width, 10¼". Height, 3⅝". Depth, 8".



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would be advisable to retain the ASZ15, PNP type, in order to keep the transistor cases at chassis potential. No change is necessary to circuit values so this choice is left to the constructor to balance cost against safety.

The converter power supply section is a saturation-controlled, transformer-coupled, push-pull oscillator which operates in the following manner: When battery is first applied both transistors will draw current through their respective halves of the primary of the converter transformer T1. Due to the presence of R3, a greater current will be drawn by TR2. Thus a resultant magnetising current will appear in T1. By inductive coupling this current will produce a voltage across both the feedback windings such that the larger TR2 current increases and the smaller TR1 (Ico) current decreases.

Positive feedback is therefore established and TR2 will quickly switch to the saturated state and allow almost full battery voltage to appear across its half of the primary winding. The inductance of this winding being quite small, the current will rise very quickly towards a high value set by the resistance of the winding. However, the core of T1 will reach its saturation flux density before that current can be reached.

When saturation is achieved no further change in flux will occur. From our transformer theory: no change in flux means no induced voltage. Therefore at saturation the feedback voltages will fall to zero, thus returning the transistors to their quiescent condition. The resultant removal of battery volts from the primary winding will cause the magnetising current to fall towards zero. However, the moment the current falls below saturation level a decreasing flux density will commence. Again from our transformer theory: a reversal of flux movement means a reversal of induced voltage. Thus the feedback voltages reappear reversed in polarity. This results in TR2 turning off completely and TR1 quickly driving T1 into saturation in the opposite magnetic polarity. Again, at saturation, loss of feedback voltages occur and a repeat of the first cycle begins. The circuit continues to oscillate in this way with the waveforms of figures 4 and 5.

Under conditions of close match of transistor Ico's, low temperatures, or heavy loads, the circuit would not always start oscillating were it not for the presence of R3. This resistor provides the large unbalance necessary to ensure starting under all conditions, bar one.

This one condition provides a unique feature of this type of converter. It is short circuit safe. With a short across the secondary of T1, provided leakage inductance is low (and we ensure this by our winding technique) transformer action transfers the short across the feedback windings and thus prevents the supply from oscillating. Instead transistor TR1 will remain at Ico, and TR2 at a value set by R3. The value of R3 is therefore carefully chosen to be low enough to ensure positive starting, and high enough to keep dissipation in TR2 within safe limits under the short circuit condition.

If leakage inductance is not kept low in T1, the converter will continue to run (at a frequency dependent on L/leakage) with a destructive level of

power dissipation in TR1 and TR2. Also, spiking of the waveforms will result with possible over-voltage failure of these transistors under normal running conditions. To keep this leakage inductance low we must ensure both 13 turn primary winding halves are exactly equal and tightly coupled. Likewise for the 6 turn feedback windings. This is easily accomplished by the bifilar winding technique. ie., double the wire to be used and wind both halves simultaneously.

With the converter oscillator functioning, transformer action results in a step-up of battery volts to 400V square wave AC in the secondary of T1. This AC voltage is then rectified by the AD4004 bridge and supplied to the charge capacitor C3 in the trigger section as 400V DC.

When C3 is fully charged, (via the ignition coil primary and R5), triggering the SCR into conduction instantly dumps the entire charge across the coil primary with a resultant very high peak of current. The corresponding rise in magnetic field induces a fast-rising high voltage pulse in the secondary. The SCR when triggered will also apply a short circuit across the 400V DC converter output but, as explained earlier, this has no detrimental effect on the supply, which simply turns off.

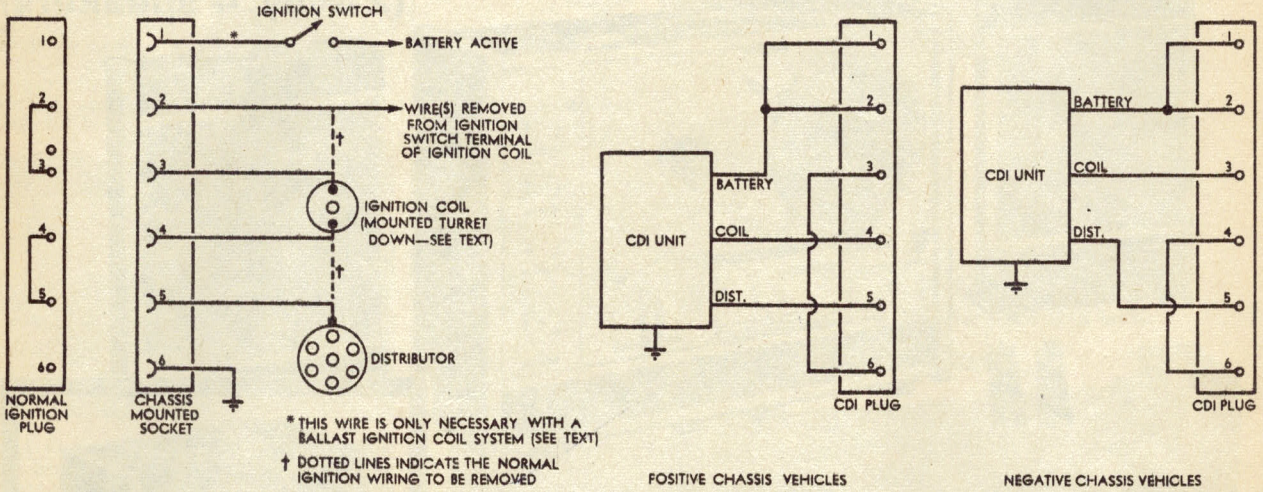
As C3 discharges into the primary inductance of the ignition coil, a damped oscillatory waveform commences. When this voltage rises negatively again after C3 has discharged, it will attempt to conduct back through the SCR in the reverse direction, thus commutating the SCR to its blocking state once more. Resistor R5 provides a damping action on the oscillatory waveform, which could otherwise result in over-voltage peaks up to 800V, under spark misfire conditions, reaching the SCR (via C3) and destroying it by dV/dT triggering.

Reversion of the SCR to the open condition allows the converter to resume operation and commence recharging C3. Capacitor C2 is necessary to prevent too fast an initial application of the 400V across the SCR at this time, and also assists R5 in its damping action. Too large a value C2, however, can cause loss of some spark power at high speeds. The value of 0.01uF was found by experiment to be optimum. Resistor R4 is included simply to provide a safety discharge path for C2 and C3 if the ignition is turned off with a charge stored.

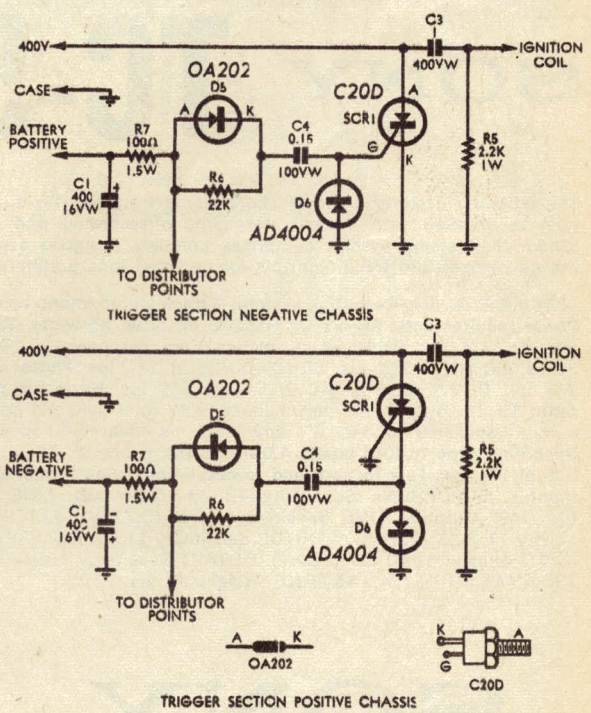
Operation of the trigger circuit is basically the same for either negative or positive chassis systems in that a pulse is supplied to make the gate of the SCR more positive than the cathode. The explanation here will deal specifically with the negative chassis system, but serves equally well for the positive system. With the distributor points closed the junction of R7 and D5/R6 is at chassis and a current, limited by R7, flows through the points. This "contact wetting" current is essential to keep the points clean.

When the distributor points open, C4 charges to the battery voltage via R7, D5, and the gate/cathode junction of the SCR. This positive charging current is sufficient to provide the necessary trigger power to turn on the SCR, and so produce the spark pulse as described earlier. The time constant of this charging circuit is quite short, (approx 7uSecs), and so does not interfere with the commutation of the SCR to its blocking state. Capacitor C1 provides filtering of any ignition, generator/alternator, or converter pulses likely to cause false triggering of the SCR while the distributor points are open. The normal distributor capacitor provides additional filtering of the higher frequencies.

When the distributor points close again C4 will be forced to discharge via D6 and R6 due to the blocking action of D5. The value of R6 is chosen as a compromise between two conflicting requirements: the suppression of distributor point contact bounce impulses which calls for a high value, and a high enough discharge rate for C4 to ensure reliable triggering of the chosen SCR at the highest spark repetition rate



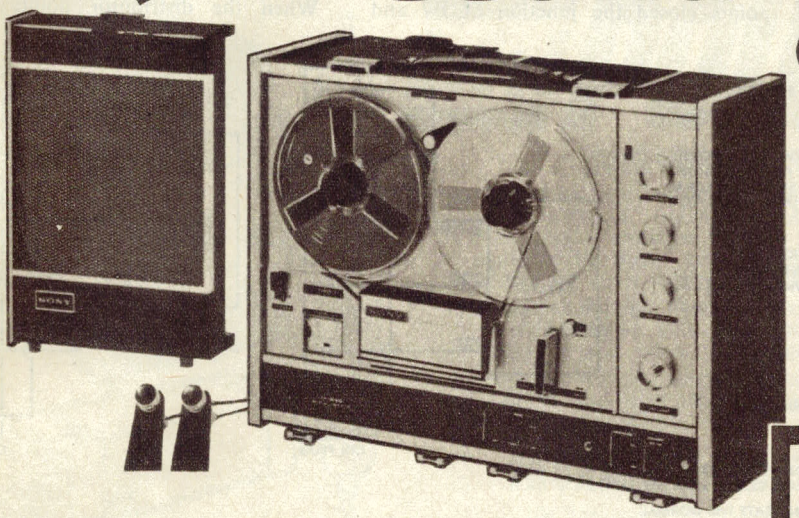
Diagrams showing how the CDI system is wired for either a negative or positive chassis car, using a plug and socket arrangement. In the unlikely event of a CDI failure, a suitably wired plug may be substituted to restore the normal ignition system.

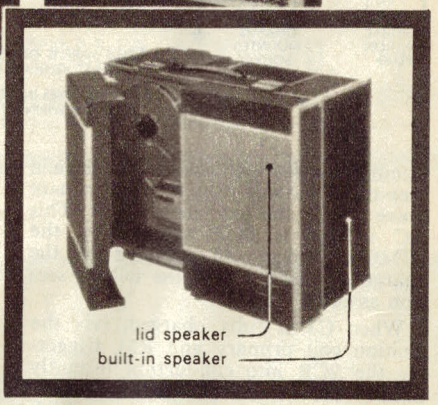


Trigger circuits to suit either positive or negative chassis cars. Both operate in essentially the same manner, the main difference being the method of applying the trigger pulse to the SCR. The operation is explained fully in the text.

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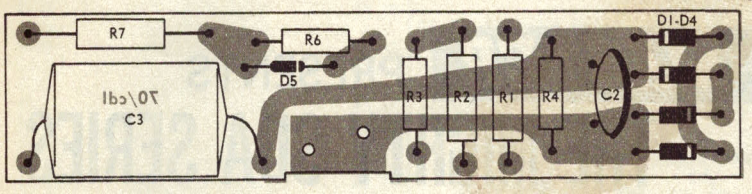
required, which calls for a low value.

The more sensitive the SCR, the higher the value of R6 and so the greater the protection against contact bounce, although this is not a linear progression. To indicate the wide variation between similar types of SCR, the highest value of R6 usable with any C20D is 22Kohms, yet the highest for any 2SF18 type is 6.8-Kohms. With R6 in circuit the discharge of C4 is slowed sufficiently to prevent any recharge current from triggering the SCR again, if the distributor points bounce open a short time after they close, as they can do at high speeds.

So much, then, for the manner in which the system functions. Let us now consider the constructional details. When winding the converter transformer, close adherence to the following points is essential to enable all windings to be fitted into the available space. The transformer is wound on two Mullard type FX2242 cup core sections in conjunction with a Mullard DT2180 single section Delrin former and associated hardware. The Delrin material is relatively pliable, and unless the ends are clamped between stiff plates of either wood or metal during winding, a splaying of the sides due to winding pressures will make assembly of the completed transformer impossible without damaging the windings or snapping the brittle core material.

The 375-turn secondary goes on first, in close wound formation, with carefully formed layers of 28 gauge enamelled copper wire. A thin paper insulation should be used between layers. (Thin, waxed, lunch-wrap paper, cut into suitable width strips serves very nicely.) Only a single thickness of this paper should be used between each layer, and three thicknesses over the finished secondary winding. The feedback windings are applied next and must be bifilar wound, using 26 gauge enamelled copper wire. Space the turns of this winding to occupy the full width of the former. Complete with a single layer of paper.

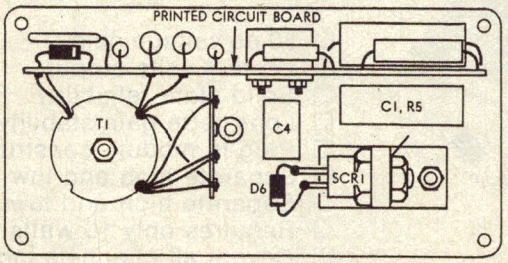
The 13 turn, bifilar wound, primary windings are added last. The primary windings should be wound in the same direction as the feedback windings, and the start and finish of each winding labelled. These labels may then be used to connect the windings in series, according to the S (start) and F (finish) markings of the circuit. Ensure all windings are firmly anchored and finish off the windings with a layer of ordinary cloth-backed sticking plaster from the first-aid kit (or local chemist).



COMPONENT LAYOUT ON PRINTED CIRCUIT BOARD

Layout of components on the printed wiring board, viewed from the component side. The wiring pattern is shown approximately full size. Ready made boards should be available through trade outlets by the time this article appears.

Arrangement of components, including the printed wiring board, on the inside of the lid of the die-cast box. Compare this with the drilling pattern shown on the next page.



COMPONENT LAYOUT ON CASE COVER
(TR1 AND TR2 MOUNTED ON ENDS OF CASE)

When assembling the completed windings into the transformer cores, a few small balls of "plasticine" or similar will help greatly in reducing squeal from the converter, although a slight whistle is quite normal, and serves as a handy indication that the unit is running. However, ensure that this or any other foreign substance does not contaminate the mating faces of the two core halves. It is good insurance to clean these faces carefully with a good spirit cleaner before assembly, as even the slightest air gap here, apart from producing a higher magnetostrictive squeal from the transformer, will re-

WARNING

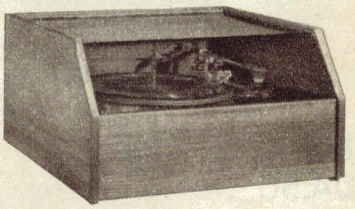
The converter unit is capable of delivering a fatal electric shock. Treat it with the care and respect you would normally accord any dangerous 400V supply. Even the AC voltage across the ignition coil primary when the engine is running could deliver a nasty shock. The secondary of the coil, while uncomfortable to contact, is not lethal.

A wise precaution before delivering a CDI equipped vehicle to a mechanic for repairs, would be to either revert it to normal ignition, or firmly and positively warn the mechanic of the danger.

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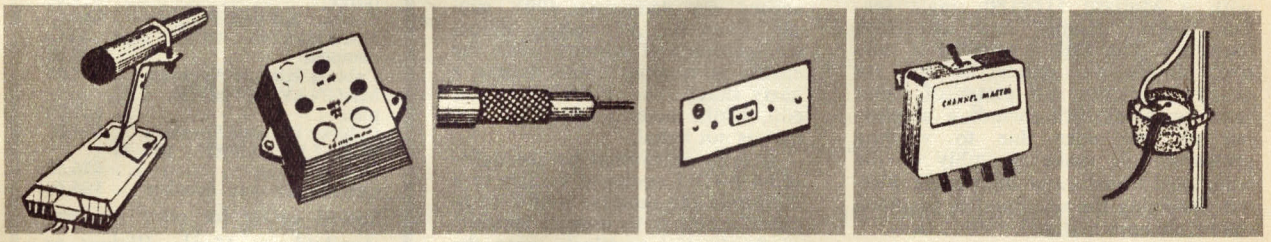
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SDA-31	,,	30 db	30 db	20 millivolts	0.3 volt	1.5 volts	100+	81.25
SDA-50	,,	50 db	50 db	20 millivolts	1 volt	4 volts	500	111.25
SDA-50L	,,	—	50 db	20 millivolts	1 volt	4 volts	500	95.00
SDA-50H	,,	50 db	—	20 millivolts	1 volt	4 volts	500	95.00

NOTE 1—This figure is maximum input ON ANY ONE CHANNEL when the amplifier is operating on 4 Channels. NOTE 2—This figure is maximum output ON AN ONE CHANNEL when the amplifier is operating on 4 Channels. NOTE 3—The number of outlets which an amplifier will drive satisfactorily depends upon a number of factors—signal available from the aerial, length of cable runs, etc. The figures quoted are for favourable conditions.



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duce the efficiency of the converter by preventing complete saturation of the core. If complete saturation is not reached, switching times increase in the converter and so increase the dissipation in the transistors.

The case is an Eddystone diecast box type 7134/P. This case has just adequate size and thermal efficiency for a heat-sink. Any constructor deciding to manufacture his own case must ensure that at the very least an equivalent heat-sink is provided.

When mounting the transistors on the diecast case, ensure the ends of the case are quite flat and deburred over the contact area to provide maximum possible thermal contact. A smear of silicone grease, or a good quality heat-sink compound should be used. Also deburr the edges of the diecast case and lid so that a good seal and best thermal contact can be made. Again silicone grease will improve thermal contact and additionally provide satisfactory waterproofing at this join.

For better thermal efficiency, the completed CDI should finally be given a light coat of flat black heat resistant paint.

subject hourly to more thumping, bumping, and vibration than most pieces of electronic equipment would receive in a lifetime. Therefore he should make every connection quite secure and use lock washers wherever possible.

The method of mounting the completed CDI is best left to the ingenuity of the constructor to tailor to his individual car and mounting position. However, all surfaces of the case must be left clear for air circulation and the case kept watertight. Whatever the method used to mount the unit remember to drill the case before commencing the installation of components. The method of mounting illustrated was found to suit most situations and consisted simply of two pieces of scrap 16g. extruded aluminium angle riveted to the sides of the case.

However, regardless of the mounting method or position, the following points must be observed:

1. Ensure a good electrical contact between the CDI case and the vehicle chassis. This contact will be called upon to provide the chassis return for both the converter current and the 30 amp. pulses of the firing circuit.

2. If the vehicle uses "ballast coil" Kettering system, an ignition-switch controlled, direct battery supply lead will have to be run to the CDI unit.

In some cars (e.g., Ford Falcon), the ballast resistor is actually a resistive wire in the car loom. If in doubt this simple test will determine the system used:

(a) Ensure distributor points are closed.

(b) Switch on the ignition.

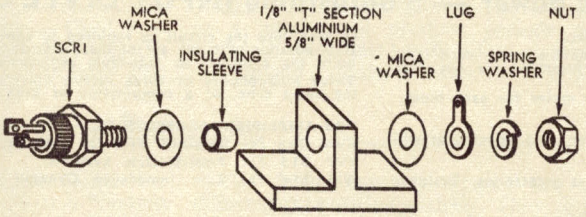
(c) Measure voltage across battery.

(d) Measure voltage across ignition coil primary terminals.

If the voltage read at (c) is greater by 2 volts or more, than the voltage read at (d), a new wire must be run.

3. Keep all wires as short as possible.

Details of the mounting block for the SCR, fashioned from a short length of aluminium extrusion.

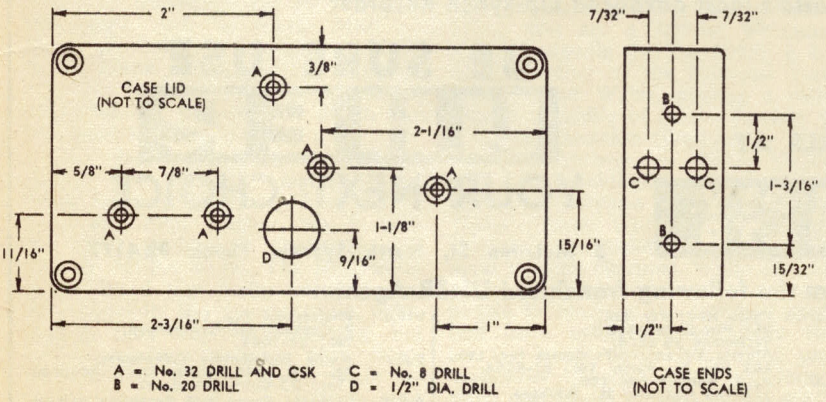


SCR MOUNTING DETAILS

The minor components are mounted on a printed wiring board as shown in the accompanying diagram. A copy of the printed wiring pattern will be distributed to our advertisers in the usual way, and ready-made boards should be readily available. The printed wiring board, the transformer, the SCR, etc., are mounted inside the lid of the diecast box. The SCR is first mounted on a piece of aluminium "T" section — but insulated from it — and the complete assembly mounted on the lid.

The circuits and diagrams in this article should suffice to allow construction of a satisfactory unit by any reasonably skilled person conscientious enough to follow the advice given.

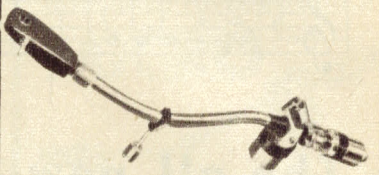
During the building of this CDI, the constructor is advised to keep in mind at all times that this small unit will be



Drilling details for the lid of the die-cast box. While useful as a guide, constructors are advised to check hole positions against their own sub-assemblies before drilling.

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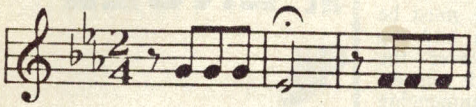


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S.A.: Kallin Distributors (Wholesale) Pty. Ltd., 140 Gawler Place, Adelaide. Tel.: 23-6055 (11 lines).

A.C.T.: Canberra Sound and Recording Service, 109 Malura Ave., Dickson. Tel.: 47-7980.

N.T.: N.T. Musical and Electrical (W/S) Pty. Ltd., 54 Cavanagh St., Darwin. Tel.: 3072.

4. Increase all spark-plug gaps to .05in.

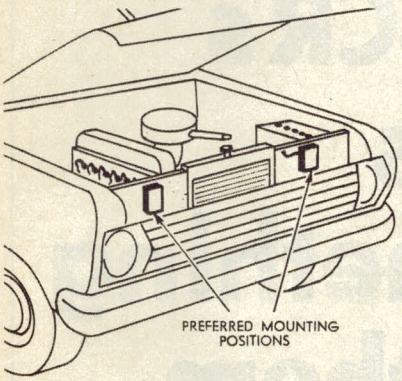
5. Connect the CDI according to the circuit on page 51. The use of the changeover plug is not essential and may be omitted if not required.

6. If not already the case, the ignition coil should be remounted with its high-tension turret downwards. Due to the higher voltages available with CDI, some coils can fail internally by insulation breakdown if a spark-plug lead comes off with the engine running at speed, when the coil is mounted with the turret up.

7. The unit should always be mounted in one of the preferred positions indicated, particularly when used in hot climates. If deep underbonnet positioning has to be used, mount the unit where it will receive the maximum possible free air circulation.

In no circumstances must this unit be mounted directly on the engine itself or exposed to the direct radiated heat of the vehicle exhaust system.

8. Examine all the engine high-tension wiring, and replace any damaged, cracked, or perished wires. The wider plug gaps and higher spark voltages will soon find such weaknesses with



Recommended mounting positions for the CDI system, designed to provide maximum flow of cool air around the case.

subsequent annoying intermittent misfiring.

Due to the much faster rise time (15-20uS) of CDI compared to the Kettering (50-60uS) spark voltages, some engines exhibit a characteristic sometimes referred to as "lean fuel surge." This appears to be due to the small additional advance in ignition timing at higher speeds. (A six-cylinder engine would receive approx. 1½ degrees extra advance at 6,000rpm.) If the ignition timing of the engine was already at maximum tolerable advance, say due to maximum static timing settings, or perhaps a maximum manufacturing tolerance in the automatic advance distributor mechanism, this additional advance can make the engine run erratically on the leaner cruising fuel mixtures. The effect is felt as a slight "surging" motion when cruising that disappears on a trailing throttle or under acceleration. It may be eliminated by simply retarding the static timing setting by 1 to 2 degrees, usually resulting in a smoother idle into the bargain.

One unpredicted side effect noted with this CDI, was the lack of any need to fit ignition noise suppressors. In fact in a number of cases car radio interference was less with wire HT leads and CDI, than it had been with normal ignition and a full suppression kit and TVRS HT leads.

In one case, however, a 3KHz whistle appeared in the car radio after CDI was fitted. This turned out to be due mainly to two things. Firstly, the CDI battery supply point had been taken from the same fuse used to supply the radio, and secondly the CDI supply lead was unnecessarily long. The lead was shortened, separate supply point provided, and a standard 0.1uF metal clad interference capacitor fitted close to the CDI unit, on this battery supply line. The problem was cured completely.

An interesting fact.: Any available 6V, 12V or 24V coil will provide adequate performance with CDI. Very handy if a failure of a coil should occur somewhere in the "Back-blocks," and the small country store only happens to have "a coil what's for some tractor or t'other."

While not tried by the author, it is suggested that operation of this CDI on 6-volt systems should be successful if the following changes are made:

1. Increase the heat-sink area. (Use the next size diecast case.)

2. Reduce the 13-turn primary windings of T1 to a figure of 7 turns of 20-gauge wire.

3. Reduce R1 and R2 to 10 ohms each.

4. Reduce R3 to 270 ohms.

5. Reduce R6 to 12Kohms for C20D-type SCR.

6. Due to the higher transistor dissipation the mounting positions shown in the diagram must be used.

Editorial comment: As we go to press it appears that there is a temporary shortage of Mullard FX2242 core sections. As nearly as we can determine at this time delivery is expected about the third week in September. However, there are adequate stocks of the Delrin former (DT2180) and associated hardware. This means that the winding operation can be completed without delay and the core sections fitted when they become available. ■

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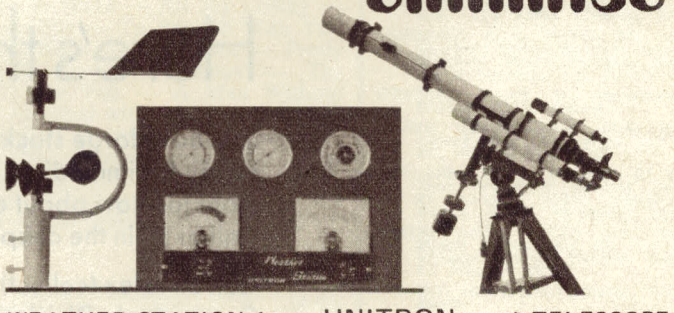
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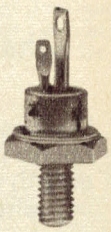
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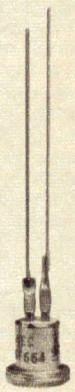
SCRs — MAXIMUM RATINGS — 30 Amp RMS

STANDARD ITEM	Symbol	2SF 32A	2SF 34A	2SF 36A	2SF 38A	2SF 210A	2SF 211A	2SF 727	2SF 728	2SF 729	Unit
HIGHSPEED ITEM		— —	2SF 762 2SF 762A	2SF 763 2SF 763A	2SF 764 2SF 764A	2SF 765 2SF 765A	2SF 766 2SF 766A	— —	— —	— —	— —
*Non Rep. P.R.V.	V_{Rsurge}	150	300	400	500	600	720	1000	1200	1500	V
*Rep. P.R.V.	V_{RM}	100	200	300	400	500	600	800	1000	1200	V
*Rep. P.F.V.	V_{FOM}	100	200	300	400	500	600	800	1000	1200	V
Avg. Rect. Current	I_O	10 (T_a = 50°C FN12 H. Sink									A
		19 (T_c = 45°C), 30 Ar.m.s.									



SCRs — MAXIMUM RATINGS — 17 Amp RMS

STANDARD ITEM	Symbol	2SF 22	2SF 24	2SF 26	2SF 28	2SF 205	2SF 206	2SF 717	2SF 718	2SF 719	Unit
HIGHSPEED ITEM		— —	2SF 752 2SF 752A	2SF 753 2SF 753A	2SF 754 2SF 754A	2SF 755 2SF 755A	2SF 756 2SF 756A	— —	— —	— —	— —
*Non Rep. P.R.V.	V_{Rsurge}	150	300	400	500	600	720	1000	1200	1500	V
*Non Rep. P.R.V.	V_{RM}	100	200	300	400	500	600	800	1000	1200	V
*Rep. P.F.V.	V_{FOM}	100	200	300	400	500	600	800	1000	1200	V
Avg. Rect. Current	I_O	5.0 (T_a = 50°C FN12 Heat Sink									A
		11 (T_c = 25°C) 17 Ar.m.s.									



SCRs — MAXIMUM RATINGS — 10 Amp RMS

Item	Symbol	2SF 660	2SF 661	2SF 662	2SF 664	Unit
*Non Rep. P.R.V.	V_{Rsurge}	75	150	300	600	V
Rep. Pk-Fwd. Blocking Voltage	V_{FOM}	50	100	200	400	V
Repetitive P.R.V.	V_{RM}	50	100	200	400	V
Avg. Rectified Current	I_O	3.5 (Ta = 50°C / 10 Ar.m.s. FN11 H. Sink				A

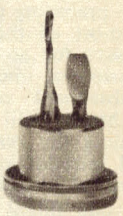
*GATE CIRCUIT OPEN.

UJTs PLANAR TYPE — MAXIMUM RATINGS

ITEM	Symbol	2SH16A 2SH17A	2SH18 2SH19	Unit
Power Dissipation	P	200	300	mW
Emitter Rev. Voltage	V_{B2E}	30	30	V
Interbase Voltage	V_{BB}	25	30	V
Peak Emitter Current	I_{EM}	1	1	A
Emitter Current	I_E	50	50	mA
Junction Temp.	T_J	+ 150	+ 150	°C
Storage Temp.	T_{stg}	− 40 ~ + 150	− 40 ~ + 150	°C

TRIACs — MAXIMUM RATINGS

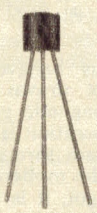
ITEM	Symbol	AC06DR	AC10DR	UNIT
Peak Block Voltage	V_{BLM}	400	400	V
Conduction RMS Current	I_{RMS}	6	10	A
Surge Current	I_{surge}	50	70	A
Peak Gate Power	P_{GM}	5.0		W
Junct. Temp.	T_j	+100		°C



2SH18
2SH19



2SH16A
2SH17A



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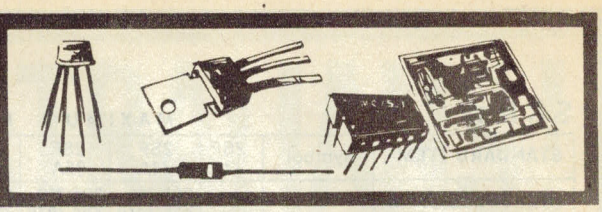
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Fundamentals of SOLID STATE



Chapter 15

by Jamieson Rowe

Devices and their fabrication — refining the raw semiconductor materials — zone refining and float zone melting — growth of monocrystals — sawing into wafers — passivation — epitaxial deposition — selective diffusion — photolithography and oxide masking — multiple diffusions — contact metallisation — probe testing, scribing, cleaving, die and wire bonding — encapsulation and classification.

From the discussion of each of the various types of semiconductor device treated in the foregoing chapters, it may be apparent that the characteristic behaviour of each device type is very much a function of its particular configuration of semiconductor regions and junctions. Hence it is generally true that every device of a given type has the same basic configuration, this configuration in each case being very similar if not identical with that which we have used to explain basic device operation.

In dealing with each type of device, we have until now simply assumed the existence of its particular configuration of regions and junctions. This has been a justifiable assumption, because a discussion of actual device fabrication is not only unnecessary, but also largely irrelevant in a treatment of basic device operation and applications. It is a fact also that most of the techniques and processes involved in device fabrication are common to all modern semiconductor devices, so that rather than treat these in a piecemeal and distributed manner, it is really more appropriate to accord them a separate and unified discussion.

A very suitable place for such a discussion of device fabrication is provided in this treatment by the present chapter. At this point the discussion can at the same time both round out the treatment of discrete devices given in the preceding chapters, and also provide most of the foundation concepts necessary for an easy transition to the discussion of microcircuits to be given in subsequent chapters. Accordingly, the chapter will be directed towards providing the reader with a brief but useful introduction to fabrication techniques and processes.

As one might perhaps expect from earlier chapters, the first step in semiconductor device fabrication involves the preparation of extremely pure semiconductor material.

Because the performance of most semiconductor devices is highly dependent upon the actual impurity doping levels and gradients which are ultimately present in the various device regions, these doping levels and gradients must of necessity be tightly controlled and reliably maintained. To allow this to be achieved, it is generally essential that the semiconductor material used for device manufacture is initially purified such that it becomes virtually "intrinsic" material.

It may be recalled from chapter 3 that this involves the reduction of total impurity concentration in the material to less than one part in 10^9 — or in more familiar terminology, refinement to a level where the material is 99.9999999% pure.

This degree of refinement is considerably beyond that which could be achieved using the traditional physical and chemical methods available when the "semiconductor revolution" began in 1948 with the discovery of the bipolar transistor. Accordingly, the developing semiconductor industry has been forced to develop its own specialised refinement techniques, which are used to perform further extensive purification after the "raw" semiconductor materials have been refined to the limit of traditional techniques.

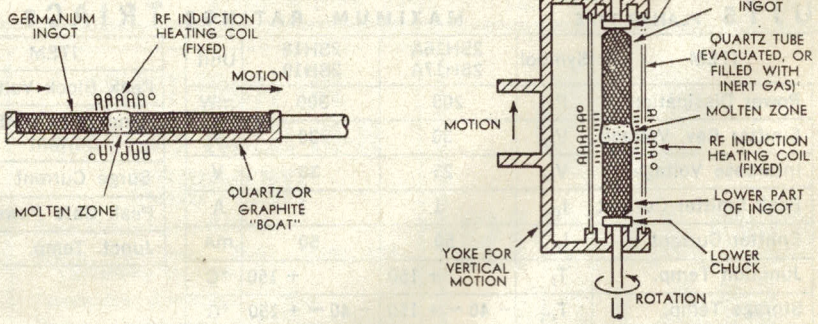
One of the earliest of these special refinement techniques to appear was the **zone refining** technique developed in 1954 by W. G. Pfann of the Bell Laboratories. This technique is still used for the refining of germanium material, and is illustrated in basic form in the diagram of figure 15.1 (a).

As may be seen the process involves the placing of an ingot of chemically pre-refined germanium in a long crucible or "boat" of either graphite or quartz, which is then moved slowly and repeatedly in a horizontal direction through the load coil of an RF induction heater. The rate of motion is adjusted so that the portion of the ingot within the RF heating coil is maintained in the molten state, in effect creating within the ingot a zone of molten metal which is caused to sweep repeatedly in one direction along the entire length.

How does this operation reduce the impurity content of the ingot? The answer to this lies in an interesting and most fortuitous effect known as **segregation**, wherein virtually all of the impurities which contaminate the commonly used semiconductor materials prove to be less soluble in the solid phase of the host semiconductor material than in the liquid phase. The semiconductor material which is re-crystallising from the liquid phase thus tends to contain a lower impurity concentration than any remaining liquid, because the differential solubility results in a tendency for the impurity atoms to remain in the liquid.

Because of the segregation effect, the "sweeping molten zone" tends to accumulate the impurities from the ingot. It thus behaves rather like a small magnet drawn through a mixture of non-magnetic powder and iron dust. If the operation is stopped after a number of passes through the RF heating coil, with the molten zone at one extreme of the ingot, it is found that almost all of the impurities in the cooled ingot are concentrated at the end which finally solidified. This portion may then be cut off, leaving the remainder of the ingot in a highly refined state.

It is possible to repeat the zone refining process almost indefinitely, each time producing material having a lower impurity concentration. However, in practice economic considerations dictate that the process is continued only until the impurity concentration is re-



(a) ZONE REFINING (b) FLOAT ZONE REFINING

Figure 15.1

duced to a level sufficient to allow adequate control over ultimate device performance. As chemical tests are not capable of showing when the required degree of refinement has been reached, the indicator used to determine this is the rising electrical resistivity.

For a variety of reasons, the zone refining process in the form illustrated in figure 15.1(a) is not suitable for the refinement of silicon material. Silicon has a higher melting point than germanium (1420°C vs. 960°C), and tends to react strongly with both the atmosphere and a graphite crucible at temperatures near the melting point. On the other hand it is also incompatible with a quartz crucible, because "wetting" causes adhesion between the two, and this causes a problem due to the difference in temperature coefficients of expansion.

Because of these problems, silicon refining is performed using a modified zone refining technique developed by H. C. Theuerer of Bell Laboratories. This is the ingenious float zone technique, which is illustrated in figure 15.1 (b).

As may be seen, the float zone technique obviates the need for a crucible, by supporting the silicon ingot vertically between two rigidly separated chucks. The chucks are located at the ends of a large quartz tube which forms a protecting chamber around the ingot, this chamber being either evacuated or filled with an inert gas. The entire assembly of chucks, ingot and protecting chamber is then moved slowly up and down through the RF heating coil, to produce the same "sweeping molten zone" effect as before.

In this arrangement the molten zone is supported solely by its own surface tension, the length of the zone being adjusted carefully to ensure that it does not collapse. Although the ingot is rotated during the refining process by means of the chucks, to ensure even heating and thorough segregation, this is done very slowly to prevent disturbance of the molten zone due to centrifugal effects. As a further precaution the ends of the ingot are rotated in opposite directions.

Although it is initially necessary to refine the semiconductor materials for device fabrication using the foregoing techniques, the highly refined material obtained is not normally used in this state for device manufacture. Rather, it proves convenient to dope the material following refinement with carefully controlled quantities of a donor or acceptor impurity, to obtain uniformly doped N-type or P-type material having a known resistivity.

This preliminary doping process is generally performed during the next main fabrication step, which is the operation of **crystal pulling.** Here the semiconductor material is converted to a large single crystal or "monocrystal," having a consistent lattice structure throughout.

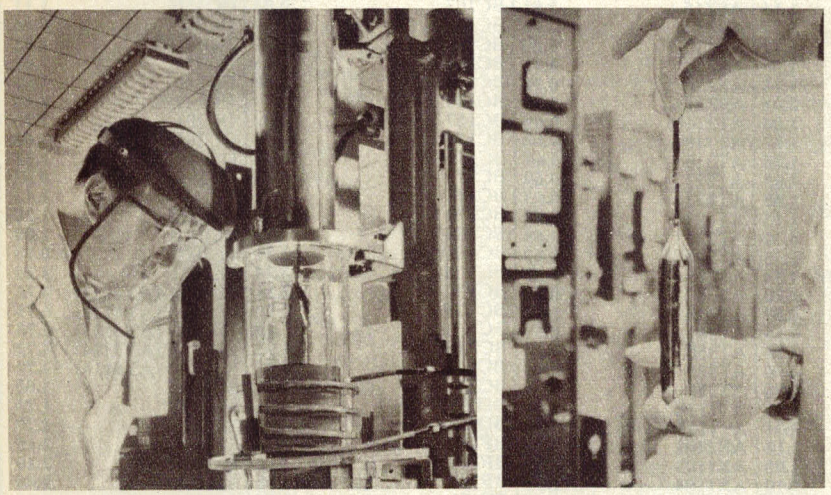


Figure 15.2: A germanium monocrystal boule being "pulled" from the melt, by the Czochralski technique, at left, while at right is a silicon boule grown in a similar fashion. (Courtesy Delco Radio, Fairchild Australia.)

It is essential that semiconductor material used for device fabrication be in the monocrystalline form, because in a multi-grain crystal structure the lattice discontinuities formed by the crystal grain boundaries produce spurious effects which completely swamp out the mechanisms responsible for normal device operation.

Germanium ingots produced by the zone refining process are generally in a polycrystalline form, and it is therefore essential that the further process of crystal pulling be used to convert the material into a monocrystal. In contrast, the silicon material produced by the float zone process is already in monocrystalline form. However, this material is usually also subjected to the crystal pulling process, if only to achieve the required pre-doping.

The crystal pulling process was developed by J. C. Czochralski. It involves the melting of the refined semiconductor material in a quartz crucible by an RF induction heater, which then maintains the melt at a temperature slightly above the melting point. A small single crystal of solid material is then introduced into the top of the melt, in a suitable crystalline orientation, and then slowly withdrawn. The crystal acts as a recrystallisation centre or "seed," and progressively grows into a large monocrystal. This may be seen in the photographs of figure 15.2.

The pre-doping of the material is achieved by adding a "pill" of pure dopant material to the melt prior to the crystal pulling operation. To ensure uniformity of doping in the final monocrystal, the melt is gently stirred just below the crystallising level, by slow rotation of the seed crystal during the pulling operation. The doping concentration in the liquid melt is deliberately made higher than that required in the final monocrystal, to allow for the segregation effect.

In general two levels of doping are used in the pre-doping process, each producing material intended for the fabrication of devices with particular characteristics. A relatively heavy doping level is used to produce low resistivity material (in the order of .005 ohm-cM), which is used in the fabrication of the so-called "epitaxial" devices to be described shortly. Conversely, a relatively light doping level is used to produce the high resistivity material (from 0.5 to 50 ohm-cM) used in the fabrication of non-epitaxial devices.

The monocrystal "boules" of doped semiconductor material produced by the crystal pulling process form the basic material from which most semiconductor devices are made. Typically a boule measures from 1¼in to 2¼in in diameter, and from 6 to 9 inches long; from it may be made many hundreds of thousands of individual devices.

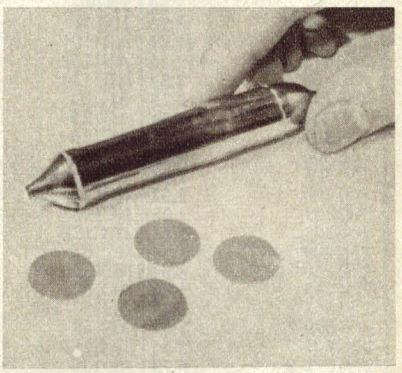


Figure 15.3: A silicon boule compared with the wafers cut from a similar crystal. (Courtesy Mullard-Australia.)

In the relatively few years since semiconductor devices were first produced on a commercial basis, many different alternative techniques have been used to fabricate semiconductor devices from the prepared boules of doped semiconductor material. These techniques have tended to produce a wide variety of different "versions" of most of the semiconductor devices which we have examined in earlier chapters.

Unfortunately no attempt can be made in this chapter to even briefly describe many of these techniques and device variations. To do so would involve considerable space which could scarcely be justified, because many of the techniques and devices are now regarded as obsolete and of purely historical interest.

The fact is that in recent years, one particular group of techniques has emerged as that most capable of achieving low cost, high-yield fabrication of reliable, high performance devices. This group of techniques has virtually eclipsed all others, and is now used almost universally for the fabrication of low and medium power discrete de-

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2N270	1.07	2N3645	1.44	AS306	0.81	AY8113	6.08	OA90	0.32
2N277	3.77	2N3646	0.90	AS307	0.81	AY8114	4.72	OA91	0.33
2N278	4.32	2N3691	0.85	AS308	0.81	AY8115	2.25	OA95	0.39
2N301	2.66	2N3692	0.90	AS310	0.81	AY8116	1.80	OA202	0.75
2N301-A	3.84	2N3693	0.86	AS311	0.77	AY8117	9.15	OA670	1.68
2N384	2.88	2N3694	0.90	AS312	0.77	AY8135	5.40	OA675	0.60
2N388A	2.36	2N3702	1.01	AS313	0.81	AZ069	0.51	OC20	6.38
2N394A	2.13	2N3703	0.96	ASY73	2.12	BA100	0.44	OC22	3.03
2N404	1.50	2N3704	1.77	ASY76	2.10	BA102	1.46	OC23	3.80
2N404-A	1.74	2N3705	1.73	ASY77	1.83	BA114	0.39	OC24	3.45
2N406	1.01	2N3706	1.65	ASY80	1.68	BA122	0.53	OC44N	1.11
2N417	1.77	2N3707	1.14	ASZ15	2.81	BC107	0.83	OC45N	1.11
2N441	3.08	2N3731	3.17	ASZ16	3.03	BC108	0.76	OC74	0.96
2N443	3.51	2N3819	1.77	ASZ17	2.60	BC109	0.91	2-OC74N	1.92
2N456A	4.20	2N3826	1.68	ASZ18	2.91	BC147	0.76	OC75N	1.49
2N458A	6.12	2N3827	1.74	ASZ20	0.98	BC148	0.68	OC140	1.95
2N489B	14.76	2N4036	2.01	ASZ21	2.16	BC149	0.79	OC141	2.60
2N591	1.05	2N4121	1.04	AT316	0.68	BC157	0.89	OC201	3.78
2N649	2.12	2N4250	1.17	AT318	0.68	BC158	0.76	OC202	3.68
2N657	4.79	2N4354	1.28	AT319	0.69	BC159	0.89	OC915	2.21
2N696	1.13	2N4355	1.65	AT321	0.69	BC177	0.91	SD55	0.63
2N697	1.17	2N4356	1.65	AT322	0.63	BC178	0.84	SE1001	1.13
2N706A	1.08	2N4360	1.58	AT323	0.68	BC179	0.92	SE1002	1.20
2N929	1.50	2SB474	3.30	AT324	0.68	BC186	0.79	SE1010	1.80
2N930	1.80	3N140	2.55	AT325	0.83	BCY10	2.59	SE2001	0.98
2N1038	3.92	3N141	2.34	AT331	1.02	BCY11	3.24	SE2002	1.20
2N1046	17.94	AB1101	1.20	AT337	0.75	BCY12	3.14	SE3030 (AY8112)	6.75
2N1073B	11.60	AB1102	0.87	AT338	1.50	BCY39	5.19	SE3031 (AY8112)	6.75
2N1100	7.23	AB1136	0.54	AT341	0.69	BCY71	2.05	SE3032 (AY8113)	6.75
2N1132	2.25	AC107	2.28	AT350	1.14	BCZ10	1.95	SE3033 (AY8114)	4.72
2N1302	1.01	AC125	0.96	AT355	0.98	BCZ11	2.37	SE3035 (AY8114)	4.72
2N1303	1.01	AC126	0.96	AT356	0.75	BCZ12	2.16	SE4001	1.05
2N1304	1.13	AC127	1.16	AT1138	2.66	BDY20	3.51	SE4002	1.13
2N1305	1.13	AC127/128	2.21	AT1138A	3.84	BDY38	2.59	SE4010	1.20
2N1306	1.32	AC127/132	2.16	AX1101	1.53	BF115	87c	SE5001	2.10
2N1307	1.32	AC128	1.05	AX1103	1.70	BF145	64c	SE5002	2.10
2N1308	1.64	2AC128	2.10	AX1104	1.86	BF167	1.08	SE5003	2.48
2N1309	1.64	AC132	1.05	AX1107	1.37	BF173	1.15	SE5020	4.05
2N1540	4.08	AC172	1.20	AX1108	1.86	BF177	1.63	SE5023	3.15
2N1546	5.96	AC187	1.20	AX1127	1.50	BF178	1.80	SE5025	1.35
2N1563	5.45	AC187/188	2.36	AX1130	1.50	BF179	2.04	SE6001	0.75
2N1639	1.02	AC188	1.16	AX1131	1.70	BF180	1.80	SE6002	0.90
2N1671-A	5.16	2AC188	2.31	AX1132	1.50	BF184	0.72	SE7001	4.05
2N1671-B	5.73	AD139	2.52	AX1142	1.20	BF185	0.72	SE7002	3.60
2N1908	24.47	2-AD139	5.04	AX1143	1.58	BF194	0.67	SE7010	4.05
2N2101	2.55	AD149	2.45	AX1144	1.44	BF200	1.32	SE7020	5.40
2N2147	2.24	2-AD149	4.89	AX1166	1.37	BFY51	5.19	SE8001	4.05
2N2148	1.68	AD161/162	4.32	AX1284	1.41	BSX19	2.16	SE8002	4.50
2N2188	2.79	AD4004	0.63	AX1285	1.28	BSY11	8.43	ST2	1.47
2N2189	3.57	AF114N	1.08	AX1298	1.37	BY126/200	0.48	T1C31	4.44
2N2270	2.64	AF115N	1.08	AX1304	1.44	BY126/400	0.56	T1C44	1.68
2N2613	1.83	AF116N	0.93	AX1305	1.49	BY126/500	0.63	T1C45	1.92
2N2646	2.19	AF117N	0.93	AY1101	0.68	BY127/800	0.78	TIC46	2.03
2N2996	3.15	AF118	2.52	AY1102	1.04	BZX70 Series	1.95		
2N3005	5.32	AF185	2.40	AY1103	1.35	BZY88 C3V3 to C11	0.83	T1C47	2.27
2N3053	2.48	AF186	4.46	AY1104	1.35	BZY88 C12 to C30	0.98	T1S37	2.36
2N3054	2.63	AN1101	0.60	AY1108	1.65	BZY94 (Obsolete)	0.98	T1S43	2.36
2N3055	2.63	AN1102	0.68	AY1110	1.50	BZY95 Series	2.16	T1S68 Pair	17.40
2N3525	3.17	AN1103	0.60	AY1112	0.69	BZY96 Series	2.16	TIS88	2.63
2N3563	0.90	AN1104	0.60	AY1113	0.69	BZZ14 to 29	2.37	40250	1.78
2N3564	1.08	AN1105	0.60	AY1114	0.60	C106Y1	2.10	40360	2.48
2N3565	0.86	AN2001	0.45	AY1115	0.60	D13-T1	1.95	40361	2.49
2N3566	1.01	AN2004	0.60	AY1116	0.68	MB05	1.88	40362	2.69
2N3567	1.08	AN7102	0.90	AY1117	0.68	MB1	2.03	40406	1.80
2N3568	1.08	AN7105	0.68	AY1119	0.60	MB3	2.65	40407	1.31
2N3569	1.23	AS43	0.65	AY1120	0.98	MB6	3.39	40408	2.36
2N3638	0.90	AS147	0.66	AY1121	0.98	MJE2955	4.55	40409	1.59
2N3638-A	1.13	AS148	0.63	AY6108	1.65	MJE3055	3.06	40410	1.65
2N3641	1.13	AS149	0.68	AY6109	1.65	OA5	0.65	40411	6.36
2N3642	1.26	AS208	1.25	AY8108 (AY8103)	3.75				

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vices of each of the types described in earlier chapters. Not only this, but the same techniques are used in the manufacture of most integrated microcircuits, being in fact the very techniques which made possible the development of these devices.

Accordingly it is these techniques, and the versions of each of the various types of device produced by them, which will be described in the remainder of this chapter. Interested readers will find descriptions of many of the older and now little-used techniques in the established texts, together with descriptions of the corresponding versions of the various types of device.

Throughout the description, silicon material and devices will be assumed, as this material is currently used for the vast majority of devices in commercial production. In many cases the techniques used for germanium and other materials are similar to those described, although some techniques used with silicon are not directly applicable to other materials.

Currently the first step in preparing a monocrystal boule for device fabrication is to slice it transversely into dozens of thin wafers, using a diamond saw. The thickness of the wafers is typically about 15 mils (.015in), or 375uM (microns); one mil being equal to 25uM. A typical boule and some wafers are shown in figure 15.3. Each

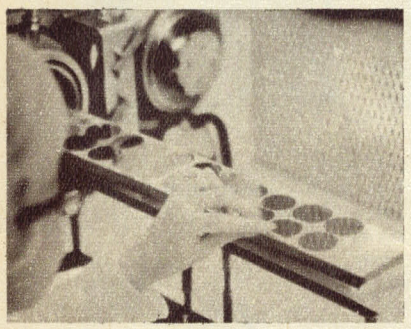


Figure 15.4: Silicon wafers being removed from an epitaxy reactor after deposition and passivation. (Courtesy Fairchild Australia.)

wafer ultimately becomes a complete two-dimensional array of individual devices, which are subsequently separated and individually packaged.

After slicing, one surface of each wafer is lapped and polished to a mirror finish. It is this surface of the wafer which is treated to produce the "active" regions of the device array, and the mirror finish is necessary to ensure precision during the various processes. After the polishing process the wafers are subjected to a chemical etch which removes all traces of sawing and polishing lubricants, and leaves the wafer in an extremely clean condition. Its thickness is now typically between 5 and 10 mils.

At this stage of the fabrication process, the lightly doped high resistivity wafers intended for non-epitaxial devices are simply subjected to the process of **passivation.** This involves the growth of a protective coating of inert material over the surfaces of the wafer, both to protect it from contamination during handling, and to prepare it for subsequent processing.

Typically the passivation coating is composed of silicon dioxide (quartz), or silicon nitride. The former is generally grown on the wafer by heating it to a temperature of 250°C or higher in an atmosphere containing either saturated water vapour, hydrogen peroxide vapour or pure oxygen. An alternative procedure involves heating the wafer to a temperature of between 900 and 1350°C, in an atmosphere containing hydrogen and carbon dioxide.

The heavily doped low resistivity wafers intended for epitaxial device fabrication are not passivated at this stage, but are instead subjected to the process of **epitaxial deposition.** In this process, a thin layer (typically from 5 to 20uM) of lightly doped silicon is grown on the polished surface of each wafer, in such a way that the crystal structure of the layer is aligned with, and virtually an extension of, that of the wafer itself. Each wafer is thereby provided with a high resistivity region surmounting the original low resistivity substrate, without disturbance to its monocrystalline structure.

The process of deposition is performed in an "epitaxy reactor," so named because in order to ensure reliable epitaxial growth of the new material on the wafers, it is necessary to arrange for the silicon to be formed directly at the wafer surface by a thermally triggered reaction between vapours.

In the reactor, RF induction heating is used to heat the wafers themselves to around 1200°C, while the remainder of the reactor is maintained at a relatively low temperature. Dry hydrogen gas is then passed through the reactor for a short period, to chemically reduce any silicon dioxide which may be present on the wafer surfaces. Following this a carefully adjusted mixture of vapours is passed through, whereupon silicon material of the desired doping concentration is formed directly upon the hot wafer surfaces. This process is continued until the epitaxial layer grows to the desired depth.

Typically the principal vapour constituents used for epitaxial deposition are hydrogen and either silicon tetrachloride or silane (silicon tetrahydride), which react together at the hot wafer surface to produce the silicon itself. Doping of the epitaxial layer is performed by adding minute quantities of such dopant vapours as phosphine (phosphorous trihydride), diborane (boron hydride), or arsine (arsenic trihydride).

Immediately following the epitaxial deposition process the wafers are passivated, again both to protect them from contamination during handling, and to prepare them for subsequent processing. Only after the passivation is complete are the wafers removed from the epitaxy reactor, as illustrated in figure 15.4.

At this stage of the fabrication process the wafers for epitaxial and non-epitaxial devices have cross-sections as shown in figure 15.5. In both cases it is at the top of the wafer, and within the lightly doped high resistivity material, that the various functional areas of the devices formed from the wafer are produced in the subsequent processes.

The presence of the heavily doped low resistivity "substrate" region in the epitaxial wafer provides the means whereby a very low resistance connection may be provided to the lowest functional region of each device fabricated from this type of wafer. Hence this type of wafer is used in preference to the non-epitaxial type wherever such a very low resistance connection is required.

An example is bipolar transistors designed for switching applications, where the use of the epitaxial structure gives the devices a very low series collector resistance, and a correspondingly low saturation voltage, Vce(sat).

The various functional regions of the

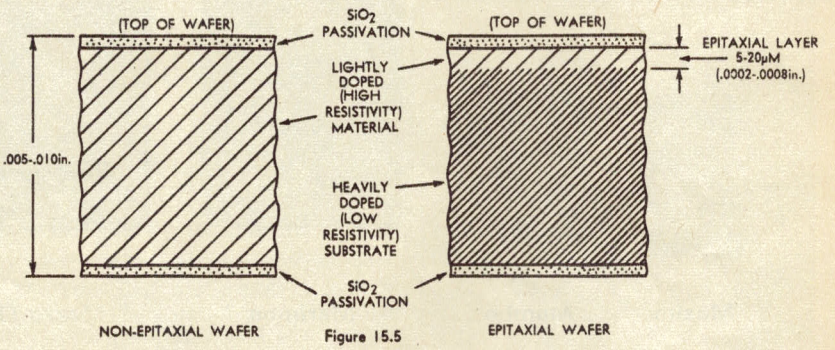


Figure 15.5

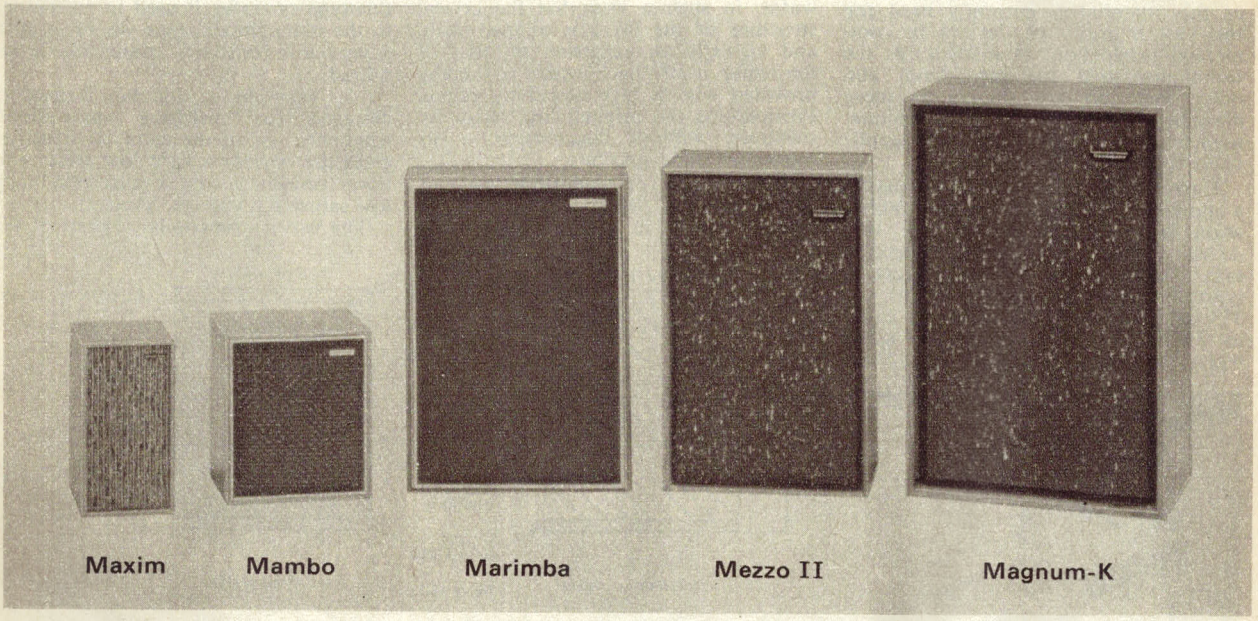
devices to be fabricated from the silicon wafers are currently produced by means of a series of **selective diffusion** processes. These processes involve the diffusion of dopant atoms into the crystal lattice from a concentrated vapour surrounding the wafers, in selected patterns controlled by "windows" formed in the silicon dioxide passivation layer.

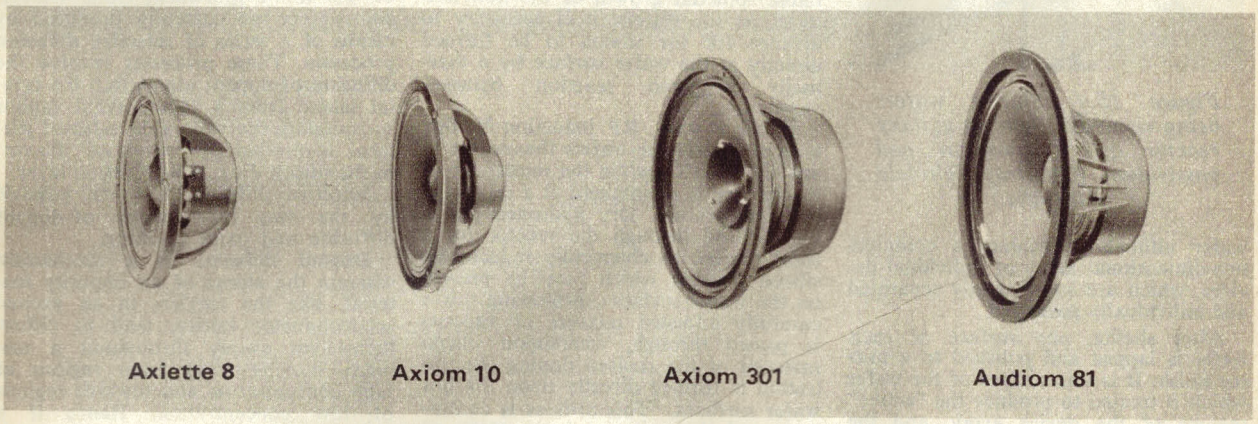
Selective diffusion is made possible by the two mechanisms of dopant diffusion and oxide masking.

Dopant diffusion is a mechanism wherein the atoms of an impurity material, like the carriers in an excited semiconductor lattice, tend to diffuse themselves evenly throughout a medium, moving away from regions of high concentration and towards regions of low concentration. Hence if a high concentration of dopant atoms is created at the surface of a heated semiconductor crystal, for example by passing concentrated dopant vapour over the crystal, the dopant atoms will be found to diffuse into the surface of the crystal.

Not surprisingly, the rate at which the dopant atoms diffuse into such a crystal depends upon the dopant concentration produced at the surface, relative to the doping concentration already present in the crystal. In other words, the diffusion rate is proportional to the concentration gradient. It is also proportional to the temperature of the system, proceding more rapidly as the temperature is raised. The dopant distribution produced by diffusion is exponential in shape, decaying from the

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surface at a rate proportional to the temperature and duration of the diffusion process.

The diffusion mechanism is potentially a very useful one, providing as it does a means whereby dopants may be introduced into a semiconductor crystal to form regions of any desired type adjacent to the crystal surface. This should become apparent shortly.

The second important mechanism which makes possible the process of selective diffusion is **oxide masking.** This is based on the happy fact that silicon dioxide, even in the form of a thin layer, is virtually "opaque" to almost all of the impurities normally used as silicon dopants.

areas corresponding to the desired diffusion "windows," the plate having been prepared by a high-reduction photographic step-and-repeat process such that it carries an array of many thousands of tiny identical images of a master pattern.

Following this exposure, which is shown in diagram (b), the photoresist is developed and the unexposed photoresist etched away. This leaves the desired "window" patterns as exposed areas of the silicon dioxide passivation, as in (c). The wafer is then immersed in a silicon dioxide etchant, such as hydrofluoric acid, which etches away the exposed passivation, leaving the wafer as shown in diagram (d). Removal of the exposed photoresist material then leaves the wafer with the silicon dioxide layer completely formed into the precision mask required for selective diffusion.

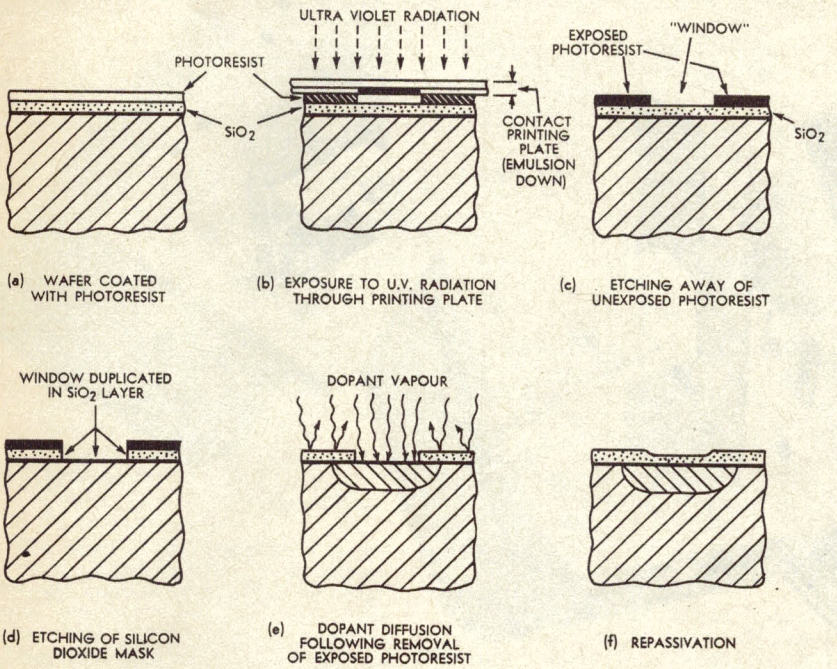


Figure 15.6

The fact that silicon dioxide is "opaque" to the dopants means that the silicon dioxide layer grown on the surface of the silicon wafers for passivation purposes can also be made to serve as a mask to control the dopant diffusion process. Hence the diffusion may be restricted to those areas on the wafer intended to become the active region of the individual devices, simply by etching away corresponding areas of the passivation layer using a **photolithographic process.**

The way in which the techniques of photolithography and selective diffusion are combined to convert the silicon wafers into arrays of completed devices will now be briefly described, with reference to the diagrams of figure 15.6.

The wafer is first given a thin coating of photoresist, as shown in diagram (a). The photoresist is a photosensitive material which, when exposed to ultraviolet light, becomes capable of resisting the etchant used for dissolving the "windows" in the silicon dioxide layer. The photoresist is applied as a drop of liquid to the wafer, which is then rotated rapidly in the horizontal plane to ensure even coating.

After drying, a contact printing plate is rigidly clamped to the sensitised surface of the wafer, and the assembly exposed to ultraviolet light. The emulsion of the printing plate has opaque

The diffusion process itself, illustrated in (e), is performed in a tubular electric furnace, at a temperature between 900 and 1300°C. The wafers are introduced into the furnace in a quartz "boat" crucible, and, after the temperature has stabilised, a carefully controlled mixture of dopant and inert "dilutant" vapours is passed through for a predetermined period.

Typical active vapours used for donor diffusion are phosphorous pentoxide and ammonium phosphate, while acceptor diffusion is usually performed using boron trichloride vapour. The inert dilutant vapour is either nitrogen or helium. Figure 15.7 shows silicon wafers being loaded into a diffusion furnace.

Often the diffusion process consists of two distinct phases. In the first and shorter phase, known as **pre-deposition,** dopant material is deposited through the silicon dioxide "windows" on to the surface of the wafer, as a thin solid film. This typically takes about 30 minutes. Then in the second phase, known as **baking,** the wafers are maintained at a constant high temperature while the dopant atoms diffuse into the silicon. This may take from 3 to 20 hours.

The depth and concentration of the diffusion is readily controllable by manipulation of conditions during the two phases. Thus a shallow but highly doped diffusion region is produced in the wafer if a high dopant vapour concentration is used in the first phase, to produce a relatively thick predeposition film, and then baking for relatively short time. Conversely a deep but lightly doped region may be produced by using a relatively dilute vapour concentration in the predeposition phase, and baking the wafers for a relatively long period.

As may be seen in figure 15.6(e), the semiconductor region formed beneath each "window" in the diffusion mask actually extends beyond the edges of the "window" itself. This occurs because the concentration gradient "seen" by dopant atoms upon entering the crystal extends both laterally and vertically, and thus causes diffusion to occur in both directions. To allow for this effect it is necessary to arrange that the master pattern and the opaque areas in the contact printing plate are somewhat smaller than the final area required for the diffused regions.

The final step in the selective diffusion process is repassivation, shown in figure 15.6(f). Here a new layer of silicon dioxide is grown on the wafers, both to cover and protect the wafer surface areas exposed during the diffusion, and to prepare the wafers for any subsequent diffusions. The repassivation is often performed in the diffusion furnace, during the last part of the diffusion baking phase.

The sequence of operations just described and illustrated in figure 15.6 may be performed a number of times during the fabrication of a semiconductor device, depending upon the configuration of functional regions required for each individual device. Thus it is common to speak of devices as having a "single diffused" structure, a "double diffused" structure, a "triple diffused" structure, and so on.

A specific device example may help the reader to visualise how a number of diffusions may be used to fabricate any desired device configuration. The diagrams of figure 15.8 show the relevant stages in the fabrication of a double-diffused NPN bipolar transistor.

In (a) is shown a small cross-section of the initial state at the top of the wafer used to fabricate such a device, together with a graph plotting dopant concentration against distance from the surface. As may be seen the material is lightly doped homogeneous N-type material, having a donor concentration which remains at a constant low value. This corresponds to either the bulk material of a pre-doped non-epitaxial wafer, or the doped epitaxial layer of an epitaxial wafer.

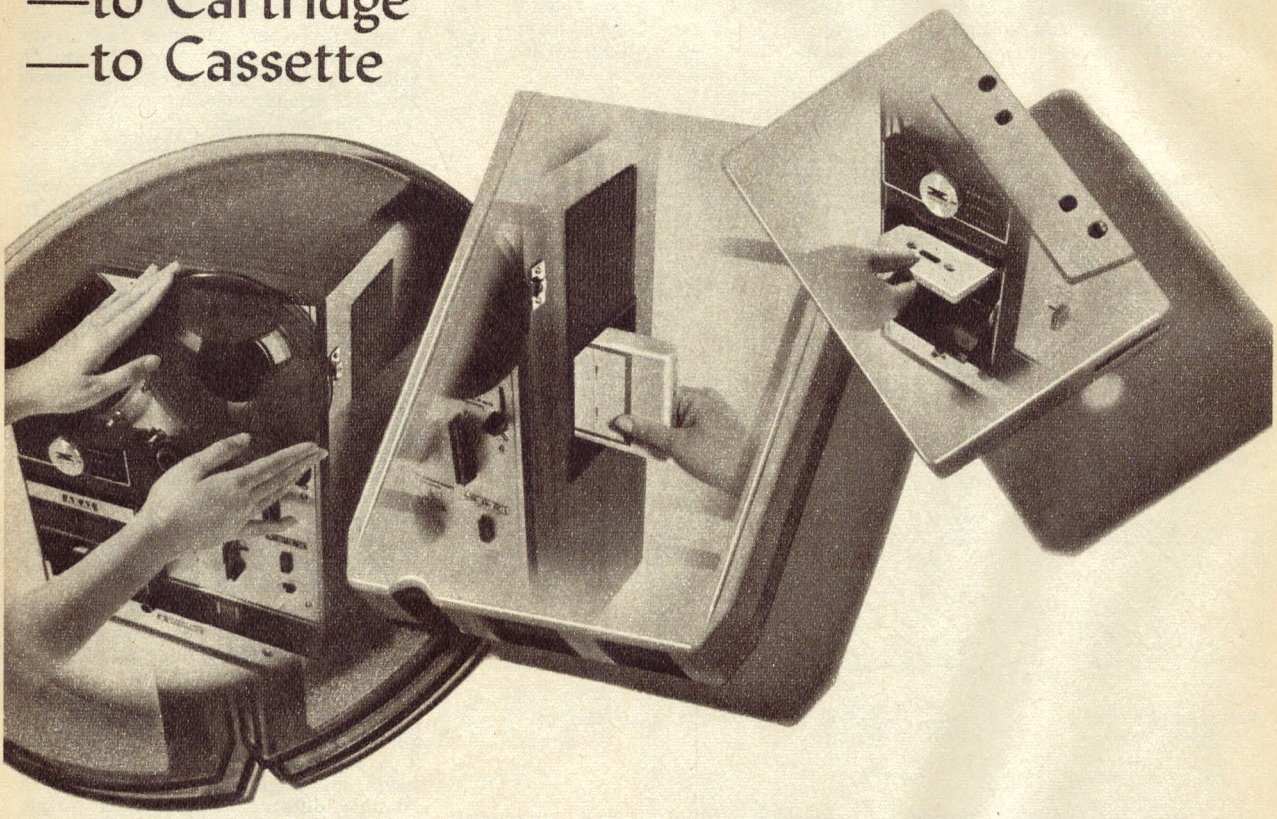
The corresponding situations following the first or "base" diffusion are shown in 15.8 (b). Here a relatively light but prolonged diffusion of acceptor dopant has been made, with a profile represented by the curve drawn in short dashes.

The resultant effective doping profile is represented by the heavy curve. It may be seen that the phenomenon of compensation has caused the region near the surface to be converted into P-type material, and a P-N junction to

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be created at a distance D1 from the surface. This junction is that which ultimately becomes the collector-base junction of the completed device.

In the fabrication of this particular type of device the second or "emitter" diffusion operation is a short but relatively heavy one, in which donor dopant is diffused into relatively small areas within each of the "base" areas formed by the first diffusion. It is performed using the same procedures as the first diffusion, and produces the situation shown in figure 15.8 (c).

It may be seen that the diffusion of donor dopant has caused the region nearest the surface to be converted back to heavily doped N-type material, and a second P-N junction has been created at depth D2 — the emitter-base junction. At the same time, the high temperatures present during the second diffusion operation have caused the acceptor dopant from the first diffusion to move slightly further into the material, so that the first junction has moved to depth D1'. The area of the first diffusion has also increased slightly, for the same reason.

The combined effect of the two successive diffusion operations thus produces the NPN configuration required for the devices concerned, with a heavily doped N-type emitter region, a relatively short and lightly doped base region, and a lightly doped collector region separated from the base by a relatively large-area junction capable of appreciable power dissipation. Other types of device are fabricated in a similar fashion.

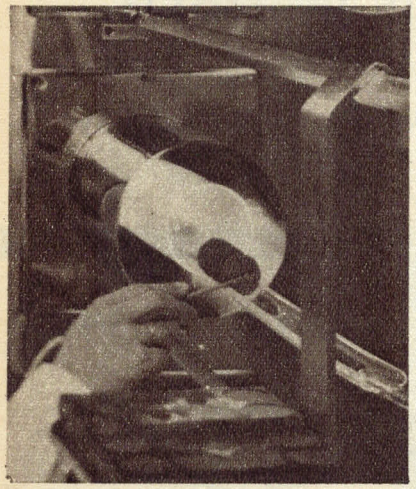


Figure 15.7: Silicon wafers being loaded into the quartz crucible of a diffusion furnace. (Courtesy Philips Industries Ltd.)

The last stage in the on-wafer phase of modern semiconductor device fabrication is **contact metallisation.** In this process each of the individual devices which have been formed on the wafer is provided with a set of ohmic contacts to those of its functional regions accessible from the top.

The sequence of operations involved in contact metallisation is as follows: Windows are first etched in the silicon dioxide passivation in the positions at which contacts are required, using the same photolithographic process used previously. Then a thin film of aluminium is deposited over the entire top surface of the wafer. This is achieved by placing the wafers in a vacuum vessel in which aluminium pellets are vaporised. Finally the excess aluminium is photo-etched away to leave the desired contact pads.

At the same time that the metallisation windows are etched in the passivation layer on the top of the wafer, the complete passivation layer on the lower surface is also etched away. This is done both to facilitate the next process of on-wafer testing, and also to prepare the devices for bonding and encapsulation.

It may be noted that for virtually the whole of the device fabrication sequence described, the devices on the silicon wafer are protected from contamination by the silicon dioxide passivation layer. The only areas not continuously protected in this way are those at which windows are etched for selective diffusion, and these areas are easily protected against contamination by impurities other than the desired dopants. Hence the devices fabricated using the foregoing procedures tend to exhibit very stable and consistent performance, and to be particularly reliable.

The suitability of a silicon dioxide layer as both a passivation layer and as a mask for selective diffusion was discovered in 1960 by Jean Hoerni, then chief physicist at Fairchild Semiconductor. As a result the use of a silicon dioxide layer for these purposes has been patented by Fairchild, and is called by them the Planar process. Devices which are fabricated using the foregoing techniques are thus often called "planar devices."

In passing it may perhaps be noted that the Planar process as described is not suitable for fabrication of germanium devices, for the reason that although it is relatively easy to grow an oxide layer on germanium, such a layer proves to be virtually "transparent" to impurities. It is thus incapable of performing the functions of passivation and diffusion masking.

Techniques have been developed in recent years to produce planar-type germanium devices, but these tend to be somewhat more complex than those required for silicon devices. This provides a partial explanation for the current popularity of silicon devices.

At the stage in the silicon device fabrication sequence just described, the individual devices formed on the original silicon wafer are still attached physically to one another. Typically, as many as 12,000 discrete devices may thus make up the "array" into which the wafer has been effectively converted.

The remainder of the fabrication sequence involves on-wafer testing of the devices, scribing and separation of the devices into individual chips or "dice," bonding of the dice to the package headers, bonding of connecting wires to the contact pads, and final encapsulation. These processes will now be briefly described, with reference to the photographs of figure 15.9.

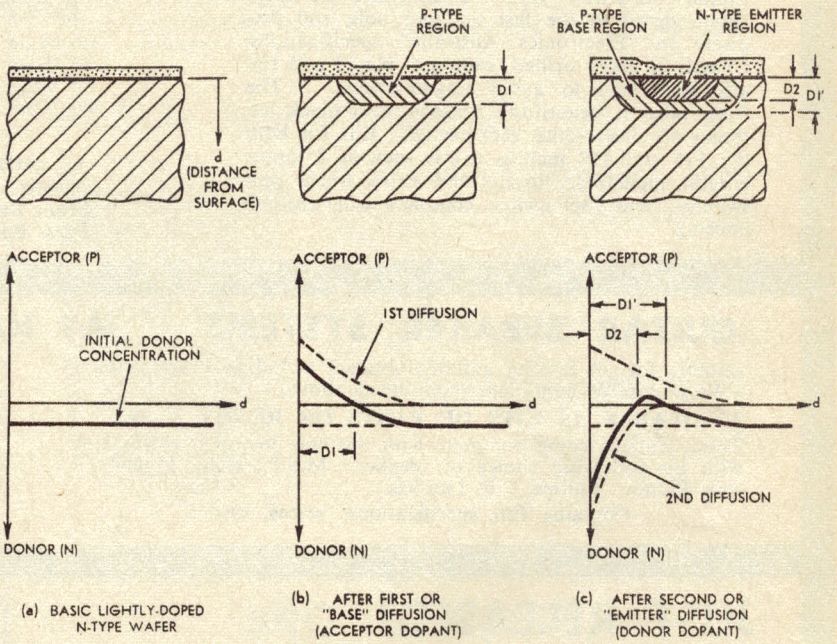


Figure 15.8

A small portion of a completed device array is shown in (a), prior to the commencement of further operations. The devices shown here are high frequency NPN bipolar transistors, each measuring approximately 25 mils square.

The first operation performed on the array is the testing of the devices, illustrated in (b). Here the wafer is mounted on a conducting table, which forms a master contact to the collector regions, and two micro-probe electrodes are applied to the contact pads of each device to check its operation. In modern manufacturing facilities this probe testing operation is done entirely automatically after initial set-up, under computer control.

During the testing, a drop of marking ink is used to identify any devices which prove to be unsatisfactory at this stage. This is shown in (c). The wafer is then precision scribed between the devices, as in (d), and broken up into individual dice as shown in (e). This operation is rather similar to that used in glass cutting. After division the marked reject dice are discarded.

The remaining dice are picked up individually by a vacuum chuck, as in (f), and bonded to the base or "header"

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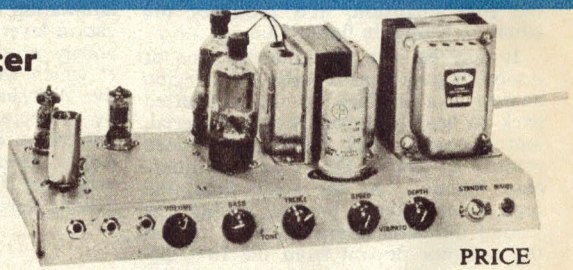
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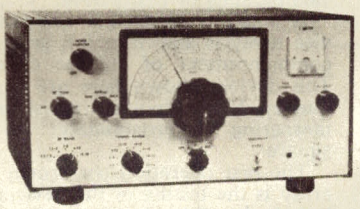
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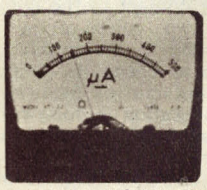
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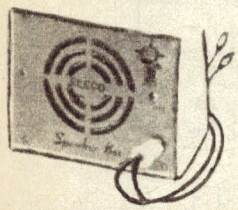


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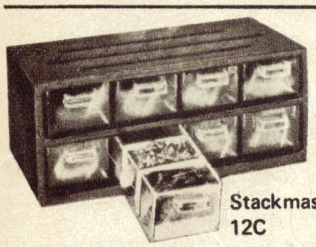
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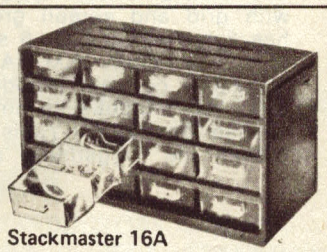


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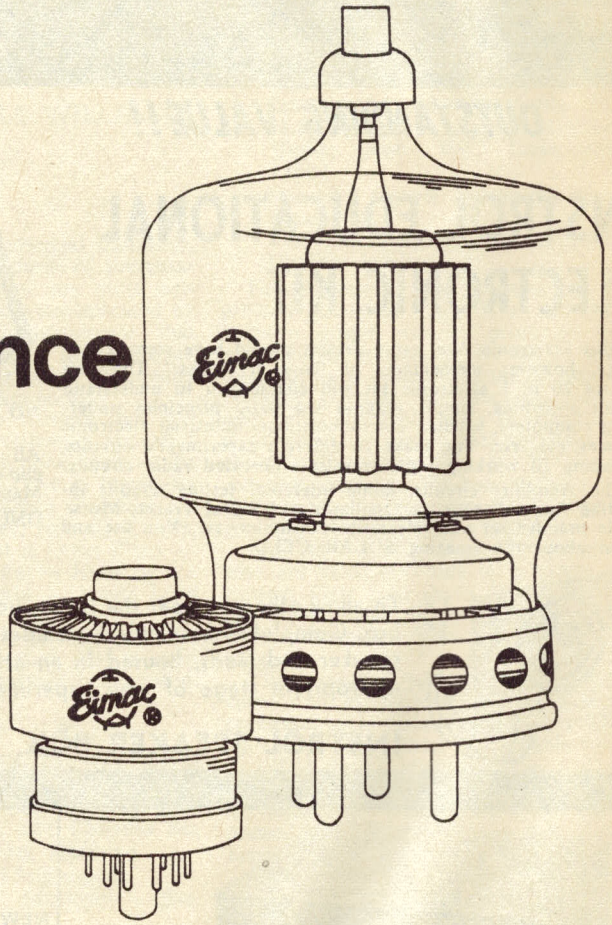
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ZL1AZR to SM7BAE by moonbounce with EIMAC tubes



John Morgan near Auckland, New Zealand, has had three QSOs with Kjell Rasmusson near Lund, Sweden, via 2 meter moonbounce. Both John and Kjell use EIMAC radial beam power tetrodes in their transmitters.

ZL1AZR gets a measured 550 watts output with 80 watts drive at 1 kW input. He uses two EIMAC 4-400A tetrodes, cathode driven, with grid and screen grounded. His antenna has 8 bays of 6 over 6 slot-fed Yagis spaced one wavelength. SM7BAE uses two EIMAC 4CX250R ceramic tetrodes, grid driven, with 1000 watts input. His antenna is an array of sixteen ten-element Yagis. Both amateurs have proven the ruggedness and dependability of EIMAC tubes, and the fact you don't need acres of land and unlimited resources to experiment with moon-bounce techniques.

John points out that he has only a quarter-acre suburban homesite, a homemade rig, wife-and-son engineers and dozens of curious neighbours. Next step is to QSO Kjell on 144 MHz RTTY.

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679 springvale road/north springvale/vic 3171/tel: 560 6211
339 coronation drive/toowong/queensland 4066/tel: 71 3277
10 stirling highway/nedlands/wa 6009/tel: 86 6930

ETD 370

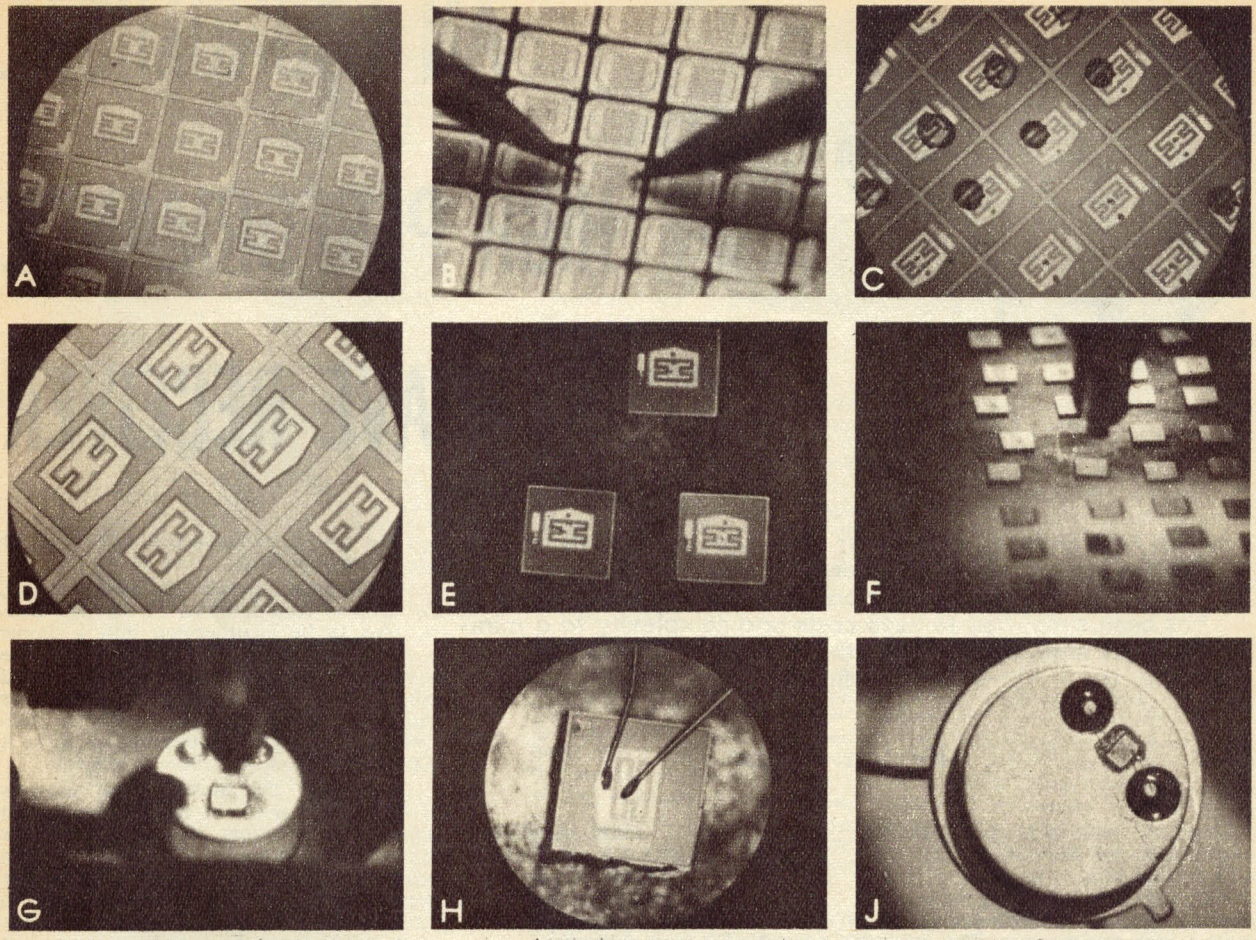


Figure 15.9: From wafer to assembled device. A—completed devices on wafer; B—probe testing; C—wafer showing inked rejects; D—wafer after scribing; E—separated dice; F—picking up die for bonding; G—bonding of die to header; H—connecting wires (.001in) bonded to metallised pads on die; J—completed TO-5 metal can device prior to cap sealing. (Courtesy STC Components Division.)

of the package in which they are to be encapsulated. With epoxy resin encapsulation the die is cemented to the header using an epoxy adhesive, whereas with metal encapsulation the die is generally bonded to the header by a gold soldering process, at about 400°C. The latter is illustrated in (g).

Connections between the contact pads on the die and the insulated terminal posts on the header are then made, this operation being known as wire bonding. The connections are performed using very fine wire, typically between 1 mil and 5 mils diameter. A variety of bonding methods have been used, but that currently favoured is ultrasonic welding using aluminium wire. Bonds of this type are illustrated in figure 15.9(h), and a completed header and die assembly is shown in (j).

Finally the completed device is sealed in its package, which protects it from both physical damage and the ingress of moisture. With devices in epoxy resin encapsulation, the final sealing is performed by covering the top of the header with a blob of epoxy. In metal package devices, a can or "cap" is welded to the header, the operation being performed in an inert atmosphere of ultra dry nitrogen.

The fabrication process is now finished, in that the devices are completed and encapsulated. However, before being marketed they are generally subjected to a series of quality control and reliability tests, to ensure that they meet published figures for both electrical and mechanical performance. The tests applied include impact resistance and hermeticity tests, electrical aging, and tests of such parameters as saturation voltage, breakdown voltages and current gain.

The fact that the fabrication of semiconductor devices involves a large number of extremely demanding, ultra-precise processes means that a large number of variables influence the behaviour of the final devices. Hence it is understandably difficult to fabricate devices having an accurately predictable and tightly controlled performance, although progress is continuously being made in this direction.

At present, however, most manufacturers operate using a system of post-fabrication classification. No attempt is made to fabricate a particular device type, but rather a group or "family" of related devices based on the same die size and configuration. Electrical testing after fabrication is then used to sort individual devices into the various device types of the "family."

In most modern production facilities this classification is performed by automatic equipment, under computer control. In addition to device classification, the same equipment is used to compile information on production yields, parameter distributions and fault analysis.

Because of space limitations the description of device fabrication given in this chapter has been rather brief. However, it is hoped that the material presented has given the reader a reasonably satisfying insight into the techniques capable of producing the devices which have been described in the preceding chapters.

SUGGESTED FURTHER READING

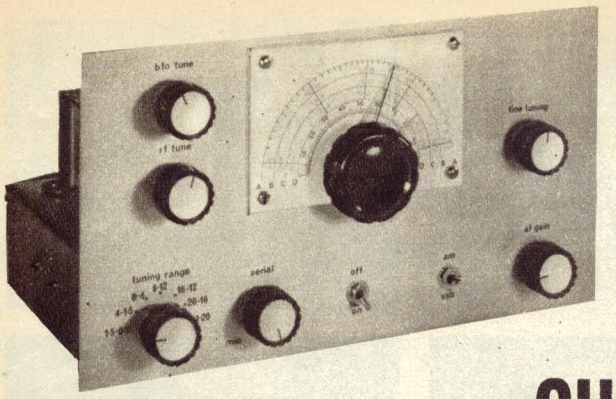
MYLES, D. D., "Silicon Planar Transistors," in **Electronics Australia**, V.29, No. 4, July 1967.

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AN ECONOMICAL HIGH PERFORMANCE SHORT-WAVE RECEIVER

This new short-wave receiver is a direct outgrowth of the 240 Communications Receiver which we described early this year. It retains the general principles of the larger unit but has been simplified to keep costs and complexity to a minimum. It should appeal to the serious short-wave listener with a limited budget.

By Ian Pogson

Early this year, in January, February and March, we described a solid state Communications Receiver, whose design, although not laying claim to be the ultimate, is nevertheless capable of quite a high performance. This receiver has proved to be very popular, and many have been built already; however, its relatively pretentious design has inevitably made it a "serious project," tackled mainly by serious Amateur Operators and short-wave listeners. Undoubtedly there are many readers who would like something simpler — and not as expensive to build.

Realising this, we recently set out to see what could be done about a simpler receiver, by a process of simplification of the former one.

One important question which naturally arises under these circumstances, is whether or not a simpler receiver should provide for the reception of SSB and CW signals, as well as AM. To provide for SSB and CW involves quite a lot of extra circuitry and therefore expense. On this score, we decided that the new receiver should basically be designed for the reception of AM signals only. Later on, it could be extended to include SSB and CW reception facilities, if the constructor desired.

Another aspect of the earlier design which could be subject to simplification is the dual-selectivity feature, with its switching. By compromising here, sharpening what was the original "broad" response to produce a fixed and fairly narrow response, we found in fact that we could come up with something which gives good selectivity for all round use on AM, and still be adequate for SSB reception later, if needed. This measure reduces the number of ceramic resonators required, eliminates switching requirements and considerably simplifies alignment.

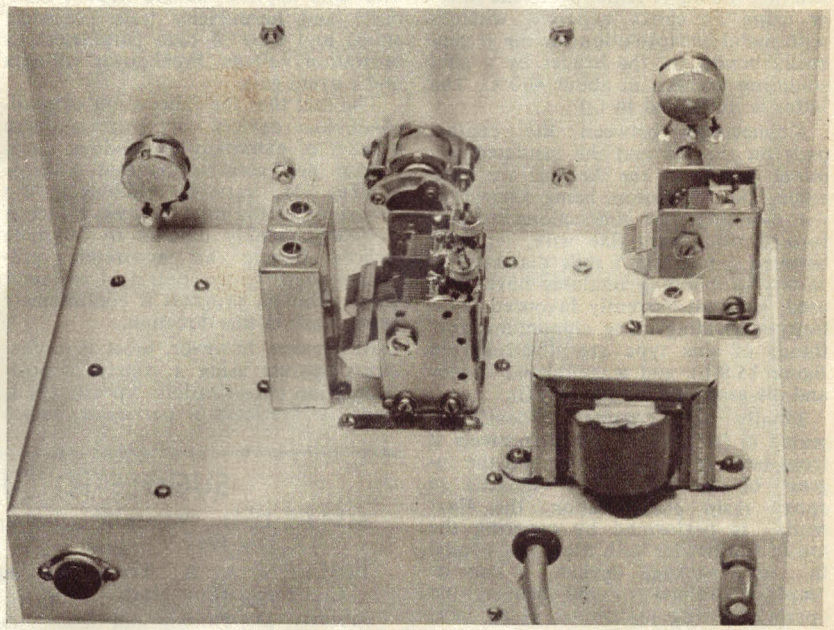
The original audio amplifier has been replaced with a much simpler unit — using a TAA300 IC on its own printed board. Although the output is less than the previous design, it is still adequate for most purposes.

Closely associated with the audio amplifier is the detector. This time, we have used a class B transistor detector, which is easy to get going and has the advantage of providing quite an appreciable amount of gain. This makes up for losses brought about by reduction in the number of stages in the front end design, about which more will be said a little later.

The noise silencer has been dropped, as it is considered to be far too complex to be incorporated into a simple design. The second mixer following the tunable IF is a junction FET, instead of the balanced mixer and its amplifier which were used previously. A balanced mixer is not required here, as it was on the more elaborate receiver.

Perhaps the most radical changes have been made in the front end, and to a lesser extent, the tunable IF. We extended the range of the tunable IF in the interests of economy. Instead of the previous 3 to 6MHz, we are using 4 to 8MHz. By using this range, we are able to cover from the broadcast band right up to 24 MHz in six ranges of equal width. Again, for reasons of economy we have dropped the tunable IF amplifier stage, but as mentioned earlier we have been able to make up for any losses here and elsewhere, in other parts of the circuit.

As the reader may remember the

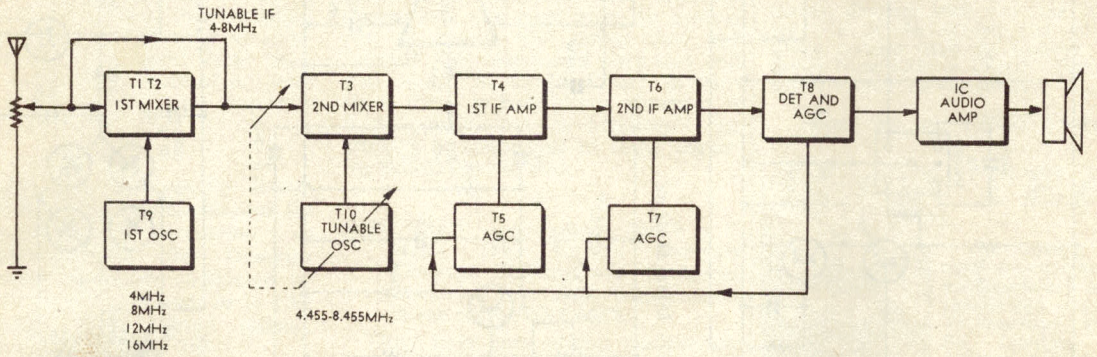


This view shows all the components behind the panel and on top of the chassis. Strips of elastic discussed in the text, can be seen protruding from the top of each of the three coil cans. Note also the dummy potentiometers in the BFO Tune and Fine Tuning positions.

front end of the EA240 Communications Receiver is crystal locked, and by suitable selections of crystal frequencies, together with the choice of the tunable IF, we were able to get a wide frequency coverage with a minimum of crystals. This worked very well, but we felt that even the cost of the few crystals involved could not really be justified for a new economy design. Accordingly we have decided to use a self-excited oscillator instead, for AGC is accordingly that which we used in our Playmaster 122 and 123 Program Sources, with remarkable success. This involves introducing a controlling transistor in the emitter circuit of each stage to be controlled, to allow adjustable degeneration and bias control. For a given number of controlled stages, this method gives one of the best AGC characteristics obtainable. Admittedly this system involves the use of two more transistors, but these are offsetting the cost of the extra transistors needed for AGC control.

No S meter has been provided, but if desired a 0-1mA meter may be placed in the emitter circuit of the detector for this function. The meter will provide forward readings, although its linearity leaves something to be desired. However, the expedient is simple and effective.

The block diagram shows the basic format of the new receiver, and before



The block diagram of the complete receiver shows clearly all the functions. Each function can be related to the main circuit diagram.

switched to the various required frequencies. Inevitably this degrades the overall frequency stability of the new receiver but past experience suggested that the degradation might only be slight, and happily this has indeed proved to be the case.

In contrast with the usual situation which applies with a tunable first local oscillator, in this case the higher frequency bands have the oscillator set on the low side of the incoming signal. This means that for the highest or 20 to 24MHz range the first oscillator is at only 16MHz, instead of say about 25MHz. The lower frequency tends to result in less oscillator drift than at the higher frequency, all other things being equal.

For the first mixer, we are again using a junction FET to replace the balanced mixer used in the previous design. By using a FET mixer we are able to achieve a useful amount of gain and this is worthwhile as the economy design does not allow for an RF stage.

By now, the reader may have noted from the circuit that this new design, while retaining the general principles of the earlier Communications Receiver, has some marked differences. As we wished to make the best use of a minimum number of stages, by getting highest gain from each, we have used bipolar transistors in the IF amplifiers, in place of the junction FETs used previously. It may also be noted that there are only two amplifier stages which are available for AGC purposes. These are the two second IF amplifiers.

This arrangement, while it performs very well, presents a problem from the point of view of providing an effective AGC system. It is not possible to supplement the AGC action on the available amplifiers with diode damping of one of the tuned IF circuits, because we have no tuned IF circuits in the usual sense. The ceramic resonators which we are using do not lend themselves for this function.

The method we have adopted for controlling the gain of the IF amplifiers quite modestly priced and we consider the addition well worth while. It is a fortunate fact that a current source for the two AGC control transistors is available at the collector of the class B detector, which allows a simplification

proceeding with the following description of the complete circuit, it would be wise to study this diagram. This should help to make the circuit easier to follow, particularly for those who are not familar with the earlier design.

From the broad outline of the design as covered by the block diagram we can turn to the circuit diagram for a more detailed description. At the aerial

PARTS LIST

1 Chassis 10in x 6in x 2in (with partition).
1 Front panel 11in x 6in.
1 Dual ratio dial assembly (Jabel).
1 Toggle switch, miniature SPST.
1 Rotary switch, 3 wafers, 1-pole, 11-position.
3 Knobs.
1 Power transformer, 2 x 6.3V, 1A.
1 2-pin miniature speaker socket.
1 Aerial terminal.
1 Earth terminal.
1 ¼in flexible coupling (Jabel)
1 ¼in extension shaft.
1 Miniature tag board, 6 prs.
1 Miniature tag board, 12 prs.
1 Miniature tag board, 13 prs.
1 Miniature tag board, 19 prs.
1 Printed wiring board (R.C.S. 745 or similar).
1 2-tag strip.
1 5-tag strip.
5 Rubber grommets.
2 2.5mH RF chokes.
1 Ferrite toroidal formers, Q2 material, Ducon type F4040/2.
2 Neosid coil formers, 7.6mm x 2¼in, with grade 900 slug and can.
1 Neosid coil former, 7.6mm x 1¼in, with grade 900 slug and can.
2 Murata ceramic resonators, type SFD-455B.
Mounting panel for IF strip. Hookup wire, solder, screws, nuts, power flex and plug, solder lugs, etc.

TRANSISTORS

1 2N5485 (Motorola).
8 BF115, BF184, BF185, etc.
1 TAA300 I.C.

DIODES

4 EM401, BY126/100, etc.
1 BZY94/C12 zener.
1 BZY88/C6V2 zener.

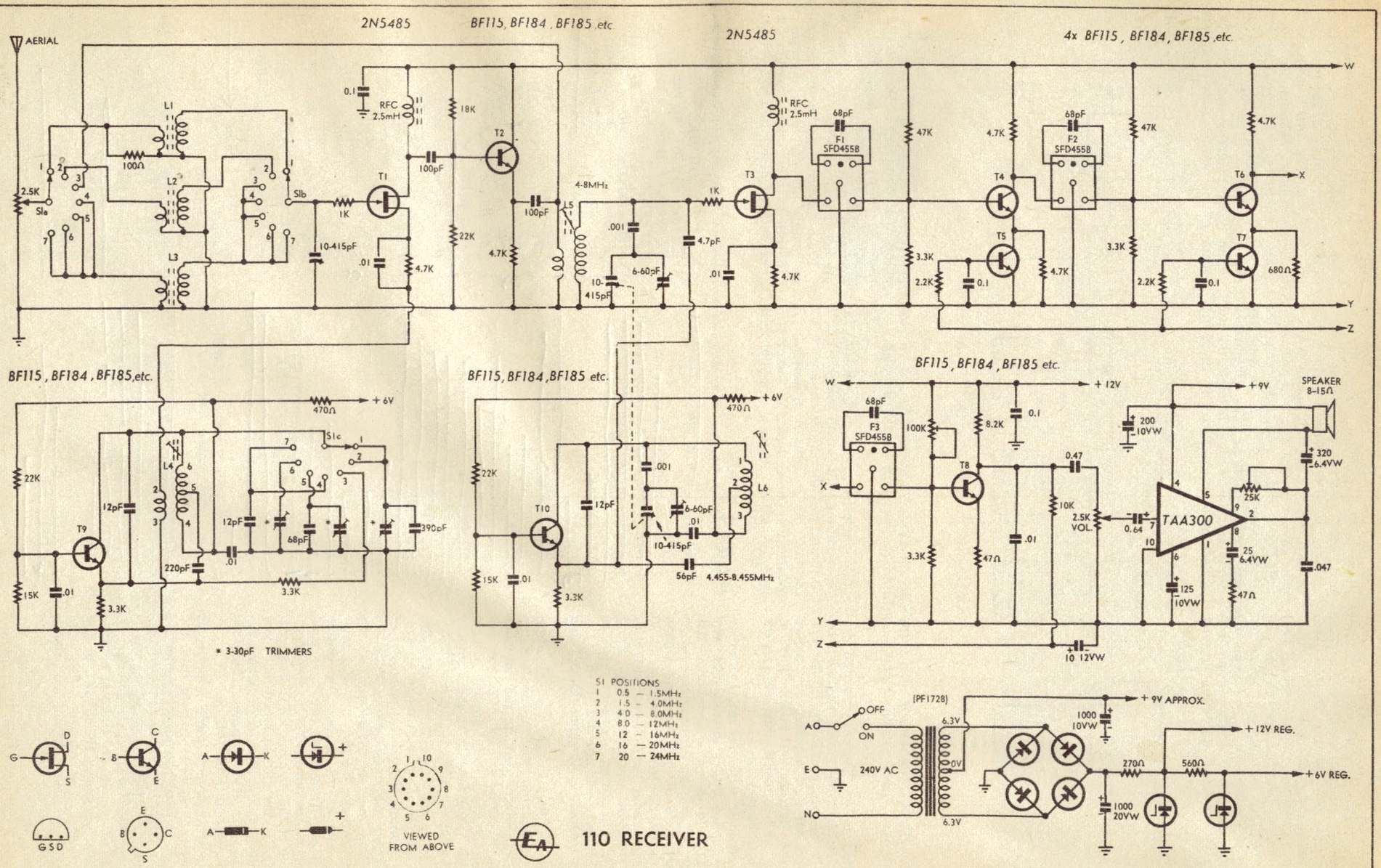
RESISTORS (all ½ watt)

1 47 ohms.	2 470 ohms.
1 100 ohms.	1 560 ohms.
1 270 ohms.	1 680 ohms
1 1K	1 10K
2 2.2K	2 15K
6 3.3K	1 18K
3 4.7K	1 22K
1 8.2K	2 47K

1 2.5K linear pot.
1 2.5K log pot.
1 25K linear tab pot.
1 100K linear tab pot.

CAPACITORS

1 4.7pF NPO ceramic.
3 12pF NPO ceramic.
1 56pF NPO ceramic.
2 68pF polystyrene.
2 100pF polystyrene.
1 220pF polystyrene.
1 390pF polystyrene.
2 .001uF polystyrene.
3 .01uF 25V ceramic.
4 .01uF low voltage polyester.
1 .047uF 25V ceramic.
4 0.1uF 25V ceramic.
1 0.47uF 25V ceramic.
1 0.6uF 64VW electro.
1 10uF 12VW electro.
1 25uF 6.4VW electro.
1 125uF 10VW electro.
1 200uF 10VW electro.
1 320uF 6.5V electro.
1 1000uF 10VW electro.
1 1000uF 20VW electro.
5 6-60pF trimmers, Philips 2222 808 01001.
1 10-415pF variable, 2-gang.
1 10-415pF variable, single.



110 RECEIVER

2/SW/53

input, we have an attenuator in the form of a potentiometer. Where necessary a series capacitor may be included to further attenuate the lower frequencies, particularly the broadcast band, to reduce breakthrough interference.

Three aerial coils are used to cover the ranges 0.5-1.5MHz, 1.5-4MHz and 8-24MHz. This leaves a gap of 4-8MHz, which is the range of the tunable IF. For simplicity the front end is not used for this range, the aerial imput being switched directly into the first tuned circuit of the tunable IF. The three aerial coils are wound on ferrite toroid formers. This procedure gives compact coils of high Q, and thus permits using only one tuned circuit.

The aerial tuned circuit selected by the range selector switch is connected to the gate of the 2N5485 junction FET mixer. The drain of the mixer is broadbanded by using a 2.5mH RF choke for its load. As a high to low impedance transformation is necessary to couple from the mixer drain to the following stage, an emitter-follower is used at the output of this stage.

Inspection of component values in the circuits thus far will show that they favour the higher frequencies. The interstage coupling capacitors are small values, and in addition the 2.5mH RF choke as the mixer load has reduced reactance at the lower frequencies and so contributes to the overall effect.

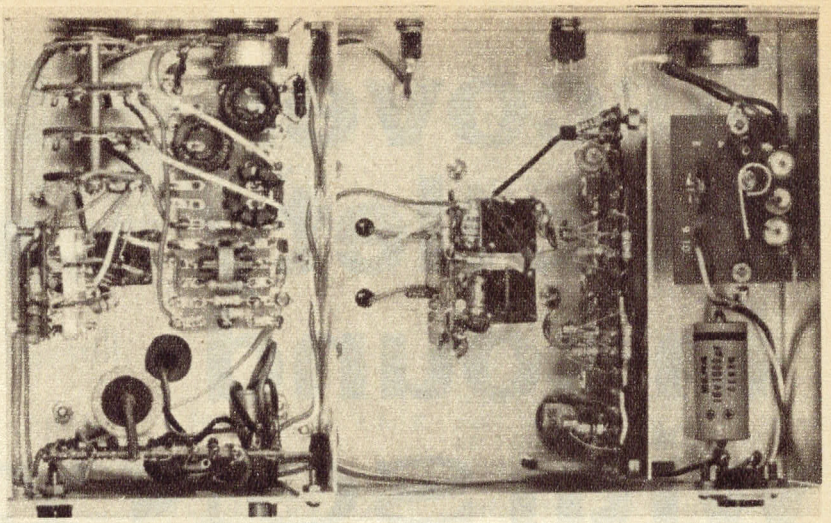
There are two reasons for this. Firstly, there is a natural tendency for the RF gain to fall as the frequency is increased, so that this approach has a levelling effect. The second is perhaps peculiar to this design. As mentioned earlier, we have used only one tuned circuit in the input to the first mixer. Although the circuits are of quite high Q, there is not sufficient discrimination to prevent strong local broadcast stations from breaking through in some circumstances. By reducing the gain at these frequencies this problem is minimised.

The self-excited oscillator associated with the first mixer uses an adaptation of the oscillator circuit which we used in a recent wide range dip oscillator. The tuned circuit of this oscillator, which determines the first injection frequency, is switched in a similar manner to the amplifier-multiplier circuit used in the 240 Communications Receiver. As the oscillator is run at the final injection frequency and not multiplied as occurred in some instances with the previous crystal oscillator, spurious responses are thereby reduced. Switching of this oscillator is carried out by ganging it with the switching for the aerial tuned circuits at the input to the first mixer.

An extra winding of low impedance has been added to the oscillator coil. This is to provide source injection to the mixer. Bias for the mixer is provided by means of a bypassed 4.7K resistor in series with the injection winding.

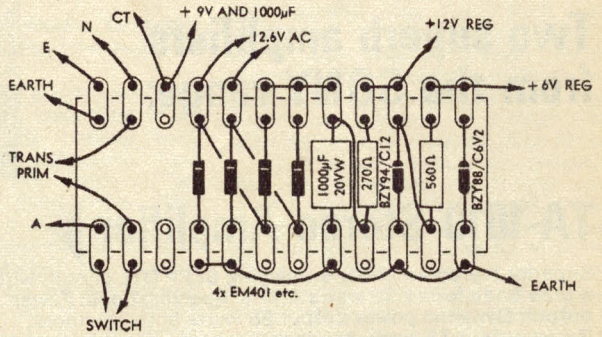
This arrangement of the first oscillator tuned circuit and injection permits the use of a single oscillator coil. It is only necessary to switch appropriate capacitors for band changing, and this makes for the simplest and most conveniently aligned front end circuit which we could devise.

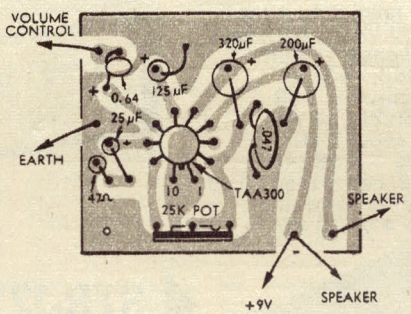
Injection frequencies for the first mixer are 4MHz, 8MHz, 12MHz and 16MHz. The 4MHz injection is used for both the 0.5-1.5MHz and 1.5-4MHz ranges, 8MHz is used for the 12-16MHz range, 12MHz for the 16-20MHz range and 16MHz is used for both 8-12MHz and 20-24MHz. These figures may be clearly seen from the table.



This view underneath the chassis shows the placement of each of the sections, with ample space and no crowding. Note the dummy switch for the AM-SSB switch position.

At right is the board for the power supply. Note that the 1000uF electrolytic for the audio supply is mounted at the speaker socket. The printed board for the audio amplifier is below.





Signal Freq. MHz	Injection Freq. MHz	Tunable IF MHz
0.5-1.5	4	4.5-5.5
1.5-4	4	5.5-8
4-8	—	4-8
8-12	16	8-4
12-16	8	4-8
16-20	12	4-8
20-24	16	4-8

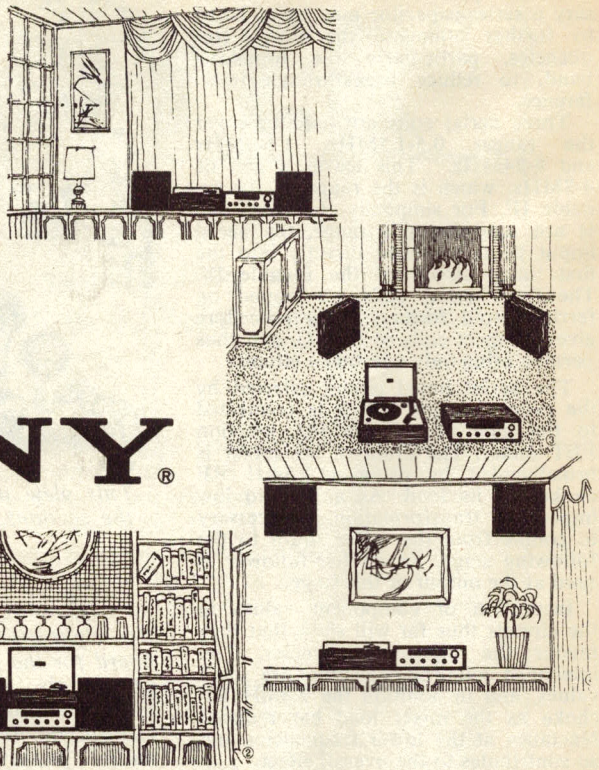
It may also be noted from the table that all ranges but that from 8-12MHz tune "forward," i.e. from 4-8MHz on the tunable IF dial. Even the "odd man out" band could have been made to tune in the same direction, but this would mean an injection frequency of 4MHz and although readily available, would have resulted in intolerable spurious responses. A reverse tuning band is considered a small price to pay for improved performance.

The "front end" which we have just described, in addition to being suitable as part of a complete receiver, could conceivably form the basis of a converter which could be used in a number of applications. Variations could be made in the oscillator frequencies, the RF tuned circuits and the tunable IF, to suit the particular need. Such a design could be readily adapted for spot frequencies, "amateur bands only," etc.

We now come to the tunable IF section. From here on the system is really a single conversion receiver in its own right, albeit one which tunes only the 4-8MHz range. The tunable IF does not have an amplifier in the strict sense, in that there is no transistor or other active device at this frequency range. However, the coil used has a tuned secondary, with a low impedance primary input. This step up does actually give quite a useful amount of gain.

Immediately following the tunable IF circuit is the second mixer, which is another 2N5485 FET. The tunable oscillator associated with this mixer uses the same basic configuration as the first oscillator, the main difference being the changed circuit values to make it tunable over the range 4.455MHz to 8.455MHz. Injection from this oscillator is via a small capacitor to the gate of the second mixer.

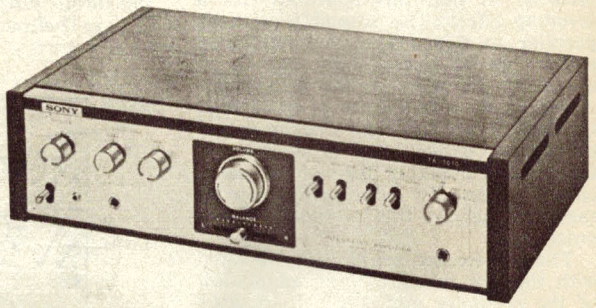
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The drain load of the FET second mixer is again a 2.5mH RF choke. The load requirement here is such that it must present a low DC resistance to the +12 volts DC supply and at the same time present a source impedance of about 3K ohms at 455KHz, to the SFD-455B ceramic resonator which follows. The readily available 2.5mH RF choke meets this requirement quite satisfactorily.

The next two stages are the 455KHz IF amplifiers, and here silicon bipolar transistors of type BF115, BF184, BF185, or similar, may be used. Collector load in each case is a 4.7K resistor and these are followed by two more SFD-455B ceramic resonators, similar to the first one. Each of the resonators is top coupled with a 68pF capacitor. This value largely determines the bandwidth of the IF system and unless you have good reason for wishing to depart from this, we suggest that you adhere to this value. As mentioned earlier, AGC is achieved by another bipolar transistor in the emitter of each IF amplifier.

After the third 455KHz ceramic resonator is another transistor which can be a similar type to the two previous amplifiers. This device is biased in class B and is the detector. The circuit shows a 100K potentiometer in series with a 3.3K resistor, as the divider for the detector base bias, but when the bias is adjusted on completion, the potentiometer may be replaced with a fixed resistor if desired.

The detector collector load is an 8.2K resistor, with a .01uF shunt capacitor which functions as an IF filter, audio being recovered from this point. It will be noted that there is an unbypassed 47 ohm resistor in the emitter of the detector. The main purpose of this resistor is to give some degeneration to reduce the audio output, as only a fairly low level is required for the IC audio section.

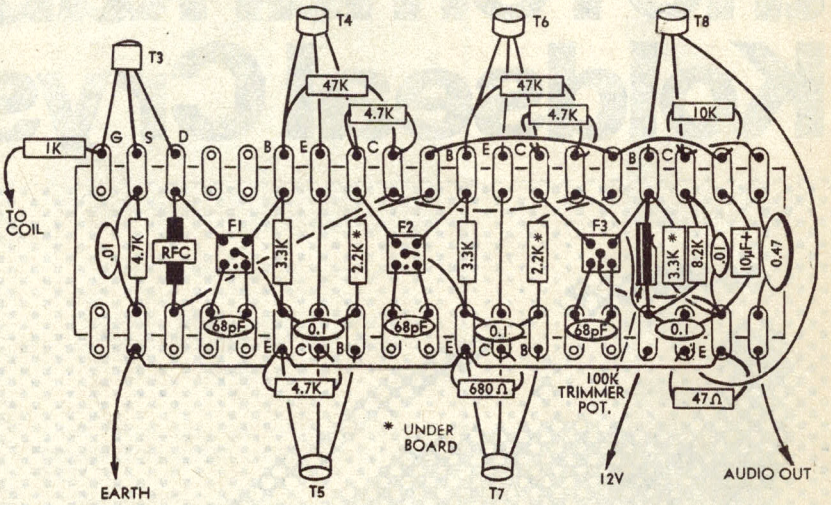
As mentioned earlier, AGC is derived from the collector of the detector. AGC filtering is performed by a 10K resistor and a 10uF electrolytic capacitor, the output of the filter driving the bases of the two controlling transistors, each with a 2.2K isolating resistor in its base. Briefly, the AGC functions as follows:

The detector, being operated in class B, is normally biased to near cut-off. This means that there is little collector current flowing under no signal conditions, and hence there will be little voltage drop across the 8.2K load resistor. Hence there is a relatively high voltage applied to the 10K resistor, charging the 10uF capacitor and feeding the maximum available current through the two 2.2K resistors to the bases of the controlling transistors. This current is sufficient to "bottom" both transistors. Under these conditions, the controlling transistors will only show a very small resistance between the collector and emitter, and accordingly the IF amplifiers will be able to contribute their maximum available gain.

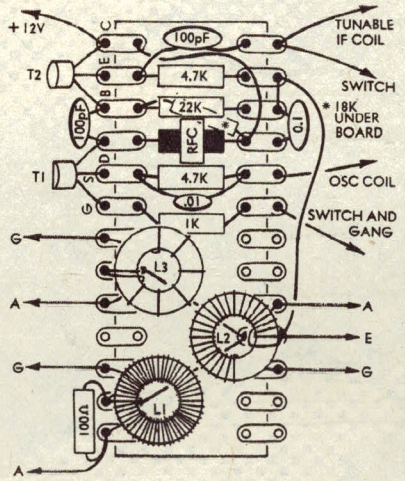
When a signal appears at the base of the detector, due to the detection process, there will be an increase in the detector collector current. This results in an increased voltage drop across the 8.2K resistor, and so a lower voltage at the collector. This means that a lower current will flow through the 10K resistor, causing the 10uF capacitor to discharge to a reduced voltage, and the current to the control transistor bases to be reduced. The reduction in base current of each transistor will cause the collector-emitter resistance to increase, producing the same effect as placing a resistor of equal value in each IF amplifier emitter circuit. Degeneration thus produces a reduction in IF amplifier gain.

It may be noted that each control transistor is shunted by a fixed resistor. By carefully selecting the correct value of these resistors the overall AGC characteristics have been determined. The values given should thus be adhered to, unless you have good reason for making any changes.

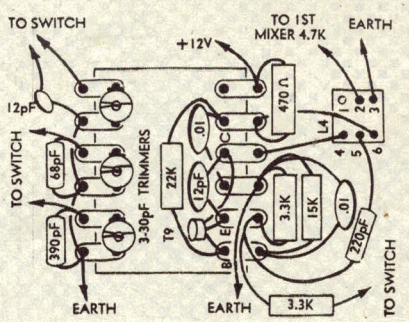
Output from the detector is fed via a 2.5K volume control to the main audio amplifier. The Philips TAA300 IC used in this amplifier is mounted on a small printed board with its associated components. It is the same audio amplifier which we used on the 1970 All-Wave Two and the Solid State Fremodyne.



Wiring of the IF amplifier is relatively simple if the above diagram is followed in conjunction with the circuit diagram.



The RF amplifier should be wired with particular care given to the switching.



The local oscillator should also be wired with emphasis on switching accuracy.

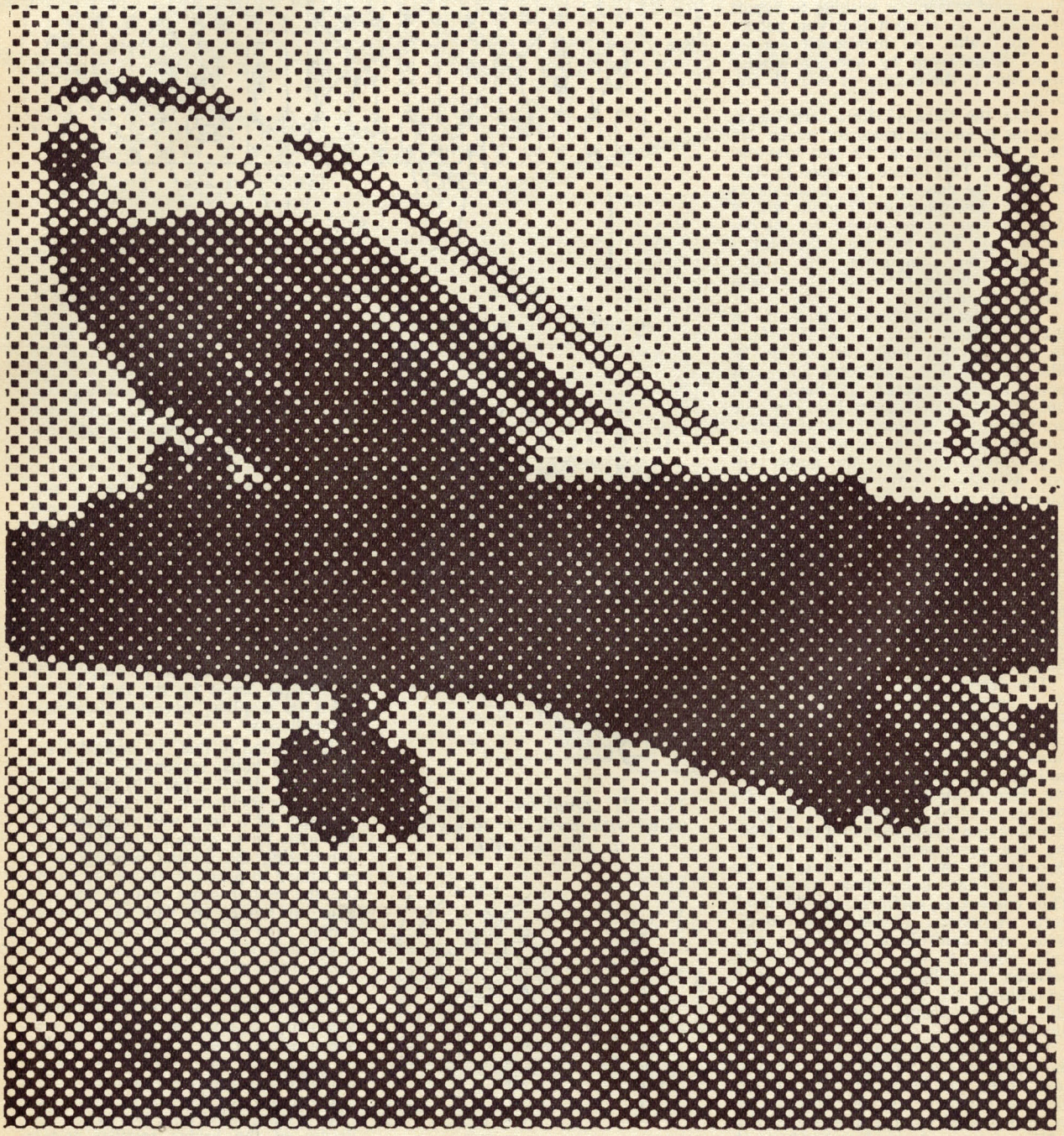
The power output is about 1 watt into an 8 ohm speaker, which is the lowest value which can be used. A 15 ohm speaker may be used, but with a reduction in power output.

The power supply is quite an interesting one. We were faced with a number of problems which at first, looked as though they might be difficult to solve at low cost. Firstly, we had the need for an audio supply of 9 volts with a maximum of 10 volts. The current requirement would vary from a quiescent value with no signal, of 8 milliamps, to a maximum of about 180 milliamps with full audio output. This is brought about by the fact that the TAA300 amplifier operates under class B conditions.

In addition to this, we needed a supply of 12 volts, reasonably well regulated, for all other parts of the receiver except the oscillators. The latter needed a supply of 6 volts well regulated. All this adds up to quite an exacting need, considering the modest receiver which we aimed to produce. However, by giving the matter some thought we were able to come up with a relatively simple and neat solution using an adaptation of an old idea used for multiple voltage power supplies.

This idea consists of using a bridge rectifier across the total transformer secondary supply, for the higher voltage need. A lower voltage may be had by taking the output from the centre tap of the transformer secondary. This is effectively fed from a full wave rectifier system, using only two of the four diodes of the bridge rectifier system, but with the diodes in the negative, rather than the positive side of the supply. With a secondary supply AC of

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about 6.3 volts, each side of the centre tap, we thus obtain between 9 and 10 volts DC for the audio amplifier while at the output of the bridge we obtain between 17 and 19 volts. This is fed through a dropping resistor of 270 ohms to a BZY94/C12 zener diode, which gives a regulated supply of 12 volts.

The well regulated supply of 6 volts required for the oscillators is obtained by a further dropping resistor of 560 ohms and a BZY88/C6V2 zener diode. Thus the overall supply voltage requirements of the receiver have been met in a very satisfactory way. In fact, although the supply current to the audio amplifier is constantly fluctuating, the other two supply voltages are virtually unaffected.

To reduce hum to an acceptable level we have found it necessary to use a minimum of 1000uF in each of two main power supply electrolytics. Readers who wish to reduce the hum to an even lower level, could increase these two electrolytics to 2000uF each.

So much for the design and theoretical aspects. In the practical description which follows we hope to supply sufficent details to ensure that readers will have no difficulty in duplicating the prototype.

Perhaps a good place to start construction is the power supply, for by starting here and working backwards, one can finish off each section and test it immediately. The power supply, less transformer, is built on a piece of miniature tag board, with 12 pairs of tags. It is a simple item to wire, particularly when reference is made to the wiring diagram. Note that as there is not a great deal of room around the wiring board, the relatively large 1000uF capacitor on the 9-10 volt supply is located between the speaker socket and the audio amplifier.

There are a number of small transformers available which should do the job. The prime need is for one having a secondary of 12.6 volts, centre tapped, and rated at between 500mA and 1A. We used a type PF1728, which has two 6.3 volt windings rated at 1A. These windings are connected in series, thus giving an effective centre tap.

The printed board for the audio system has only nine items to be soldered into place and the job is done. The appropriate diagram should be followed carefully and a few important points should be observed to ensure success. Make sure that all the electrolytic capacitors are in their correct positions and that correct polarity is observed. When fixing the IC, make sure that it is done with due respect for the correct orientation of the connections. The tag on the IC is between connections 1 and 10 and these should be soldered to the appropriate band of copper on the board. The other connections will then automatically be correct.

Although this completes the wiring of the board, it is still necessary to provide a heat sink clip for the IC. We made one up from a piece of aluminium sheet, measuring 2in x ¼in. One end was wound around a 5/16in diameter drill and the resulting loop was adjusted by hand so that it was a neat fit over the case of the IC. Although aluminium is excellent for this job, other metals such as brass, copper or steel, would be satisfactory.

The next assembly is the largest of the whole project. It includes the second mixer, two IF amplifiers, detector and AGC system. Wiring is again based on a miniature tag strip, in this case with 19 pairs of tags. The board is secured with two screws, to an aluminium panel, 4¾in long, 1-7/8in high and with a 5/16in foot. This panel simply serves as a mounting bracket for the complete assembly. The holding screws are at the extreme end in each case. The board is spaced from the panel by about ¼in. Instead of spacers, we used ¼in screws, with nuts against three faces in each case. Under each screw, we fixed a solder lug and soldered to the nearest earth point.

The three ceramic resonators are mounted directly on the tag board. A little care must be used in mounting, as it is necessary to drill five small holes fairly accurately. Only holes large enough to pass the leads should be drilled. The resonator leads are passed through the holes and the other leads and components are then soldered to the opposite side. This is sufficient to hold the resonators in place. Make sure that the "dots" on the resonators are orientated correctly.

Most of the remaining assemblies involve the use of one or more coils, so this would be a good time to wind all the coils.

The aerial tuning coils L1-L3 are wound on Ducon toroids, which are about ¾in outside diameter, and of O2 material. These coils have a high Q, can be wound readily and they have the extra advantage of being compact. The coil winding details are given in the table. The number of turns on each winding and the disposition of the windings should be closely adhered to. However, the gauge of wire specified is simply a guide. If you do not have the exact gauge, then something close to it should suffice. At the same time, particularly at the higher frequencies, the gauge of wire should be as heavy as practicable. This will reduce the resistance of the coil and so give a higher Q. The switched oscillator coil L4 is wound on a Neosid former with a diameter of 7.6mm. The secondary is wound first, with the primary wound over the earthy end of the secondary. Do not forget to make the centre tap on the secondary winding. When this point is reached, we suggest that you carefully remove the enamel for about 3/16in, tin and bared copper and place a small piece of insulation tape under the wire at this point and continue winding. Later on, a small piece of the same wire can be soldered to the centre point and this can serve as the extra lead.

The means of anchoring each end of the windings is largely up to the reader. We have used a couple of different methods of anchorage. In one, a loop of linen thread is placed lengthwise on the former, with the loop near the start of the winding. The end of the wire is passed through the loop, a few turns made, and then the linen ends are drawn tight, causing the loop to anchor the wire at the start. A similar method is used at the finish. The loose ends are cut off and the anchorages augmented with a small application of cellulose glue.

An alternative, but perhaps not quite such a good method, is to use a small strip of plastic adhesive tape, in a manner similar to that for the linen thread. In any case, when the secondary is wound, it is a good idea to place a piece of plastic adhesive tape over the secondary, where the primary will be wound. This will prevent any possibility of a short-circuit between windings.

Coils L5 and L6 are wound on longer formers of the same type as used for L4, and in a similar manner to L4. Although care should be taken to make all windings in a firm and workmanlike manner, this applies more particularly to L4 and L6, which are oscillator coils. These must be wound tightly and precautions taken so that there will be no movement of the turns. If this is not done then the stability of the whole receiver could be spoiled.

When coils L4, L5 and L6 are wound and terminated, each winding is then placed in a can, ready for use in the final assemblies. The Neosid cans are provided with a pair of lugs and the intention is that these lugs be bent over to hold the coil former in position. Two screws through the holes anchor the coil and the can to the chassis. This system is excellent but it requires a very special set of punched holes in the chassis. An alternative method which we used, is to bend the lugs outwards, rather than inwards. The former is firmly held in the can by crimping the aluminium over with a screwdriver, at a couple of spots which do not interfere with the terminating pins. The assembly is then held to the chassis with a couple of screws and nuts.

The next board to be wired is that

COIL WINDING DATA

L1 Secondary, 120 turns 30 B&S enamel on Q2 toroidal former. About 90 turns occupy full former length. Overwind remainder back. Primary, 10 turns, interwound at earth end of secondary.

L2 Secondary, 43 turns 24 B&S enamel on Q2 toroidal former, wound to occupy about 90 per cent of former. Primary, 5 turns interwound at earth end of secondary.

L3 Secondary, 7 turns, 18 B&S enamel on Q2 toroidal former, wound to occupy about 90 per cent of former. Primary, 1 turn 24 B&S enamel, interwound at earth end of secondary.

L4 Secondary, 30 turns centre tapped 26 B&S enamel close wound on 7.6mm (0.300in) x 1¼in Neosid former. Primary, 5 turns over earthy end of secondary. Grade 900 slug.

L5 Secondary, 35 turns, 26 B&S enamel close wound on 7.6mm (0.300in) x 2½in Nesoid former. Primary, 7 turns over earth end of secondary. Grade 900 slug.

L6 One winding, 32 turns centre tapped, 26 B&S enamel close wound on 7.6mm (0.300in) x 2½in Neosid former. Grade 900 slug.

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containing the three toroidal coils, with the first mixer FET and the emitter-follower stage. This is wired up in the usual way, according to the wiring diagram. When the coils are wired in place, it will be noted that they are more or less loose, according to the gauge of wire used for winding. In order to keep the coils held firmly in place, it is a good idea to tie each one to the board, with a piece of nylon or linen thread.

The last board to be wired is that for the first oscillator. It cannot be over-stressed that this board must be wired with the greatest care, making sure that all components are held firmly in place. Failure to do so will result in an unstable receiver, or one which is more susceptible to shocks than it should be. Details are shown in the wiring diagram, which also includes the coil which is mounted separately. The new Philips dielectric film trimmers fit quite nicely between adjacent tags on the board, as may be seen from the photograph.

Having completed all the sub-assemblies, we are now in a position to undertake the final assembly and wiring. The unit is built on a chassis, 10in x 6in x 2in, with a front panel, 11in x 6in. As the order of assembly and wiring can affect the ease of the job, here are some suggestions as to how it may be done.

Fit the chassis partition first, making sure that a rubber grommet is fitted at least to the hole which must pass the 240V AC lead to the switch. Next, fix the speaker socket and aerial and earth terminals to the back skirt of the chassis. A solder lug is fitted under each of the terminals, making contact with the chassis for the earth and insulated for the aerial.

Solder timmers to the top of the two gang capacitor and at the bottom lugs solder two pieces of hookup wire, about 4in long. Fix a similar piece of wire to the single gang and mount both units to the chassis. Mount coils L4, L5 and L6, making sure that the pins are so orientated as to give the shortest wiring leads. Under one mounting screw of L6, provide a 5-tag strip and under the corresponding screw of L5 fix a 2-tag strip.

Mount the power transformer with the low voltage leads nearest the back of the chassis. Make sure that the two holes in the chassis are fitted with rubber grommets, to protect the transformer leads. Fit another rubber grommet to the hole in the back skirt of the chassis, for the power flex.

Mount the power supply board assembly. We used a couple of 1/8in Whitworth screws, one at each end hole of the board. Three nuts are used on each screw, so that a spacing of about ¼in is effected between the board and the chassis skirt. The board is orientated so that the vacant terminals for the 240 volt wiring is nearest the dividing partition. It is a good idea at this stage, to wire up the leads of the transformer, power supply and switch. This gets rid of flying leads, which can be a nuisance when doing the rest of the assembly.

Now the audio amplifier board can be next. It is also held off the chassis, by about 5/8in, with a couple of 1/8in Whitworth screws, using the three nut technique as before. Before finally fitting the board, make sure that all leads from it are fitted, with sufficient length so that each will comfortably reach its intended destination. Under each fixing screw and next to the board, provide a solder lug for earthing purposes. At this point, you may fit the 1000uF electrolytic capacitor, between the speaker socket and the nearest earth lug of those just referred to. The 9-volt lead may also be run from the power supply.

The IF strip assembly is the next logical step. Note that it is mounted with a gap of only about ¼in between the end of the panel and the back skirt of the chassis. The detector must be at this end. Before fixing, provide leads for the 12 volt supply and the audio output to the volume control. The 12-volt lead may be run to the power supply but the audio lead must wait until the front panel is in place.

Now the tunable IF can be wired up. This involves coils L5 and L6, with associated components to the two tag strips, previously fixed. The wiring here is largely a matter of common sense. Best use should be made of the tags available, together with vacant pins on the two coil formers. Once again, the oscillator components must be firmly fixed. In some cases, it is difficult to avoid some components having leads a little longer than we would like. However, this is of no serious consequence. The 1K "stopper" resistor, from L5 to the gate of the second mixer, must be so mounted that the resistor is hard up against the gate tag on the board. The other lead should run direct to the coil.

Having completed the tunable IF, it is interesting to note that we have already completed the main wiring of the 4-8MHz tuning range. We could even test it at this point but as we would have to add the front panel with the other essential components fitted to it, it would be better to carry on with the "front end."

Perhaps the next most convenient board to fit would be that of the first oscillator. This is fixed to the end skirt of the chassis and stood off the chassis by about 3/8in, once again using the same technique with screws and nuts. As with other units, it is well to consider any leads from it, which may be difficult to fit later. Make sure that you run the 6 volt supply to this oscillator, as we hope you have already done with the second oscillator for the tunable IF.

Some may be wondering about the purpose of the 3.3K resistor which runs from the band switch to the emitter of the first oscillator transistor. Its purpose is simply to stop this oscillator when the receiver is set to the 4-8MHz position. This avoids the possibility of any unnecessary "birdies."

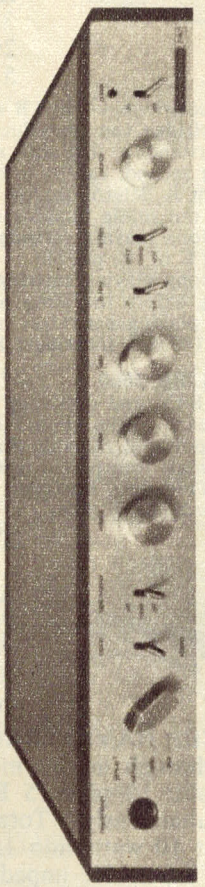
Before attempting to fit the board with the toroidal coils, drop the 2.5K aerial attenuator pot through the hole in the chassis. The nut could be just run up finger tight at this stage. Stand the board off the chassis, by about 5/8in. The mounting screws are run through the extreme end holes of the board and the same method is used as before.

Now we are in a position to mount the dial to the front panel and to fix the panel to the chassis. The panel is held in place with the nuts of the band change switch, aerial attenuator, power on/off switch and volume control. The drive from the dial to the tuning

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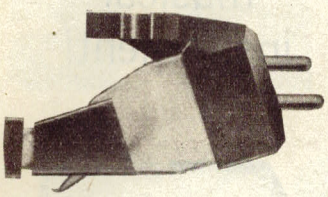
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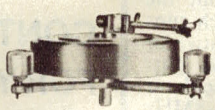
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capacitor is via a flexible coupling. To connect the coupling to the dial movement, it is necessary to provide a short length of ¼in diameter steel or brass rod. This needs to be about ¼in long and can be obtained from an offcut of one of the controls, such as the switch or a potentiometer.

When fixing the band switch, it should be orientated such that the rotor lugs are nearest the top of the chassis. This done, the switch should be completely wired. A piece of light coaxial cable should be run from the aerial and earth terminals, to the aerial attenuator. A convenient earth point for this end is a lug under the nearest fixing screw for the single gang capacitor.

A careful check should be made at this stage, to make sure that all leads have been properly terminated, and that there are no wiring errors or omissions. Assuming that all is well, we are ready to carry out final adjustments and alignment.

Before proceeding, however, it may be noticed that there are some blank holes in the front panel. These are for the optional AM/SSB switch, BFO tune, and fine tuning controls. The receiver at this stage is not fitted for the reception of SSB and CW signals but space has been provided for these additions, which will be described in a later issue.

With a speaker plugged into the socket, we may now plug into the mains and switch on. The first check which should be made is to see that the three supply voltages are correct. With the volume control turned right down the voltage to the audio amplifier should read between nine and ten volts. The 12 volt supply to other parts of the receiver, should read 12 volts, within a tolerance of 5 p.c. The supply to both oscillators should read 6.2 volts, within a tolerance of 5 p.c.

Unsolder the 9V lead between the power supply and the audio amplifier. Connect a multimeter in series with this lead and set the multimeter to the 100mA range, or a higher one, and switch on. Adjust the 25K potentiometer on the audio board, for a quiescent current of 8mA. If a meter is not available, then we suggest that you set the potentiometer to mid range. With the volume control partly advanced, a finger on the active lug of the potentiometer should now give a healthy noise from the speaker.

Set the 100K potentiometer in the base of the detector so that the full resistance is in circuit. Check the voltage at the collector, then reduce the 100K potentiometer resistance until the voltage drops by about half a volt on the previous reading. Later on, the final setting can be determined, to give best detection and AGC operation.

The IF strip should need no adjustment at all: This is surely a very good thing, as it simplifies the procedure considerably. With the three Murata type SFD-455B ceramic filters, top coupled with 68pF, we obtained an excellent result. The top of the band pass shape is almost flat, with a slight dip in the middle. The band width has been measured at 4.4KHz, at the 6dB points. The skirt selectivity is very good and is borne out by the receiver's ability to separate cleanly, adjacent signals about 5KHz away.

Fit a slug each to L4, L5 and L6. To ensure that the slug remains in its final position, it is necessary to use some sort of locking arrangement. This can take the form of a locking compound, which looks rather like a heavy grease, but the method which we prefer is the use of a short length of elastic. The elastic which we used is available from drapery stores in reels, being just under 1/32in in diameter. It is generally double cotton covered, like some of the copper winding wires, but the cotton should be removed. A length of about 1in is introduced into the former tube before screwing in the slug, which provides a binding and very reliable locking action.

The scale provided with the dial assembly has a separate logging scale and four blank scales. These may be filled in as part of the calibrating and alignment, or you may obtain a photographic reproduction of the original scale through the Information Service, for 50c each.

Set the dial pointer to 100 on the logging scale, with the gang fully meshed, and then tighten all grub screws.

To perform the alignment, set the dial pointer to 4MHz, or 95 on the scale. Set the band switch to the 8-4MHz range. Feed in a signal from a signal generator, set precisely to 4MHz and adjust the slug in L6, followed by the slug in L5, for maximum response. Set the dial pointer to 8MHz, or 6 on the scale. Adjust the trimmer for L6, followed by the trimmer for L5, for maximum response. Return to 4 MHz and make any readjustment necessary. Then return to 8MHz and make a further adjustment. This procedure must be repeated until both points are correct.

Luckily even if a signal generator is not available, the foregoing alignment may still be performed accurately using the 4.5MHz and 7.5MHz signals of station VNG, the new standard frequency station in Victoria. Details of this station were given in the magazine for May, 1970. As the 4.5MHz frequency is only in operation during the night time, alignment will be subject to this restriction.

The front end is aligned as follows. Set the dial pointer to 4MHz, corresponding also to 12MHz on the scale, then set the band switch to the 8-12MHz range. Feed in a signal from the signal generator, set precisely to 12MHz and adjust the slug in L4 for maximum response, making sure also to peak up the tuning of L3. If a generator is not available, then the VNG time signal on 12MHz may be used instead, between the hours of 7.45 a.m. and 7.30 p.m., Australian Eastern Standard Time. Once set, the slug in L4 MUST NOT BE TOUCHED AGAIN.

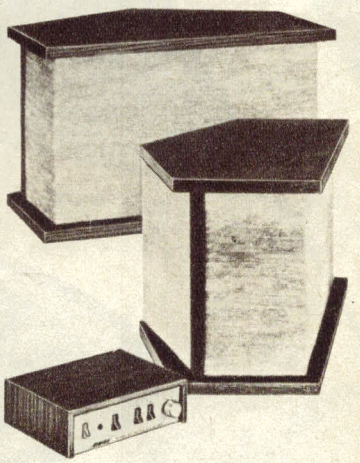
With the dial pointer still in the same position, corresponding to 16MHz, set the band switch to 20-16MHz. Feed in a signal from the generator, set precisely to 16MHz and adjust the appropriate trimmer across L4 for maximum response, followed by peaking of the tuning of L3. If a generator is not available, we suggest that you tune in a station within this range and on a known frequency, and adjust the trimmer across L4 to bring the station to the correct position on the dial.

(Continued on page 190)

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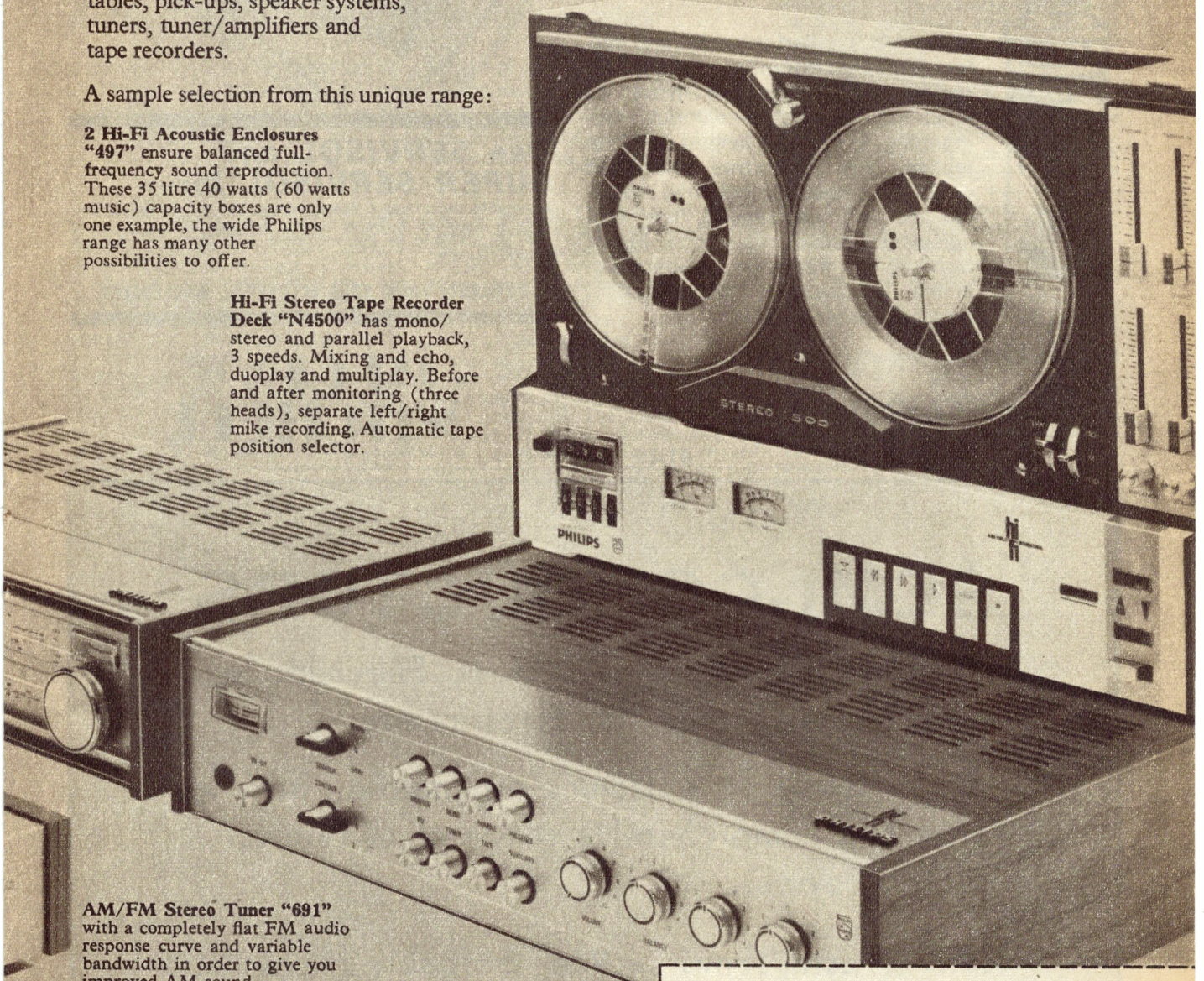
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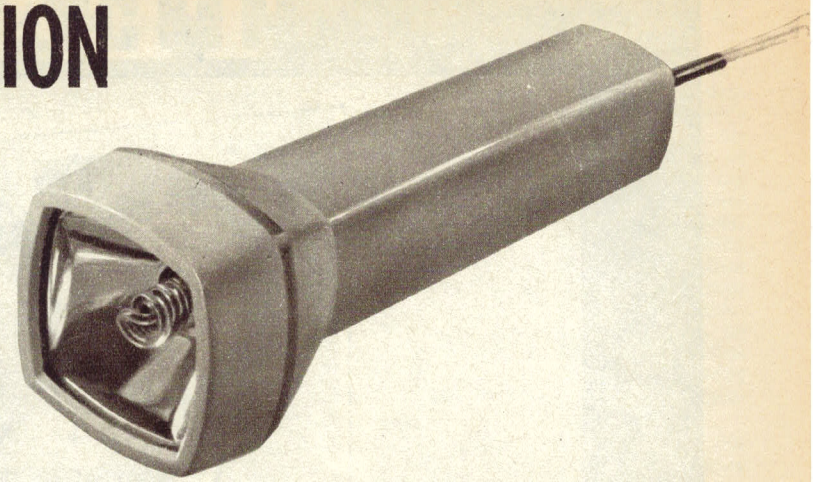
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A LOW-COST IGNITION TIMING LIGHT



Perhaps one of the simplest projects we have ever described, an ignition timing light nevertheless plays an important role in optimising the performance of the internal combustion engine. Its use, coupled with a little "know how," permits timing adjustments to be made easily and accurately with a minimum of effort.

By Alan Nutt

In February, 1961, we described an ignition timing light using a small neon pilot lamp as the active light source. While this lamp performed as required, its light intensity left a great deal to be desired and it was, in fact, quite difficult to use under normal ambient light conditions.

The difficulty was compounded somewhat when the light had to be poked well down into the "works" in order to shine on the timing marks located on the flywheel of most earlier model cars. Even when used with more recent models having the timing mark located on the crankshaft fan belt pulley, operation was still far from ideal.

Obviously, a lamp having a higher intensity flash was required so that, even when held some distance from the timing mark and operating under fairly high ambient light conditions, sufficient reflection could be obtained from the timing mark surface.

Just such a lamp is available and, in fact, has been for some time, although only recently has personal necessity made its incorporation into a project possible.

The lamp we have used is one developed specifically for timing light applications and consists of a helical glass tube filled with neon gas under moderate pressure. Because the gas is under somewhat higher pressure than normally encountered in indicator lamps, the breakdown voltage is consequently higher. This, in turn, results in a discharge flash of quite high intensity when used in the normal manner in series with the lead to the spark plug.

Known as type NS102, the tube is available quite cheaply from Circuit Components (A/Asia) Pty. Ltd., P.O. Box 70, Bexley, N.S.W.

Having obtained the tube, the only other requirement is to mount it conveniently. We chose to use a cheap plastic torch housing which, in addition to providing an insulated holder, also provided a very satisfactory reflector, thereby further enhancing the light output.

Almost any holder can, in fact, be pressed into service although the one we chose used a polystyrene reflector which we found could be worked easily, some filing being required in order to accommodate the flash tube. Refrain from fingering the reflector surface at any time and do not wipe with cloth or tissue as fine surface scratches will inevitably result. These tend to impair the effectiveness of the reflector.

We removed the original globe mount and enlarged the hole so that the helical section of the flash tube would pass through easily. The straight section of the tube we slid into a 2in section of plastic radio coil former having a diameter of about ¾in, the tube leads passing through a pair of holes drilled in one end.

The whole assembly was then cemented on to the rear of the styrene reflector with just the tube helix projecting into the reflector proper. The connecting leads are required to withstand the full ignition voltage and, for this reason, standard ignition type cable is recommended, although we used some inner conductor from coaxial cable which happened to be on hand.

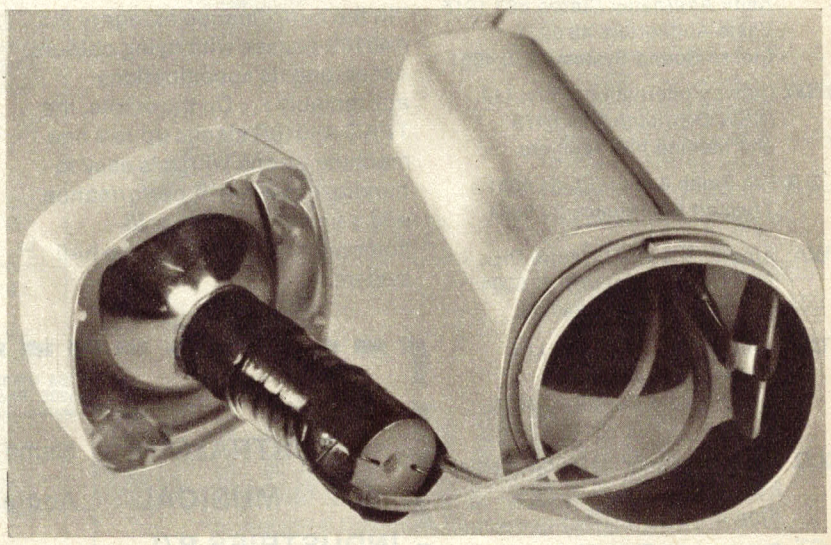
The cable will need to be anchored securely at the tube end to prevent any strain being transferred to the tube itself, which should be treated as fragile. We chose to tape the cable to the former housing the tube although some form of mechanical clamp could be used to advantage if the light is to be used often in a commercial situation.

The far ends of the connecting cables are terminated on opposite ends of a 2in length of styrene or perspex rod, one end being drilled and tapped to take a standard spark plug screw and the other fitted with a Utilux H120 plug cap. Ensure that at least 1in of clearance remains between the ends of the rod after the hardware is fitted, otherwise a breakdown may occur along the rod rather than through the tube.

For those contemplating a device of this type, a description of its use is probably quite redundant but, for the sake of the amateur mechanic who may be a little unfamiliar with its use the following information is provided:

The tuning of a car engine is a skilled job and must be left to those familiar with its intricacies. The engine timing, however, although part of the overall tuning procedure, is relatively simple and, in fact, is one of the very first tasks undertaken during a complete tune-up.

A workshop manual is a very useful aid in determining the setting of plug



The interior of the timing light, showing the method used to support the flash tube and terminate the leads. The coil former used to house the tube is cemented to the styrene reflector.

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and distributor points and also for the exact procedure to be followed in setting the timing. Prior to any timing adjustment being made, the distributor points should be examined and either replaced if worn or reset to the recommended gap. The plugs likewise should either be renewed or cleaned and reset.

It is a wise precaution when working on engines having the timing mark on the crankshaft pulley to remove the fan belt. Not only does this simplify access to the timing mark area but it removes the very real danger of damage or injury caused by the fan blades. During testing the blades may appear stationary because of the strobing effect and this illusion can be very powerful.

The ignition timing is normally refenced to the number one cylinder. The timing mark on either the flywheel or crankshaft pulley will coincide with its respective reference pointer or mark when ignition in the number one cylinder occurs at the correct point of the piston cycle. The exact point will vary from model to model but in a late model Holden, for example, will be some 5° before top-dead-centre.

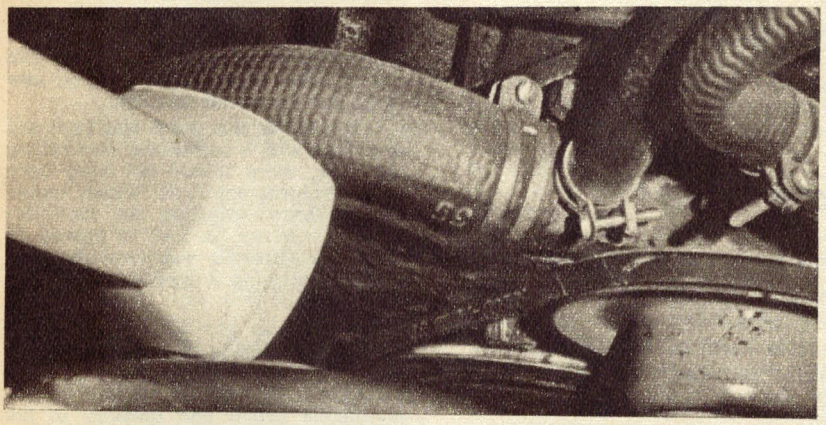
This figure in itself is not of particular interest, the important thing being the adjustment of the ignition timing by rotation of the distributor body until the timing mark and its reference point coincide at the moment of ignition.

As the timing light is connected in series with the HT lead to the number one cylinder, it will flash each time number one cylinder fires. The flash is used to illuminate the timing mark area and will show the relationship of the moving mark and its reference point at the moment of ignition. If the marks do not coincide, ignition is occurring too early in the cycle (advanced) or too late in the cycle (retarded) and the distributor will have to be adjusted accordingly until they do, then locked in the correct position.

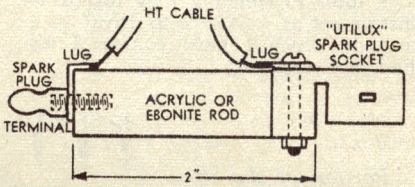
This check is conducted with the engine running at idle speed, usually around 400rpm. To prevent any misleading effects, the hose from the vacuum-operated advance mechanism should be disconnected during this adjustment. When completed, the hose should be reconnected and the operation of the mechanism checked.

As the engine speed is increased, the timing mark will appear to move in the opposite direction to the rotating shaft, taking up a position some 6 or 7 degrees from the original reference point at about 800rpm, increasing to around 30 degrees at 3,500rpm. The exact figures will necessarily vary between models and should, ideally, be checked in a maintenance manual.

Although this instrument will be used by the average motorist only a few times a year, the low cost and ease of operation will make this timer a very useful workshop accessory. ■



The timing light (left) in use. The reference markings on the engine block are just visible behind the fan belt. It is strongly recommended that the fan belt be removed, thus permitting a better view of the markings, and closer working with the light without risk of damage or injury to the operator.



A simple assembly to terminate the two HT cables. It clips on the number one spark plug.



The high intensity neon lamp on which the timing light is based. It is connected in series with the spark plug lead.

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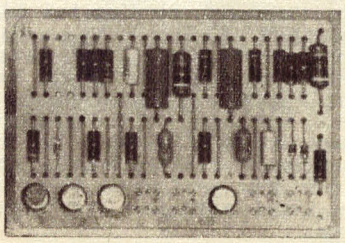
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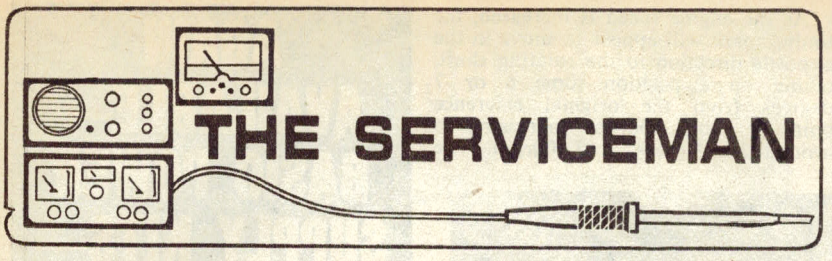
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Jobs the other fellow gave away

What do you do when faced by a fault which everyone else has given up as being "too hard"? Assuming reasonable competence on the part of those who have given up, it is fair to assume that it must be some kind of a "stinker." It is against such a background that this month's stories, concerning a couple of curly TV faults, are presented.

A recent experience by a colleague not only produced some interesting technical stories in their own right, but also indicates the value of using the right instrument to track down a fault when the conventional techniques have failed.

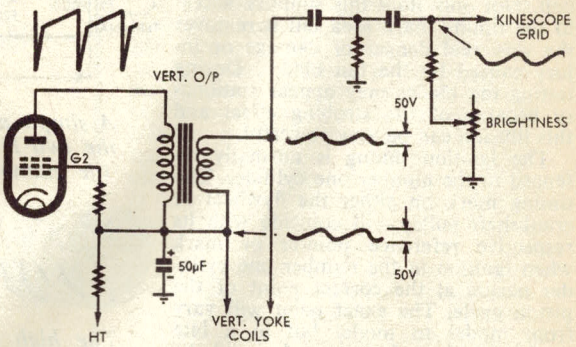
My colleague, who has contributed stories to these notes on several previous occasions, is in fact only a part-time serviceman. He is normally employed at engineering level in a quite different field of electronics, but he works several nights a week and at weekends for a large service organisation. He regards both the additional remuneration and the practical servicing experience as extremely valuable. And, because he has earned something of a reputation as being able to solve the hard ones, he usually finds that all the hard ones are saved up for him. A nice compliment of course, but one which he views with mixed feelings at times.

The first set was a current model 25in type, probably less than 12 months old. The customer was complaining about vertical retrace lines visible in the top two thirds of the picture, plus a noticeable flattening of the top of the picture. Before the set was passed over to my colleague two regular members of the staff had already spent a couple of days trying all the routine possibilities suggested by such symptoms, all to no avail.

This included the replacement of the capacitors in the vertical blanking network, a number of capacitors in other likely parts of the circuit, measurement of all the likely resistors, checks for shorted turns in the yoke and vertical output transformer, and measurements of peak-to-peak voltages on a VTVM. All of which had taken a good deal of time.

Not that this time was necessarily wasted. Because all the routine tests had been made it was not necessary for my colleague to repeat these. On learning what had already been done he could fairly assume that the fault was a subtle one and bring his "heavy armament" into the fight.

His heavy armament is the CRO. My colleague is a great believer in the CRO, and never looses an opportunity to give examples of how it has enabled him to locate faults which seemed to defy all other approaches. He also expresses some concern that the other service staff in this organisation seem unwilling to adopt the CRO as a service tool. Presumably they regard the instrument as "too hard to drive" — an attitude which I must confess I also find very surprising.



Portion of the circuit involving the retrace line fault. The waveforms measured at both ends of the vertical transformer secondary give the clue to the fault.

Thus it was that the CRO was brought into the job immediately. The first check point, fairly logically, was the plate of the vertical output stage. (See circuit diagram.) This revealed an apparently normal trapezoidal pattern, or as nearly so as could be judged from a preliminary examination. Also, the peak-to-peak voltage appeared to be within normal tolerances.

Next point was the secondary of the vertical output transformer, feeding direct to the yoke. Here it was a quite different story. The waveform was nothing like a trapezoid, being more like a sawtooth, with somewhat rounded teeth and much reduced in amplitude. This provided a clue as to why the retrace blanking had failed, since there was no spike to generate a blanking pulse. On the other hand, it posed another question. If the waveform was really this bad how come the height and linearity of the picture was almost normal? Granted, it had some compression at the top but the rest of it was quite good, much better than one would expect from such a waveform.

The solution came almost by accident. While pondering on the seeming anomaly of all these observations, my colleague was prodding idly at various parts of the circuit with the CRO probe. He happened to put the prod on the other end of the vertical output transformer secondary, the end which was commoned with the primary winding and connected to the HT supply. Lo and behold, here was another waveform, similar to that at the opposite end of the secondary; roughly saw tooth, but somewhat rounded.

Inasmuch as this point was bypassed to chassis with a substantial electrolytic capacitor, there should not have been any waveform apparent. Which immediately threw suspicion on the electrolytic. And so, in fact, it proved to be. The electrolytic was virtually open circuit. Replacing it cured all the problems.

However, as my colleague pointed out, it is interesting to speculate on the reasons for some of the symptoms. In particular, why did the picture exhibit reasonable height and linearity in the face of such an apparently inadequate waveform?

The answer is that the waveform being supplied to the yoke WAS normal or, at any rate, essentially identical with what was present in the primary. The reason for this was that the yoke was connected to both ends of the transformer winding, not between the "hot" end and chassis, the two points between which the CRO measurement had been made — and also between which the blanking voltage was developed. Thus both the CRO and the blanking circuit were presented with the distorted saw-tooth waveform, while the yoke was fed with an almost perfect trapezoid.

I say "almost" because it is pretty obvious that the failure of the bypass had had some effect on the waveform generated in the plate circuit of the vertical output valve. It was this that caused the slight cramping at the top of the picture.

My colleague's next story also concerned a TV set, a much older 21in model this time. The main complaints were pronounced blooming, lack of brightness, and a general degradation of the picture in a manner which the customer found difficult to explain but which, as it subsequently turned out, was due to poor AGC action. Weak signals tended to produce pictures with more noise than they should have had, while strong signals created video overload and distorted tonal range.

The story had really started several weeks earlier, when the set had been the subject of a field service call. Ex-

actly what had been the symptoms on that occasion, or what repairs had been carried out, was not precisely known. It was perhaps unfortunate that the particular field serviceman who had done this job was notorious for his unwillingness to fill out the service forms in sufficient detail. He was usually content to simply list the description and number of components replaced, without any details as to their position in the circuit. Which was what he had done in this case, a matter of some significance as it ultimately transpired.

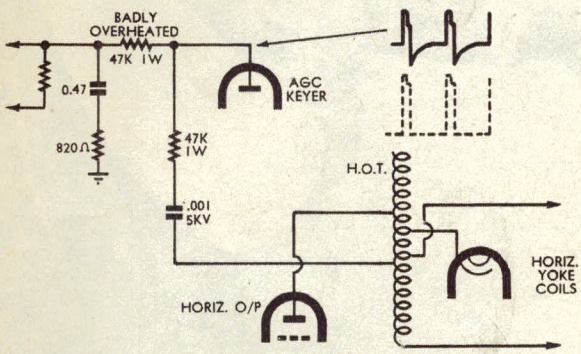
As before, several man-hours had already been spent on the set before it was handed over to my colleague. Items which had been checked included the yoke (by substitution), the EHT transformer (by substitution), all the capacitors in the boost and AGC circuit (by replacement), the flyback resonating capacitor, the capacitor across the yoke winding (by replacement), the EHT rectifier, the damper diode, the horizontal output valve (by substitution), the drive to the horizontal output valve (measurement by VTVM), and even the continuity of the EHT rectifier filament circuit — the winding, series resistor, etc. All this, together with routine voltage measurements had yielded only one clue; the fact that the boost voltage was only 400V instead of the 700V it should have been. But why, no one could say.

So my colleague fired up his trusty CRO and set to work. His first check point was the plate of the AGC keyer valve, which seemed a logical starting point for two reasons. In the first place it seemed fairly obvious that there was something wrong with the AGC system and, secondly, this is a handy point at which to make an observation of the horizontal output pulses. While, in theory at least, it should be possible to observe this waveform at the plate of the horizontal output valve, the peak voltages involved are such as to make such a measurement awkward to say the least. Unless a specially designed probe is used, there is a very real danger of damaging the probe and the CRO.

It was immediately obvious that something was wrong here. Instead of the classic waveform (shown dotted in the circuit) there was a more or less normal positive spike followed by somewhat rounded negative spike. Also, the amplitude of the two spikes together, i.e., the peak-to-peak voltage, was approximately the same as one would expect from the normal positive spike. Which was another reason why the previous technician had been unaware that there was anything wrong; he had been content to measure the voltage with a VTVM and was satisfied when this indicated an approximately correct peak-to-peak voltage.

My colleague's interpretation of the waveform was that something was wrong with the time constant network in the AGC valve plate circuit; a .001 capacitor and a 47K resistor. And the most likely component in my colleague's view would be the .001 capacitor, probably "gone leaky." Which was a nice theory, but it didn't work out. A test on the capacitor indicated that it was normal in all respects.

Nevertheless, he was convinced that there was something wrong with the time constant; something that also appeared to be loading the EHT system to the point where it was unable to deliver an EHT voltage adequate in either amplitude or regulation. So if it wasn't the capacitor, what else could it be? Closer examination showed that the 47K resistor in the AGC line (i.e., in series with the .47 capacitor and the 820 resistor) was running very hot. While it is normal for this resistor, and its mate the other 47K, to run moderately hot, this one was sizzling. All colour code markings had been destroyed.



The clue to this fault lay in the waveform at the keyer valve plate, which should have been as shown dotted. Note also the overheated 47K resistor.

Its mate appeared to have fared somewhat better. While it had apparently run hot enough to discolour the code markings, it was not nearly so distressed. In any case, colour codes or no colour codes, it was time to measure these resistors. Strangely enough, the very hot one proved to have a normal value, it was the not so hot one (in series with the .001 capacitor) which produced the surprise. It measured a mere 3.9K.

Small wonder that the time constant was all wrong and the EHT system overloaded. In fact, amost all the components in the AGC circuit must have been embarrasssed to some extent by the increased current flow which this permitted.

Needless to say a new resistor of the correct value, plus a new one to replace the overheated one, put the set back into normal operation.

How come the 3.9K resistor? Apart from the fact that it was obviously a result of the initial field call, no one is quite sure. My private opinion is that the original resistor had failed, but the serviceman was unable to replace it with the correct value because he had allowed his stock to run out. Instead he elected to substitute a 39K, on the basis that it would be near enough. Instead, due to any one of several reasons, he actually fitted a 3.9K. Thus he made two wrong moves; one deliberate and one unintentional.

The result must set some kind of a record for what it cost the service organisation.

In somewhat lighter vein, here is a brief story from a reader, also a serviceman, who makes the point that not only is the customer not always right but that, even when proven wrong, he will seldom admit it. He goes on:

"A customer called me in to cure 'snow' in his television picture. The cause was obvious — his so-called antenna happened to be a coat-hanger attached to a picture-rail. The line to the receiver was a piece of twin flex attached to the coat-hanger with hairdressing clips.

"I failed to convince him of the necessity for a properly designed antenna. He expressed a very decided opinion that the television industry had introduced aerials as another means of fleecing the public. Furthermore, 'a very knowledgeable mate of his had recommended a coat-hanger.'

"He called me again about 12 months later for an unrelated fault and I was surprised to see that he had installed a respectable antenna. As I would have expected, his picture was now free of snow.

"I asked him why he had changed his mind and he said that, after paying two other technicians who expressed similar opinions to mine, he thought there must be something in our theories!

"But he had the last word. He insisted that he couldn't see much improvement in the picture."

R. M., Wentworthville, N.S.W.

Just one point about the above story. While good for a laugh among fellow servicemen, I trust it will not create the wrong impression among any of my younger readers who may aspire to become a serviceman. I am sure that R.M. would be the first to agree that, at least to his face, the customer IS always right. (After all, he pays your wages.) If his appreciation of technical points is confused, by all means do your best to put him right, but learn to do it diplomatically, and in a manner which will not embarrass him. That way you'll have a satisfied customer for life. ■

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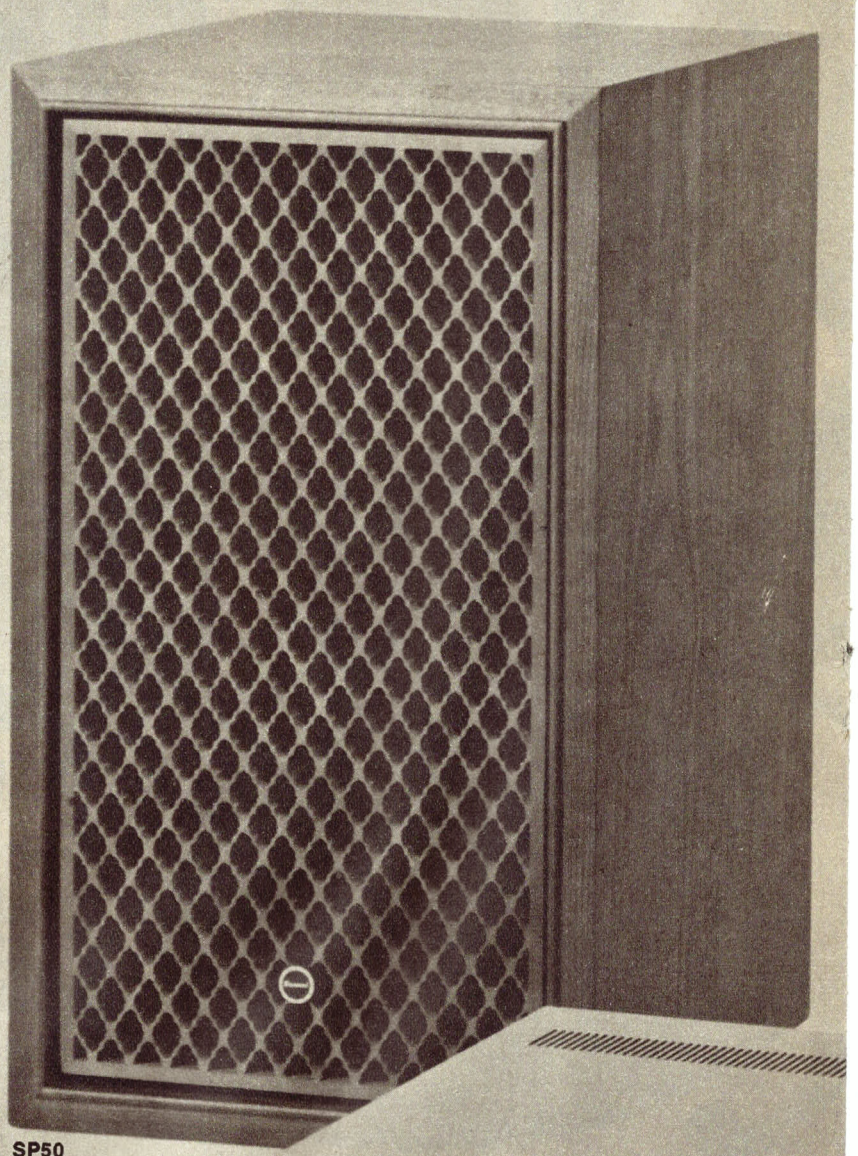
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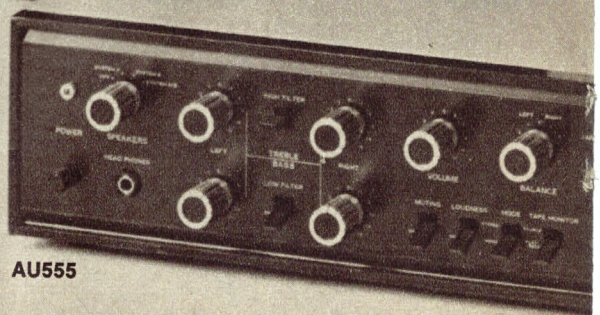
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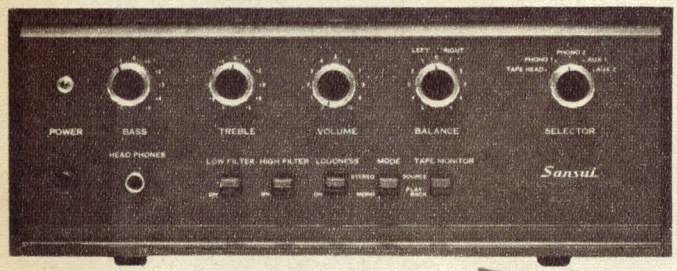
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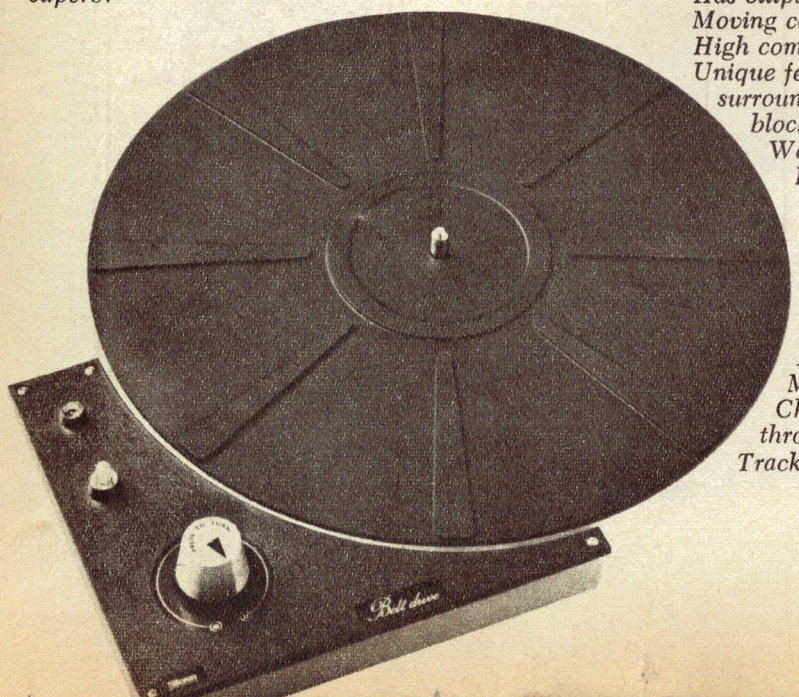
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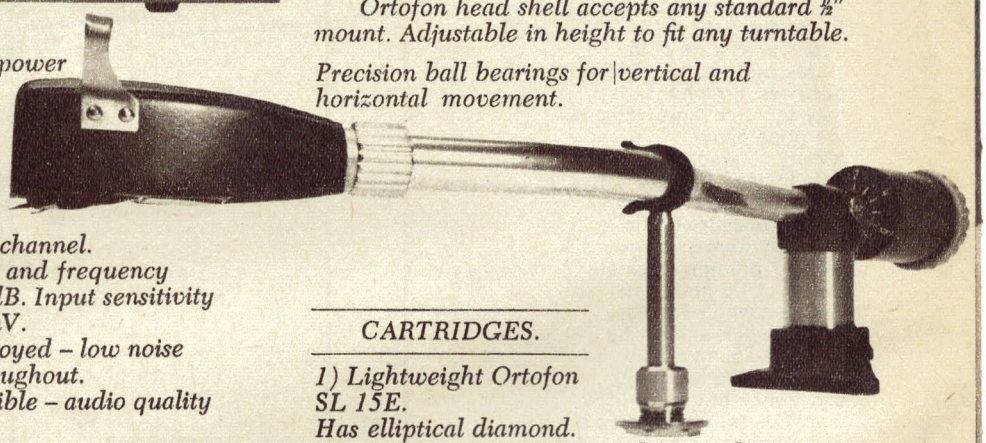
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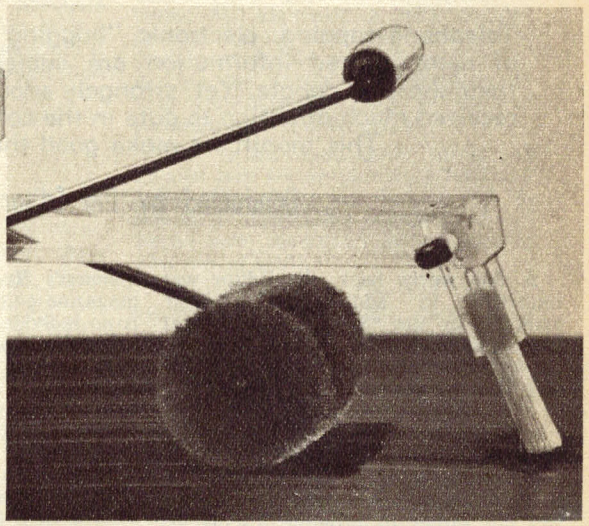
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FORUM

Is electronics endangering privacy?

Telephone tapping, electronic "bugging" and the privacy of computerised information are subjects which attract their share of debate. Yet, strangely enough, they have not received much attention to date in the columns of "Forum." This month we make good the lack.

Conducted by the Editor

A few weeks back, the Editor was requested to address a seminar arranged by the *Soroptimist Club at North Sydney. The subject for discussion was "The Infringement of Private Rights" and the Editor was asked to indicate areas where privacy might — or might not — be affected by developments in the electronic field.

His remarks were not intended to provide a complete survey of the subject but rather to promote discussion. They may possibly serve this same purpose here:

I would like to consider the topic under four main headings:

1. **Direct access** to the brain by electronic means. In broad terms, this would mean either the ability to "tune in" to what a person is thinking or to inject thoughts into their brain electronically, without utilising their normal senses.
2. **Telephone tapping:** The connection of equipment to a telephone line to enable an eavesdropper to monitor or record all conversations on another person's telephone.
3. **Bugging:** A rather unpleasant word describing the technique of hiding a microphone and associated circuitry in a room to enable a person elsewhere to listen to conversations in the room.
4. **Computerised Information:** The storage in computer systems of personal data, so comprehensive, so organised, so accessible that it poses a potential threat to the privacy of the individual, in the accepted sense of the term.

Looking at these points, in turn, the first one has to do with direct access to the brain by electronic means.

From time to time, members of parliament, the police, the Postmaster General's Radio Branch — and even magazine editors — receive complaints from individuals that their thoughts are being monitored, perhaps by the people next door, or perhaps by a relative who has a grudge against them. As often as not, they list circumstances which seem to prove that their thoughts are being "tuned in." If the offending person happens to be an electronics expert, a television serviceman, a radio amateur, or even a keen short-wave listener with a large aerial in his backyard, this is advanced as evidence of his ability to do what he is supposed to be doing!

Sometimes the complaint takes the opposite form — that somebody is using electronic equipment to inject into the complainant's mind thoughts that are foreign to their nature. Worse still, they are sometimes prompted to say things or do things that are quite uncharacteristic of their normal behaviour.

They want to know what precautions they can take against this illicit intrusion into their thought patterns. Or whether the particular authority can put a stop to such scandalous use of electronic equipment.

Let me say emphatically and without equivocation that there is no technical foundation for such complaints.

It is true that operation of the human brain involves electrical potentials.

It is true that many people believe in extra-sensory perception, or the direct transfer of information or stimuli between individuals who are seemingly isolated one from the other.

But it is not true that electrical apparatus exists which can transform electrical thought patterns in the brain into words, whether in the form of sound, of printing, or of any kind of recognisable code.

Nor is it true that any apparatus exists which can inject actual thought patterns into the brain, without involving one of the senses.

As an indication of this, one has only to consider the diligent efforts which specialists make in hospitals to diagnose and treat mental problems using electro-encephalography. In such a situation, a large number of electrodes may be attached to the patient's scalp, with wires running away to large and complex machines and to pen recorders which trace, on a long paper strip, the electrical wave patterns in different parts of the brain. The specialists can see whether the patient is relaxed or disturbed; they can note the patient's overall reaction to various stimuli or to various treatments but they certainly cannot say that the patient is thinking this or that about so and so. Nor can they feed signals into the electrodes and have the patient "hear" speech or music or "see" pictures.

You may rest assured that if specialists cannot examine thought processes directly — something they would dearly like to do — using highly sophisticated equipment and wired connections to a patient's skull, there is little room to believe that a next-door neighbour can do it, using a mere radio link.

It would be a very presumptuous person indeed who would say that it will never be done, but I am prepared to say that it is quite beyond the scope of present knowledge and technology.

People who lodge complaints of the type I have mentioned undoubtedly have a problem — but it is psychiatric not electronic in origin! For the time being, at least, we need have no worries about possible invasion of privacy on this plane.

Wire tapping

Turning now to telephone tapping, this involves, in its most elementary form, clipping a couple of wires to a subscriber's line anywhere between his actual instrument and the exchange which serves his area. Once having made the connection, an eavesdropper, using a pair of headphones, can listen to conversations on the line — at least for as long as he can remain at his post.

If he has sufficient access to the system, a wire tapper may go one better and establish an illicit link between a subscriber's line and one that leads to a more convenient listening point.

In fact, he could conceivably go one better again and connect the line under surveillance to a tape recorder which operated only while an actual conversation was taking place. With a voice-operated recorder, there are no long, silent lengths of tape to check. The conversations are all neatly recorded, immediately one after the other, ready for the eavesdropper to examine. Very neat and very convenient!

**Soroptimist International is an association of classified service clubs for women. Secretary of the Divisional Union of New South Wales Soroptimist Clubs is Mrs Jean Gleeson, 30 Ivey Street, Lindfield, N.S.W. 2070.*

Unfortunately for wire-tappers, if a subscriber becomes suspicious, actual connections to his line can be spotted fairly easily by telephone investigators and can lead them to the culprit. This has brought to light a much more sophisticated method which involves connecting a special radio transmitter to the subscriber's line. This causes the speech on the line to be transmitted as a radio wave, which can be picked up by a suitable radio receiver in the vicinity. Even if investigators find the transmitter, they would have a much more difficult job to find the eavesdropper and his receiver.

A few years ago, this would not have been very practical, because radio transmitters were necessarily bulky and had to operate either from the power lines or from relatively large batteries. Nowadays, with transistors and other miniature components, a transmitter can be made match-box size, or thimble-size and operated, if need be, from the voltage on the telephone line itself. And it is no problem at all to provide a receiver, which may typically be a portable AM/FM transistor set or car radio, at most slightly modified.

There would seem to be little doubt that authorities in all countries of the world do their share of telephone tapping in the cause of security and law enforcement, using little-publicised legal powers. Equally, there seems little doubt that such powers are more "elastic" at times than they are supposed to be — a subject that has often been raised in parliaments, in courts and in other places of debate.

Over and above such "official" situations, one would gather from articles and testimonies that quite a few people have made something of a career of wire-tapping, particularly in the United States. Such a career is most practical if the person concerned has a job in the telephone company or authority. He is able to gain an intimate knowledge of the whole system and has the opportunity of making illicit installations while ostensibly going about his normal duties.

However, many a telephone tap has undoubtedly been installed by people posing as telephone mechanics, or as any other kind of tradesman who seemingly had reason to be in a particular place. For such people, the telephones most easily accessible are those in blocks of flats, home units and small-to-medium sized business premises. In such places, street cables meet the internal wiring at a common terminal block, often in some out of the way corner of the basement or foundations. To an experienced operator the job of locating a particular line and introducing a tiny transmitter poses no great problem.

One might conclude from this that telephone circuits are not as private and inviolate as we might wish them to be. Certainly there is good reason for discretion by telephone users upon whose conversations some premium is likely to be placed. One might mention national leaders and diplomats; executives of financial, commercial and industrial institutions; people involved in espionage and counter espionage; people involved in crime and those who combat crime; even in divorce and other such proceedings, where the parties have purses to match their motives.

Where discretion is not an adequate answer, modern electronics has provided a counter to the wire-tapper by devices which "scramble" the speech before it is fed to the telephone line, rendering it quite unintelligible to the eavesdropper; at the other end, another similar device unscrambles the speech, rendering it intelligible again.

Having said all this, however, I don't think that the average person need have too many fears about their telephone line being tapped. If a conversation is overheard, it it much more likely to be by accident, by a quite uninterested party, due to a technical malfunction. People need to have strong motives to get involved in deliberate eavesdropping.

A dishonest telephone technician, or an operator who has insinuated himself into such a position is not likely to risk his job for a few dollars. He will be looking for a reward commensurate with the risk of detection. Similarly, an inquiry agent is not going to trespass into basements, interfere with street wiring or climb telephone poles without a substantial monetary incentive. Individuals can decide for themselves whether their activities are likely to attract that kind of attention.

Bugging

Now for the subject of bugging — eavesdropping of another kind.

As mentioned earlier, "bugging" involves secreting a microphone in a room in order to eavesdrop on what is going on in the room. Here again, the electronics industry has succeeded in producing microphones which are very small and which might conceivably be as small as the eraser on the end of a pencil. The classic aim is to hide such a microphone behind a picture, beneath the edge of a desk, in a light fitting, in an ornament, or anywhere else where it will remain undetected.

In some cases, tiny wires may lead from the microphone into an adjacent room or closet, where the eavesdropper can listen personally or install a voice-operated tape recorder.

It isn't always practical, of course, to install wiring or to lurk in an adjacent room but this is no great barrier. Instead of hiding just a microphone, the eavesdropper may hide a tiny unit which comprises a microphone, a transmitter and a battery to operate it. The transmitter may typically radiate a signal effective over a few hundred feet.

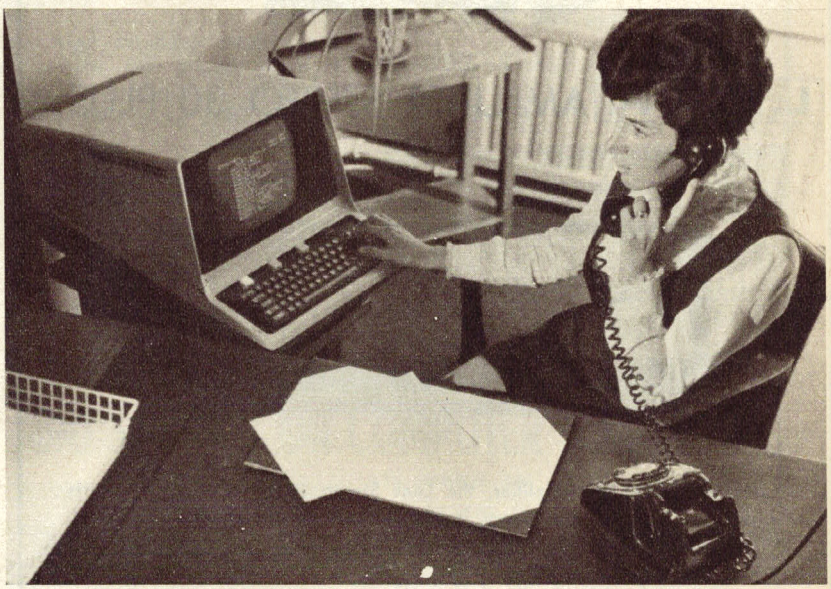
The eavesdropper needs a suitable receiver to pick up the signal but, given a radius of a few hundred feet, he may well be able to find a suitable room, particularly if the building happens to be a hotel or motel. If not, he may have to hand a truck purporting to belong to a TV repairman or an electrical contractor. Parked in the street outside, he can eavesdrop on the signal radiated by the "bug" inside the building, without attracting the slightest attention.

A variation of the hidden "bug" is one so blatant that it is often highly effective, particularly for situations where an executive is scheduled to discuss plans with a closed group of company employees. In one corner, an extra topcoat hangs unnoticed among all the others. Built into it is a "bug."

Or an extra attache case may be there among the others, with a miniature tape recorder taking down all it can "hear."

A highly sophisticated "bug" which has received some mention involves a visit to an executive's office by a man purporting to be a telephone mechanic. He will generally try to coincide his visit with a time when the office is unoccupied. His job is to add some very special extra circuitry to the executive's direct line phone but done in a way that would not be apparent to the inexpert eye. He pronounces the phone as having been checked and takes his leave. And indeed, the phone continues to work in the normal way.

But it now contains an extra facility which the executive knows nothing about. The eavesdropper dials the private (and usually "silent") number



This Marconi-Elliot Videodata 4000 terminal equipment was demonstrated recently at Olympia, London. Connected to a central processor at Essex University, it showed how a patient's medical history could be displayed at a doctor's consulting rooms. What guarantees are there that such centralised records will always remain "private"? (See also "Computerised Medicine for U.K. Doctors," page 27.)

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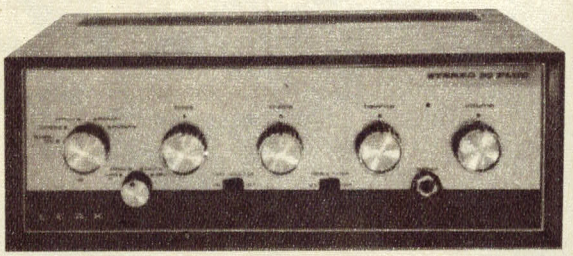
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from perhaps hundreds or even thousands of miles away. He waits for the circuit to connect, but before the bell can ring, he presses a button on a gadget attached temporarily to the calling phone. This sends a special tone down the line and energises the circuit which he has added to the executive's phone. Resting unheeded in its cradle, the phone comes alive and feeds down the line any sound that happens to be within "earshot." At least that is how the gadget is supposed to work.

In the clock-and-dagger atmosphere of political, industrial and commercial espionage, modern electronics has provided not only the means to eavesdrop but also the means to detect hidden "bugs." As often as not, the same firms which supply "bugs" can also offer anti-bugging equipment. The American market, in particular, is well supplied and, depending on one's inclinations, one can be a do-it-yourself mail-order eavesdropper for relatively few dollars or a big-time operator with units costing $1,000-plus each.

The availability of bugging equipment, whether it is actually effective or not, may give the impression that bugging is a very simple operation, widely practised and widely "successful." This is reinforced by what often seems to happen in films and television. Somebody plants a bug in a room and, elsewhere, the eavesdroppers are able to listen to everything that is said as clearly as if it were being reproduced through the latest hi-fi stereo system.

But nothing could be further from reality, as anyone will appreciate who has ever tried to record a conference, an interview or the goings-on at a family party, Even with a high quality tape recorder, a large microphone and freedom to place the microphone in the most advantageous position, it very often transpires that the wanted speech is drowned in a babble of room echoes and other noises which people in the room didn't even notice.

The explanation to this rather surprising circumstance is that people in a room are able to use their two ears and their in-built sensing capacity to concentrate on one particular speaker at a time. Even the eyes play a part in this intuitive concentration. A microphone can't do this. It simply collects all sound into a mixture of signal which thereafter cannot easily be sorted out.

And if this happens to a microphone placed in a position of advantage, in the open, on a table, what chance is there for a sub-miniature unit tucked away in an acoustically bad position?

Bugging does go on but it is generally a time-consuming, therefore costly exercise, with a high chance of being abortive due to bad acoustic conditions, failure of people to converse when and where expected, or the discovery (and confiscation) of the bug itself.

Like telephone tapping, I think it tends automatically to be confined to situations where the stakes are high!

But, in saying this, I must draw attention to those two little words "I think."

One hears stories about bugging and telephone tapping. There are firms listed in the telephone book who profess to be equipped with the latest electronic eavesdropping equipment. Quite recently, one local firm of inquiry

agents made the news pages by announcing that they were going into the business of industrial espionage, on a large scale.

That is one thing but it is quite another to ascertain how much bugging, how much telephone tapping actually goes on in any given city. I don't really know, do you?

Computerised data

Last but not least, we come to the problem posed by the storage of vast amounts of personal data in computer systems throughout all technologically advanced nations.

I think the point should be made that the storage of personal data is, in itself, not new. For generations, a lot of information about individuals has been held by various government instrumentalities — the electoral authorities, the Registrar General's Department, the Taxation Department, social welfare, employment service, and the military authorities — to mention those which come most readily to mind.

Banks, insurance companies, lending groups and such like hold a lot more personal information. There are medical records held by doctors, hospitals and other institutions. And, for good measure, we can add the information held by local government bodies, various licensing authorities, and so on.

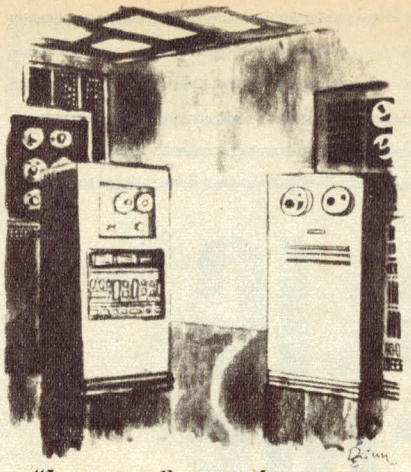
Some of this information would be embarrassing to the individual if it were published or even communicated from one file to another. In the past, however, we have not worried overmuch about this happening. There has been a strong tradition that such information is confidential to the authority or group concerned and this has provided some basic assurance. But more practically, information which is written in books or typed on to cards by the cabinet-full is so bulky, so inaccessible to other than the immediate user, and so difficult to transfer from entry to entry, that there is little chance of it gravitating into a common record system.

However, in recent years, there has been a concerted move by many of the authorities and groups I have mentioned to computerise their records. There is nothing sinister about this. With a rising population, a rising tempo of business and rising labour costs, they have had to introduce more efficient means of storing and processing data — or information — and, in most cases, this adds up to the use of computers and computer methods.

It is interesting and relevant to observe that this reorganisation has not been done by "old-fashioned" employees simply translating a multitude of old-fashioned business entries from books and cards on to reels of computer tape.

Inevitably, the transformation has been effected by people newly trained or re-trained in modern data processing techniques. Not only has the information been transferred to computer storage but in the process it has been re-organised to ensure uniformity, accuracy and the greatest possible speed and ease of access for those who need it.

One doesn't need to be told about the computerisation of business activities that is already in evidence. Your



"I must tell you about some of the data I got today!" (With acknowledgments to RCA "Electronic Age").

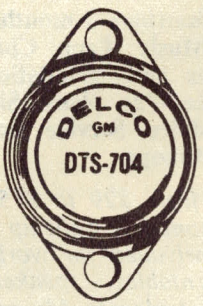
gas account, power account, bank statement, superannuation statement, salary cheque, and a variety of other documents already bear that impersonal, automated look that indicates that they have come from a computer controlled system; a system which knows you and your affairs only as a pattern of impulses on a magnetic tape.

Even the highly personalised doctor's record card is on the way out, the data being stored instead in a computer's memory system. Pilot schemes are already in operation in various parts of the world where a doctor, requiring your medical record, simply punches your name on a gadget on his desk, very similar to those in airline booking offices. But, instead of seat reservation data appearing on the screen, your medical history is displayed. If the doctor wants to add something to it, he types it straight in, as does an airline booking agent, the new entry being added instantaneously to the computer's memory.

Doctors using such a system do not own their own computer. They merely have a terminal connected by telephone line to a central computer which stores and processes the information. The system is programmed — at present anyway — so that medical records pertaining to a practice are available only to that practice.

However, with large numbers of doctors using a central computer, it would be a very simple step, technically, to modify the operation so that each indi-

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vidual doctor had access to each individual patient's medical history. Hospitals, too could easily be given the same access.

Who is to say that, with multiple access now possible, someone is not going to come up with a powerful argument that it should be given effect to. It might be argued, for example, that if a person collapsed in an environment where he was not known — in any city of the nation — it would be easy to assess his medical history and thus prescribe the most suitable treatment.

But the implications do not stop at this point.

For example, there is no technical reason why the Department of Motor Transport should not also quiz the medical records and refuse a driver's licence to any one who has a particular disability — one which they might otherwise have tried to conceal.

In fact, there is no technical reason why a medical computer network should not be programmed to alert the appropriate authorities quite automatically if a heart spasm or a fainting fit appears against the name of a person who happens to be a driver of a public transport vehicle.

A good thing? Perhaps so, in some respects. But it is also an intrusion in what we currently treasure as personal information, to be admitted to only if we so choose.

It is also relevant to remember that there are precedents. Even now some aspects of our medical condition are no longer "private." Some diseases are notifiable by law. We are compelled to submit to periodic X-ray examination for tuberculosis. International travel is impossible without certain inoculations. Airline pilots in particular are automatically disqualified by a variety of physical shortcomings.

In fact, the ease with which computerised data can be exchanged means that there is now no technical reason why all the data — not just medical — relative to individuals should not be brought together in a central computer store and be open to any group or authority who had right of access. What was once virtually impossible has become entirely feasible.

And, whereas telephone tapping and "bugging" may be an occasional and a nuisance problem to a limited group of people, the possibility of centralised information storage is something that concerns every individual and reaches right to the core of our social structure.

Logical to ask . . .

Does the State have the right to total information about the individual? Or should individual privacy be preserved in the form we now understand it?

If privacy is to be preserved are there legal safeguards to inhibit exchange of information, now that it can be done so easily?

Will a new social game emerge of living life in such a way as to produce as few entries as possible in the "Big Brother" computer?

Could this lead to a massive black-market in medical treatment and other services, offered on the basis of "keeping the computer out of it."

These are interesting questions to ponder as we enter the seventies. ■



A READER BUILT IT

Battery charger uses automotive diodes

There must be few readers who have not wished for a battery charger at some stage or other. Batteries seem to go flat at the most inopportune times. If you have a TV power transformer on hand, you can build a battery charger for little more than the price of four automotive diodes.

The standard TV power transformer usually has a 12.6 volt heater winding rated at 5 amps AC or more. Using a bridge rectifier the no load DC voltage is about 18 volts peak. With the low forward voltage of silicon diodes such a combination is ideal for a battery charger. The author's unit, which uses a typical transformer made by a local manufacturer, will supply 5 or 6 amps to a "flat" 12 volt battery, falling to around 2 amps as the battery comes up to full charge.

Using half the centre-tapped 12.6 volt winding, the charger delivers around 3 amps to a "flat" 6 volt battery and this drops to less than 1 amp when the battery comes up to full charge. At this low rate the battery can be trickle charged overnight, if need be.

The bridge rectifier is made up from two BYX21L/200 diodes and two BYX2IL/200R diodes. These are automotive alternator diodes costing about one dollar each and having a continuous current rating of 25 amps. The high current rating means that the charger is safe against short-term overloads caused by short-circuiting the DC output or accidental connection of the battery the wrong way around.

While the charger is proof against the short-term overloads just mentioned, the transformer will be overloaded and possibly burnt out if short-circuit conditions are maintained for more than a few minutes. Similarly, the diodes may be damaged by overheating if the battery is left connected incorrectly for more than a few seconds, unless protective measures are taken.

Current limiting can be arranged by the use of a 6 volt 40W headlamp bulb connected in series with the DC output. This will limit the current under short-circuit conditions to around 9 amps from the 12.6 volt winding and 6.5 amps from the 6.3 volt winding. It will also limit the current through the diodes to similar values when the battery is connected incorrectly. In addition, it will enable 6 volt batteries to be charged at a rate of about 5 amps from the 12.6 volt winding.

The lamp should be arranged so that it can be switched in or out of circuit as the need arises. It should preferably be switched into circuit when the charger is initially connected to protect against possible fault conditions. Note that, while the lamp can protect the charger against severe short-term overloads, the transformer will overheat and eventually burn out if subjected to a continuous current drain above about 150 per cent of its AC rating.

The charger should have a mains supply switch in the primary circuit of the transformer installed in the front panel of the unit. The power should be switched off before disconnecting the battery, otherwise there is a serious risk of explosion of the oxygen and hydrogen fumes produced in the battery during the charging process. Similarly, no direct connections to draw power which is likely to create a spark near the battery should be made immediately after charging.

Since the voltage from the transformer secondary is accessible, via the diodes, to human hands, the insulation qualities of the transformer in commercial battery chargers must meet high standards (S.A.A. code C.126). Since TV power transformers are not designed to meet this standard it is unlikely that they will conform. In view of this one side of the secondary winding should be connected to the mains earth as a precautionary measure.

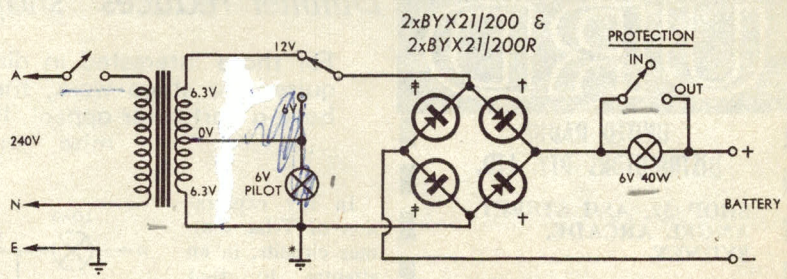
If an earthed metal case is used to house the charger it will be necessary to insulate the case when connected to a battery installed in a car. Seating the charger on a piece of timber or plywood will remove the possibility of an accidental short between the charger housing and the chassis of the car. Alternatively, the connecting leads should be made sufficiently long so that the charger may be placed on the ground during operation.

While the actual construction details are up to the reader, the diodes must be mounted on suitable heatsinks. In the author's case, each pair of diodes was mounted on a common heatsink made from a 3 x 3in piece of 16-gauge aluminium. The diodes were secured to the heatsinks by pressing them into holes drilled a little smaller than the knurled diameter of the diodes. They can be pressed into place using a vice and two short lengths of suitable diameter tubing. Alternatively, they can be mounted using the stud adapters available at about 20c each. The heatsinks must be isolated from the case using stand-off insulating posts.

The battery connectors should be 25 amp crocodile clips which make a safe connection. The connecting cable for the charger out-put should be of heavy gauge to avoid excessive voltage drop. The two switches in the secondary side of the circuit should have a rating of at least 5 or 6 amps.

The author's charger was fitted with curent monitoring facilities. Current monitoring was chosen instead of voltage monitoring as it warns of any overload condition. The meter used was a 1mA movement which was rescaled to read 10 amps F.S.D. A suitable shunt was made from a piece of 24-gauge tinned copper wire about 2 inches long.

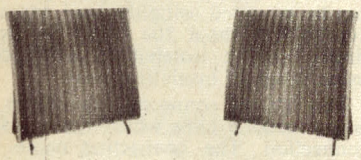
All that is needed to calibrate the shunt is another ammeter of known accuracy. The shunt should be soldered tentatively to the meter terminals. Then the two meters are connected across the charger output in series with the protective lamp. The ammeter should be switched to a current range such that it will not be overloaded. Then it is merely a matter of adjusting the shunt until the two meter readings agree.



(Submitted by: S.D.L. of Berala, N.S.W.)

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A READER BUILT IT . . . continued

Modified windscreen wiper control

The windscreen wiper control circuits published in the June, 1970 "Reader Built It" section, while suitable for most cars, may need modification if they are to be used on some most recent models.

Some late model cars are using a different form of windscreen wiper circuit. The windscreen wiper motors are of the permanent magnet type and advantage is taken of this to provide electromagnetic braking as a means of preventing overrun when the power is switched off. Thus, the cam operated self parking switch is now fitted with two switch functions; one which opens the supply to the motor, and one which short circuits the armature.

(Editorial Note: It is not clear why overrun is a problem with these systems, but we assume that it is a function of the gearing ratio employed.)

Use of the two function cam operated switch means that the dashboard control must likewise be a two function switch (single pole-two position) in order that it can override both functions of the cam operated switch. (Figure 1).

Similarly, any device which is to function in place of the dashboard control, such as an intermittent activating switch, will have to be a similar dual function device. Furthermore, to protect such a device from looking into a short circuit, it is essential that any switching mechanism be so arranged that the short circuit is removed as a first function, before the contacts which apply power are closed.

Perhaps the simplest way of achieving intermittent operation of permanent magnet motors is to use a circuit similar to that shown on page 105 of the June 1970 issue but using a relay with two sets of contacts, one normally open, the other normally closed. In operation, the normally closed contacts must open before the normally open contacts close. The wiring is as shown in figure 2.

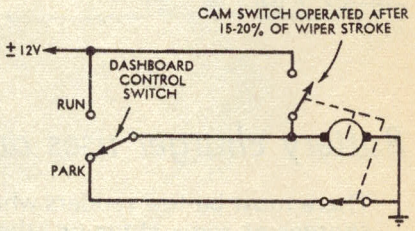


Figure 1

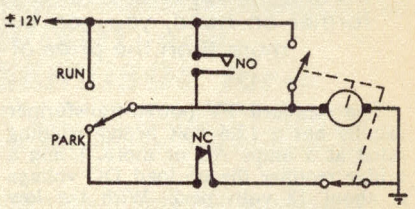


Figure 2

Submitted by Mr G. A. Tidy, Gnaryn Road, Carnegie, Victoria, 3163.

A further comment on this project comes from another reader. As well as commenting on the shorting contact configuration discussed above, he raises another point:

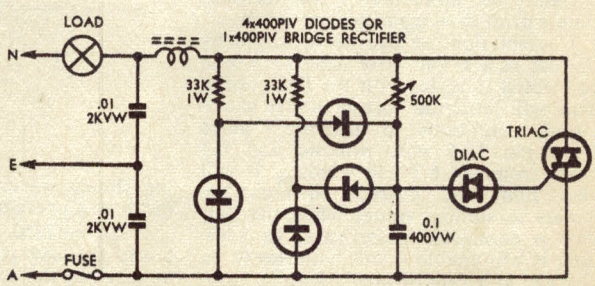
Each time the thyristor fires the motor draws its starting current, which is much heavier than its running current. Repetitive starting over a long period can cause the motor to burn out. To counteract this a resistor (0.5 ohm, 5W) should be fitted in series with the thyristor.

Submitted by Mr N. D. H. Hammond, 1/4 Seaview Street, Waverley, N.S.W., 2024.

Dimmer reduces "snap on"

For those interested in dimmers circuits, especially as required for stage work, the circuit illustrated here should have a particular appeal. It is specifically designed to minimise "snap on" effect.

In my exploration of Triac dimmer circuits, in an attempt to find one which had negligible "snap on" effect (hysterisis), the following circuit was devised. It may be of interest to other readers who have uses similar to mine.



I use these dimmers for stage and theatre work. To compete performance-wise with Variacs and resistance dimmers they must be capable of controlling the brilliance of the lamps

(Continued opposite.)

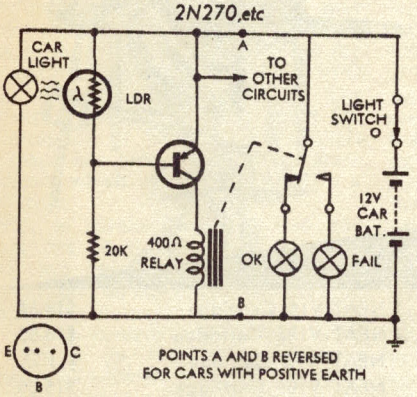
Car Light monitoring circuit

Ever been pulled up by the gendarmes for not showing a tail light? Whether you have or not, it is always a risk. A system for monitoring a car's lighting system should appeal to anyone worried about this problem.

This circuit is designed to monitor car tail lights, head lights, etc., by sensing the light from the lamp with an LDR (Light Dependent Resistor). I believe it is a novel and useful idea which can be built from oddment parts with little expense.

I installed one in my own car several months ago and it has given completely satisfactory service. It has already indicated one light failure.

The basic circuit for monitoring one light is illustrated. It can be duplicated as required to monitor the number of lights selected. Tail lights, in particular, need to be monitored, since it is virtually impossible to detect a tail lamp failure while the car is being driven.



The relay is energised when there is no light on the LDR, in which circumstance the LDR assumes a very high resistance, almost an open circuit. This allows voltage from the negative rail to be applied to the base of the transistor via the 20K resistor, forward biasing the transistor and allowing the collector current to rise to the point where the relay is pulled in. In this position it closes the circuit to the "fail" indicator lamp.

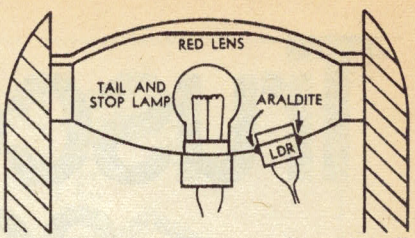
When the LDR is illuminated it assumes a very low value of resistance, effectively connecting the base to the emitter and removing the forward bias. The collector current falls, the relay drops out, and the circuit to the "O.K." indicator lamp is closed. The relay draws about 25mA on "no light" condition and about 5mA when illuminated.

The relay used was a standard 3000 type having two 200 ohm coils. These were connected in series. The transistor was a 2N270, but a large variety from the junk box were tried and found to work almost as well. The LDR was a B8 731 03 (or OPR12). Each cell is located in close proximity to the lamps and does not appear to be affected by the heat. They are fitted by boring a hole in the back of the lamp housing and securing in place with Araldite.

In my own car (FB Holden) I have four such circuits, one for each light. The switching circuits are located under the front seat and the indicator lamps, four red and four green, are mounted on an aluminium panel under the dashboard.

Submitted by: Mr F. Gospanini, 6 Miles Street, Mascot, N.S.W., 2020.

(Editorial Note: The number of circuits required may be reduced by using two LDRs in series, one in each tail light housing, failure of either lamp then causing the indicator to operate. Some adjustment of the 20K base bias resistor may be required in this case or to compensate for normal characteristic spread between individual LDRs.)



Dimmer—continued

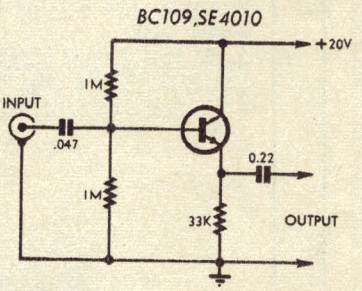
smoothly from completely off to fully on. The normal circuits were not suitable as they left much to be desired in eliminating the snap on effect.

The circuit shown completely eliminates this. It is similar to a circuit in the G.E. SCR manual, but their circuit has only 2 diodes and one 33K resistor in the resetting part of the circuit. This arrangement has the distinct disadvantage of having a discontinuity in brightness at about half range for reasons that would take rather too long to explain. With the 4 diodes and 2 resistors as shown the dimmer will dim from zero to full on and back again smoothly and very effectively.

Submitted by: Mr M. Hood, 14 Crown St, Epping, N.S.W. 2121.

Impedance match by emitter-follower

Recently, the author was faced with the problem of coupling an amplifier with high impedance tape outlet to a tape deck with a somewhat lower impedance output. Since there was not sufficient signal level available to enable resistive matching to be used, the solution to the problem was an emitter-follower using a high-beta transistor.



The input impedance of the resulting circuit is 500K which makes it suitable for use with all tape outlets with impedances up to this figure. The output impedance is such that it is suitable for use with decks with an input impedance in excess of 10K. The current drain is approximately 0.3mA with a 20V supply. The supply voltage may be less than 20V but should be as high as possible to obtain good signal handling capability with minimum distortion.

The circuit can be built into either the amplifier or tape deck with the tape deck perhaps being more convenient as it will probably have a 20V supply or close to it, if it is transistorised. Submitted by S.L. of Lidcombe, N.S.W

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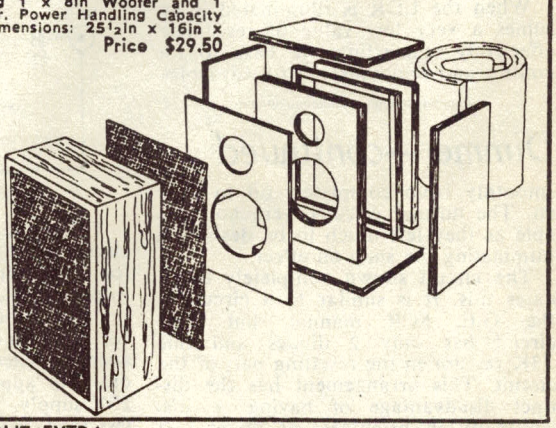
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AUDIO TOPICS

Splicing tapes—their characteristics and use

While tape splicing may be regarded by some as an emergency measure, undertaken only to repair a broken tape, for the serious tape recordist it is an essential skill which must be mastered before any serious editing and similar work can be undertaken.

by Andrew H. Persoon*

In the early days of tape recording, existing pressure sensitive adhesive tape had to be pressed into service for splicing. It quickly became evident that these adhesive tapes were not satisfactory for tape splicing. A proper slice is one that will remain intact for an indefinite period of time; it must be mechanically strong; it must have a minimum of "adhesive escape" around the edges of the splice; and it should not in itself produce any noticeable audio disturbances. While these considerations are quite familiar to recordists, the fundamental procedures which lead to correct splicing are not always understood; and, from the manufacturing point of view, achieving a completely satisfactory splicing tape is not simple.

Any pressure-sensitive tape takes two components into consideration in its design: backing and adhesive coating. While there are many types of adhesive tape on the market, only one set of combinations is truly suitable for the splicing of magnetic recording tape.

The backing for a splicing tape has to be tough and durable while being as thin as possible. Paper is not suitable, so plastic is used instead. Both acetate and polyester backings are currently being produced for splicing tapes.

The adhesive presents other design problems. Three basic adhesive qualities must be considered: (1) Shear adhesion, (2) peel back, and (3) wet grab.

Shear adhesion is the resistance of an adhesive to being parted from its adhered surface by a full force in what is called the shear direction (Figure 1.)

Peel back is a measure of the adhesive's resistance to being peeled away from the surface to which it is adhered. (Figure 2.)

"Wet grab" is an elusive quality. It is more popularly referred to as "thumb appeal" or "quick stick." It is the quality of an adhesive to feel sticky. Oddly enough, it is not an important quality as far as the actual strength of the bond is concerned, but it is a quality readily noticeable by the user. Completely untrue is the statement that the stickier the tape feels, the better the splice.

A tape with high "wet grab" might improve peel back adhesion, but this apparent advantage may result in damage to the equipment and recording tape.

First of all, a sticky adhesive creates a bond on recording tape that produces excess "ooze" which may actually bond one layer of tape to another within the tape reel. The more pressure exerted on the splice, the more probably "ooze." The result might be the complete removal of oxide on the layer of tape above the splice on the reel, or worse, complete blocking of the reel.

Secondly, an increase in "wet grab" decreases shear strength. If this is reduced, the tightly butted ends of the recording tape — essential for an inaudible splice — could "creep" and may leave adhesive on the recorder's heads and tape guides — in addition to the problems already mentioned.

A properly designed splicing tape, then, does not feel "sticky" by intentional design — yet will produce a strong bond.

There are several variations in splice geometry, the right one depending on the conditions of use. Necessarily these considerations include the size of the spliced area and the angle at which tape ends meet each other.

The length of a splice depends on the amount of curvature it will have to sustain in its path from reel to reel. (Figure 3.) As a recording tape passes around the curved surface of a guide, as is shown at (A), there is a tendency for the leading edge of the splicing tape to continue in its original direction, as at (B). In effect, it is attempting to peel itself away from the recording tape, and is an example of one design parameter: Peel back adhesion. Here, the length of the splice has no effect on the tendency to peel, but is important for another reason.

A short splice, as at figure 3, C, may fail if subjected to a tight bend because, if there is a tendency to peel, the area of peel may extend far enough to reach the splice junction, thus freeing one end of the recording tape.

A longer splice solves this problem by extending well beyond the splice junction. Even if the splicing tape tends to peel at a guide, the junction remains undisturbed. Once the tape is wound again on a reel, pressure from succeeding wraps of recording tape secure the splice firmly by pressure.

Generally, this rule of thumb evolves: The smaller the radius of the bend expected, the longer the splice.

As we have mentioned, the tendency to "creep" is dependent on the shear strength of the splicing tape adhesive.

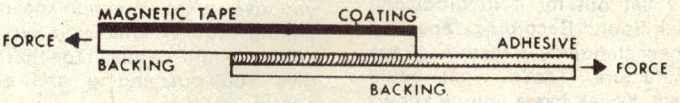


Figure 1. Shear Adhesion (creep).

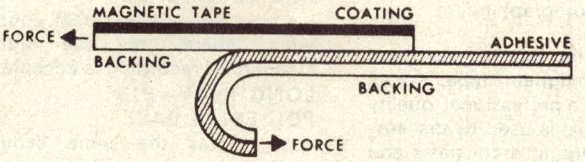


Figure 2. Peel back.

* The author is Technical Director of the Magnetic Products Division, 3M Company.
The article is reprinted from "Audio" by arrangement.

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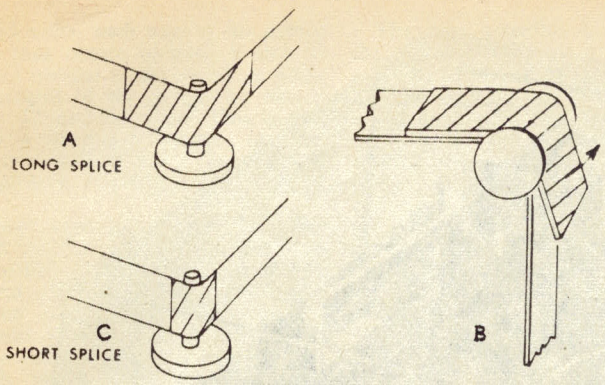


Figure 3. Splicing length and bend radius.

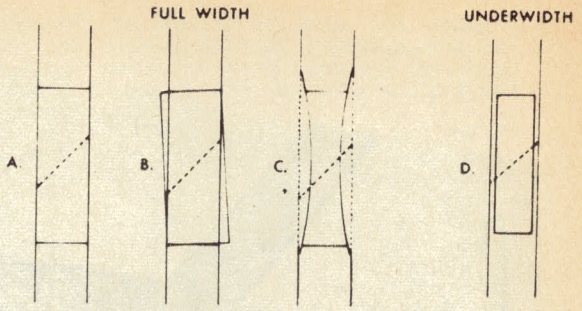


Figure 4. Splicing widths: A. full width, properly executed; B. full width, carelessly trimmed; C. full width, with an arc cut in the sides; D. underwidth splice.

The force that opposes this shear strength is the amount of tension the tape encounters on the transport and while wound on a reel during storage. (Shear strength is constant for a given splicing tape.) If subjected to a constant tension — for example a properly adjusted transport — the variable affecting "creep" is the area of the bond. The longer this area, the better the "creep" resistance.

Carrying this thought further, a splicing tape with a poor adhesive shear strength could be used if the area of the splice were increased. Limited by the width of recording tapes — ¼-inch — the area could only be increased by additional length. A spliced bond of two or three feet would increase shear strength, but would be impossible to execute mechanically. Since program material exhibits a drop in level of 2 to 4dB in the area of the bond, the shorter the splice, the less disturbance during playback. This fact supports the need for a splicing tape with high adhesive shear strength.

Should the splicing tape be the same width or narrower than the recording tape? Several considerations affect this decision.

When using a full-width splicing tape, care must be taken not to overlap the edges of the recording tape being spliced. Adhesive may adhere to adjacent tape layers causing problems similar to those encountered with ooze. While splicing jigs are available which cut an arc into each side of the splice — to eliminate overhang — the possibility of adhesive "ooze" remains.

A narrow-width splicing tape offers a number of advantages with no apparent disadvantages: (1) overlap is eliminated completely; (2) a simple splicing jig may be used, eliminating undercutting; and (3) overall bond area is not materially affected. (Figure 4 shows four examples of full- and under-width splices.)

Ideally, a recording tape to be spliced will be cleanly cut at an angle of 45 to 60 degrees — measured with respect to the tape edge. As the angle increases above 60 degrees toward the perpendicular, the amount of electrical disturbance is increased because the recorder head sees the discontinuity as an abrupt change — producing an annoying pop or click.

A shallower angle produces less disturbance, but as the angle is decreased below 45 degrees, the pointed corners of the recording tape become extremely vulnerable to being peeled back or actually debonding.

Commercial jigs are available which produce the ideal 45-degree splice angle as well as affording a means for an even, clean tape cut.

Cleanliness is probably the most important consideration in making a good splice. Hands especially should be free from oil or dirt as a single oily fingerprint can reduce output several dB. Also, contamination of the backing or adhesive can reduce the strength of the board — possibly inducing bond failure. The cut itself must be executed cleanly using a sharp demagnetised razor blade. When handling the pressure-sensitive splicing tape, care should be taken not to touch the adhesive more than necessary. After carefully aligning and splicing the tape, all air pockets should be removed with the the fingernail to promote a secure bond. ■

"Talking Magazine" for Tape Recordists

The Recording Society of Australia, now in its sixth year of operation, is circulating a "talking magazine" to its members and some overseas tape recordists. The aim is to present a balanced content of technical and general news items, reviews of equipment, recordings and publications, advertisements, and advice on the operation of tape recorders. Editing the "magazine" will be Mr Harry Jay, of Black Rock, Victoria, who is well known in Australia and overseas for his nature recordings.

The Recording Society of Australia is at present established only in Victoria, where it organises monthly meetings for its members, and social functions. Monthly meetings are normally held at 10, "The Crofts" (off Punt Road), Richmond. Further information about the society's activities can be obtained by writing to the president, Mr Harry Jay, A.P.S.A., A.I.A.P., 5 Iona Street, Black Rock (phone 99 4185); or the treasurer, Mr Len Burge, 204 Lower Plenty Road, Rosanna (phone 45 2366).



Mr Harry Jay, with one of the "talking magazines" which he edits and circulates to members of the Recording Society of Australia.

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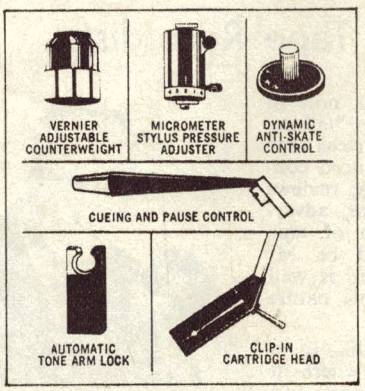
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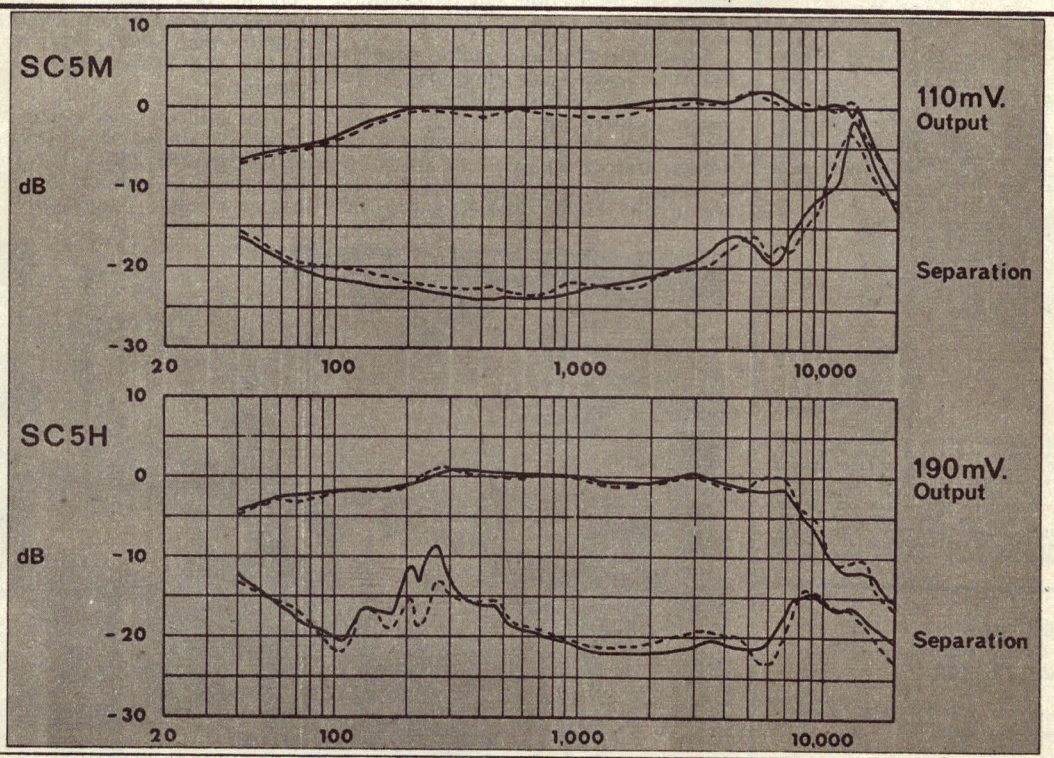
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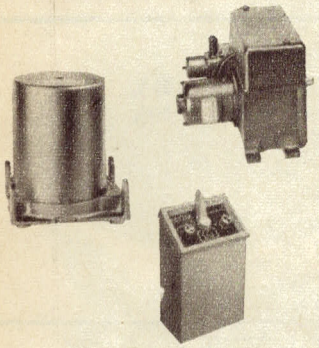
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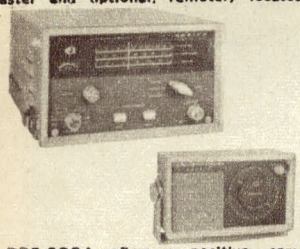
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STEREO SOUND FOR TV

Television station WGBH, in Boston, U.S.A., claims to be the first to make a simultaneous broadcast of a colour video signal with synchronised high quality stereo sound.

WGBH is a member of National Educational Television (NET), established in the U.S.A. to provide a TV service free of the constraints of commercial stations. It is sponsored by the Government and also obtains funds from private individuals and organisations. WGBH was formed shortly after the end of World War II as the Lowell Institute Co-operative Broadcasting Council by a consortium of universities interested in educational broadcasting. It operates WGBH-TV Channel 2, WGBH-FM and WGBX-TV Channel 44. Its multi-million annual operating budget is based on support from universities, grants, and sales of programs to other NET members. The Foundation established itself as a technological leader in 1958, when it acquired an Ampex VR-1000A, and became the first NET member to use videotape recording techniques.

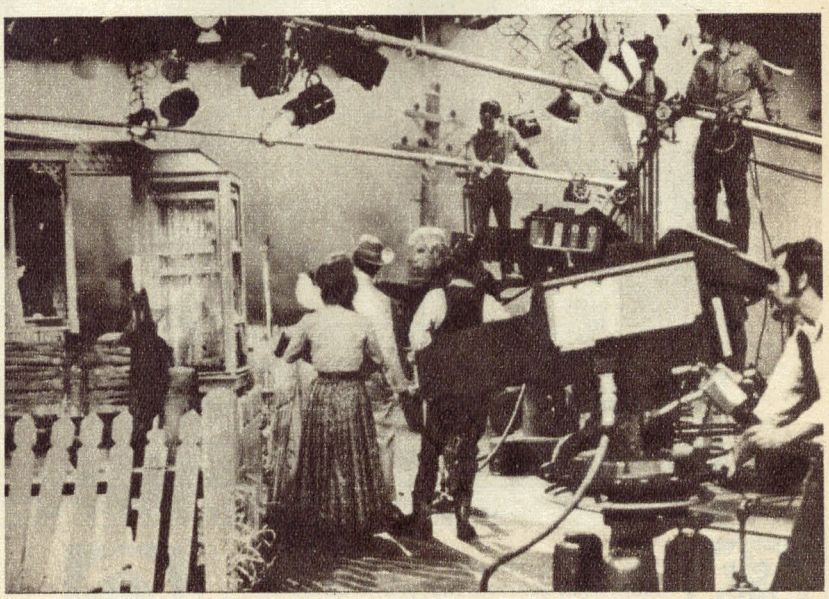
In March, 1970, WGBH used a multi-channel Ampex MM-1000-16 recorder/reproducer synchronised with an Ampex VR-2000 broadcast video tape recorder to produce a complete 80-minute opera. The experiment arose from dissatisfaction among the station's technical staff with existing arrangements for production and reproduction of TV sound.

While the film and radio broadcast industries have made enormous strides in improving sound quality, the television industry has tended to concentrate more on advanced video techniques. One of the goals of WGBH is to marry the two technologies, combining FM radio's high-fidelity sound with the strong visual appeal of colour video.

Dissatisfaction with television audio techniques came to a head at WGBH after its staff produced NET's first opera broadcast, "From the House of the Dead," in 1969. The program was successful from the visual standpoint; but traditional audio recording techniques often muffled the fine work of the large orchestra, thus obscuring or weakening climactic moments. Limitations imposed by home television set amplifiers and speakers compounded the problem. WGBH engineers were painfully aware that their audience for this type of program are those who are accustomed to hearing audio of excellent quality from their home stereo sound systems.

Under Tom Keller, Director of Engineering for the Foundation, the engineering staff at WGBH set out to develop a new technique that would permit high fidelity stereo sound from WGBH-FM to be broadcast synchronously with a video signal. After six months' preparation, the production staff and performers were ready to tape NET's "My Heart's in the Highlands," an 80-minute opera adapted from a play by Jack Beeson. It was an ambitious project. In fact, a more difficult medium than opera, with its complex staging and orchestration, is hard to imagine.

The multi-channel taping was done entirely in the 6,000 sq. ft main studio of WGBH's 65,000 sq. ft building near Cambridge. In addition to Keller, other members of the Foundation's technical



The director and the singing cast on the set of "My Heart's in the Highlands," during the colour videotaping on an Ampex VR-2000, with multichannel sound recording on an Ampex MM-1000-16.

BROADCASTS

staff participated: Will Morton, mixing supervisor; Bill Busick, radio supervisor; Dave Hutton, VTR supervisor; John LaBounty, maintenance supervisor; and Fran Abramowicz, chief engineer. They used 12 of the MM-1000's 16 audio tape tracks for recording sound, permitting them to record with clarity not only the small singing cast but the elements of the 18-piece orchestra as well. Later, the remaining four tracks were used for editing and control of the audio/video link.

Keller was pleased with the results. With 12 of the MM-1000's channels available for sound, his group achieved just the balance they wanted between instruments and voices, as well as between stereo broadcast channels, an accomplishment that would not have been possible with any other audio recorder. Says Keller: "The availability of audio equipment like the MM-1000 is what made this thing work. It gives us high quality multi-channel sounds, as well as the opportunity to synchronise with the audio signal."

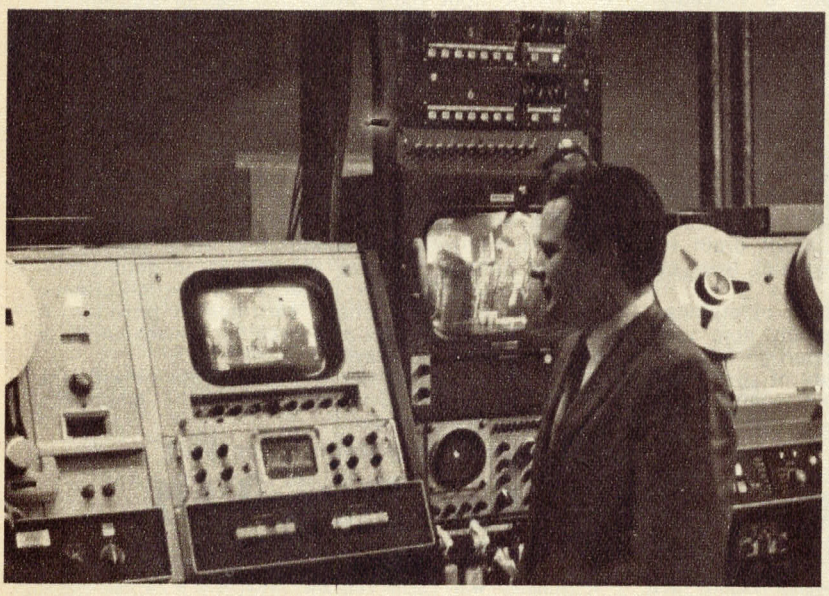
NET's "My Heart's in the Highlands" was successfully presented in Boston on March 17; in New York on March 18; and on the NET network March 19. It was simultaneously broadcast on FM radio in 2-channel stereo sound for Boston and in 2-channel stereo for New York listeners — a landmark for the broadcast industry. Of course, it was possible for listeners to hear the FM broadcast without watching the video portion. There was even a notable improvement in the quality of the network's monaural broadcast sound, because WGBH engineers were able to exercise unusual control over sound balance in the final mix.



WBGH's director of engineering, Tom Keller, studying a playback from a taping session of "My Heart's in the Highlands."

"We've established a standard procedure for stereo sound/videotape recording as a result of this production," says Keller. "We now know that we can record stereo sound and broadcast it the way we want to. The remaining step is for manufacturers of home TV sets to develop equipment that will bring it into the home. We're confident that this will follow, and soon."

Keller has announced that WGBH will record 13 Boston Pops concerts in the near future, using the new technique. His group will post mix the MM-1000-16 in each case. After that, they will do three operas each year, concerts of popular music, and some other local programs. ■



The control panel of WGBH's Ampex MM-1000-16 sound recorder. Twelve of the sixteen channels were used for sound recording, and four for editing and controlling the audio/video link.

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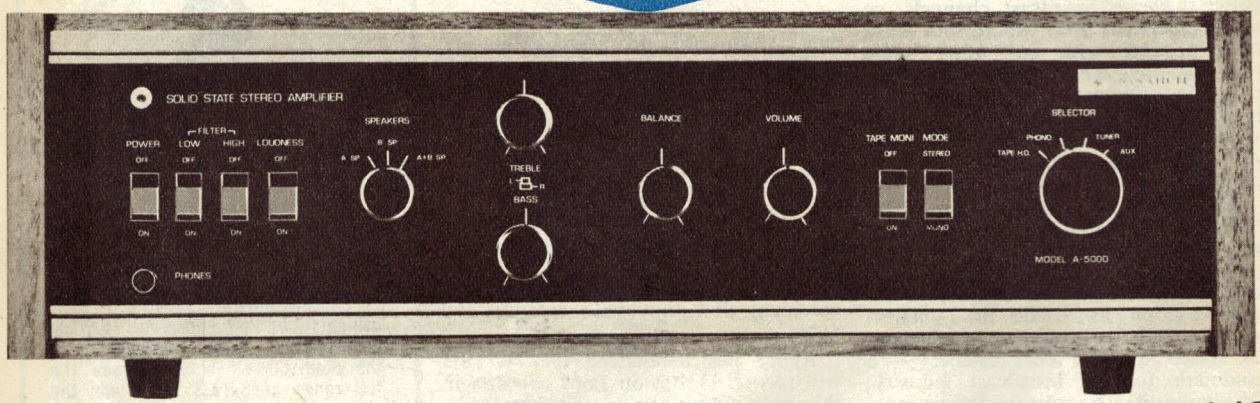
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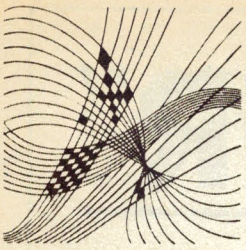
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CLASSICAL RECORDINGS

Reviewed by Julian Russell

ADAM — Giselle. (Complete Ballet). The National Orchestra of the Monte Carlo Opera conducted by Richard Bonynge. Decca Stereo SETA233/34.

Giselle may not be any great shakes musically, but this fact usually passes unnoticed in a theatre when the score provides the accompaniment to what is regarded as one of the greatest of the classical ballets. Bonynge doesn't try to make it sound any better than it is — and he doesn't have to. Under his direction the Monte Carlo orchestra play it better than I have ever heard it played in orchestra pit, and I have seen the ballet all over the world more times than I care to recall. Under Bonynge's direction the music is alternately crisp, suave and forceful. It was, of course, composed during the period (1841) which seems to have a paramount interest for this conductor and to which he most closely identifies.

The Monte Carlo Orchestra is not one of the world's greats but under Bonynge it is so splendidly drilled that one readily overlooks woodwind playing not quite out of the top drawer and horns producing a typically French squashy tone. The trumpets sometimes sound like cornets — and perhaps they are. I hadn't a score handy to check this point when listening to these attractive discs. But Bonynge pushes the ballet along with unfaltering sense of rhythm, admirable phrasing including sensitively used rubatos, and a faultless sense of period style. The sound has a fine presence and I can recommend the performance to all but musical diabetics, who will probably reach immediately for their insulin. Those who have a sweet musical tooth which they can indulge without either danger or a bad conscience will have a grand time.

There is one feature of the production that puzzles me. The boxed set is accompanied by an elaborate brochure which contains many interesting articles about Giselle and some of the great dancers who have starred in its production over the years, all of them written by undeniable authorities on the subject. It runs to 15 closely printed pages with lavish illustrations. Yet apparently no space was available to give even an outline of the story of the ballet which might have helped those unfamiliar with the stage spectacle to better enjoy the accompanying music. If Decca thought that its only appeal would be to those who love the ballet I think they somewhat underestimated a wider audience. In my opinion there are many who have never seen the ballet who might well be charmed by this performance.

SIBELIUS — Symphony No. 4 in A Minor.

SALLINEN — Mauermusik.

Finnish Radio Symphony Orchestra conducted by Paavo Berglund. Decca Stereo SXL6431.

SIBELIUS — Symphony No. 5 in E Flat.

RAUTAVAARA — Requiem In Our Time.

Helsinki Philharmonic Orchestra conducted by Jorma Panula. Decca Stereo SXL6433.

After only sporadic appearances during the past few years, recordings of Sibelius symphonies are coming back into fashion with a vengeance. Last month I reviewed new issues of his First and Second Symphonies. This month there are new recordings of his Fourth and Fifth Symphonies on disc, and the Sixth and Seventh on cassettes. It is many years since we had recording of Sibelius played by a Finnish orchestra. The last I can remember were the old Kajanus set on 78s put out before World War II. Constant Lambert seems to have been the first English musician to appreciate the force and novelty of Sibelius' compositions, at any rate in his book, "Music Ho." And between the wars it was English conductors who popularised his works. During that period there was much to-ing and fro-ing by English musicians to Helsinki where for the past 25 years of his life Sibelius lived but remained musically silent. From Australia, Sir Bernard Heinze and Sir Charles Moses were among those who made the pilgrimage.

The Fourth Symphony is a dour, laconic work, as tightly compressed as a dwarf star. It is played here by an orchestra which has developed an authentic timbre for Sibelius' deceptively simple-looking but marvellously apt orchestration. The recording engineer has used a very wide dynamic range that makes whispered pianissimos and great brass shouts equally impressive. Berglund's reading is majestic, with the music always stretched as taut as a piano wire. By taking his time over the first movement he gives it enormous spaciousness. He does nothing to make its stern message sound ingratiating. He offers instead a kind of heatless incandescence. Those looking for a schmaltzy tone will be disappointed. They will hear instead a typically Sibelian timbre offering undecorated primary colours. No interior decorator's hues!

And these characteristics Berglund sustains during the whole progress of this short but overwhelmingly powerful symphony. I think I am safe in describing it as a definitive performance, its only blemish some slight surface noise, on my pressing, towards the end of the first side.

The fill is interesting, too. Sallinen's Mauermusik (Wall Music) is in the form of a lament over the death of a young man who tried to scale the Berlin wall. The composer uses quarter tones, which might give unfamiliar listeners the impression that some of the instruments are playing out of tune, but to which the ear soon learns to adjust itself. Much of the music consists of repeated notes which, using the simplest available means, develop a terrific sense of tension. The sleeve annotations state that some of the passages must be improvised by the orchestra but I could find no evidence of improvisation in the deft performance, though I had no score with which to check the performance. A point of interest to collectors. The original recording was by A. B. Europafilm, Stockholm.

Sibelius' Fifth Symphony is likely to appeal to a much wider audience. It is much more conventional, thematically and formally, than the Fourth. Once again you are offered true Sibelian timbre, this time by another Finnish orchestra, the Helsinki Philharmonic, conducted by another Finnish conductor, Jorma Panula. It is again admirably played and recorded. The Fifth is a much more extroverted symphony than its immediate predecessor. And again I would describe the performance as definitive. Importantly Panula avoids the temptation of developing premature climates, giving a reading that is cumulative throughout the whole length of the symphony, driving inexorably towards the work's final culmination. It is all an example of well disiplined vitality, held in check until release has the greatest impact.

Another interesting fill, this time a Requiem In Our Time by the contemporary Finnish composer Einojuhani Rautavaara. It is a work, for wind instruments only, in four brief movements — Hymnus, Credo Et Dubito, Dies Irae and Lacrymosa. The Requiem is now nearly 20 years old; the composer was 25 when he wrote it. It is often a little reminiscent of Janacek in his Sinfonietta. And sometimes especially in the Dies Irae in which the Plainsong theme is placed against a tortured high upper part, the dominating influence seems to have been Stravinsky's Sacre du Preintemps. I found it all interesting, the final movement the most eloquent and truly poignant. This recording, too, was originally issued under the A.B. Europafilm, Stockholm label.

★ ★ ★

COPLAND CONDUCTS COPLAND. An Outdoor Overture; Our Town; Two Pieces for String Orchestra; Quiet City. London Symphony Orchestra. CBS Stereo SBR235367.

This is a pleasing if never very exciting disc. The earliest pieces — for String Orchestra — date from 1928. The others were all written about 1940. In Our Town (1940) you may find the mood — though certainly not the music — a little like that of Vaughan Williams in some of his slow movements. You'll also, if you are like me, find the main, nostalgic theme growing

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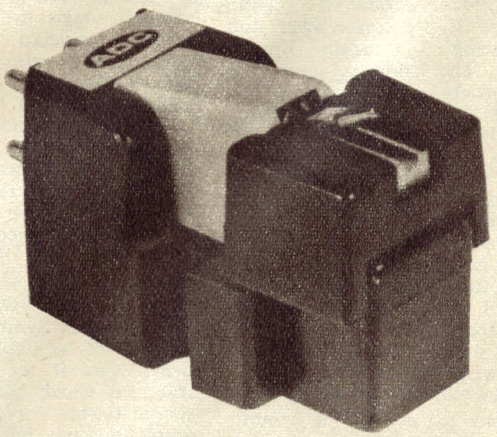
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This new "breed" of ADC cartridges is no doubt the best thing ADC have ever done and all models have been greatly improved, yet a further improvement of the 10E/11 was simply not possible and, therefore, this amazing playback head has not been superseded and was retained. The reason for this is not really hard to understand, as the ADC.10E/11 has been rave-reviewed in all overseas audio magazines. Just to quote one reviewer:—"An impeccable overall sound quality that delights the ears and places the 10E/11 right at the top of the pickup tree." Again, the laboratory report on ten **leading** magnetic cartridges in the April, 1970, issue of "HI.Fi" Sound" (U.K.) selects the 10E/11 as by far the best.

Here are some excerpts: "Of those cartridges tested here we feel that irrespective of price, our overall user-preference would be for the ADC.10E/11. The virtues of low tip mass and excellent tracing were immediately obvious in terms of open and UNCOLOURED sound reproduction. This cartridge is second in line to ADC's top-flight cartridge, the ADC.25. These cartridges represent a masterpiece of technical compromise for while it may be possible to improve on one or more particular performance parameters, it is likely that this could only be achieved at the sacrifice of another, so spoiling the balance as an integrated whole. It is just this sort of clever compromise that constitutes a 'state-of-art' product providing the user with **THE MAXIMUM OF OVERALL LISTENING PLEASURE OVER THE MOST DIVERSE RANGE OF PROGRAMME MATERIAL.** It will be appreciated only if used with care and with the best equipment, employing a low-mass arm and clean records."

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on you as the work progresses. Outdoor Overture (1938) was written for a school orchestra — that of the High School of Music and Art in New York City. They must have been a very accomplished team of young musicians. Here it is vigorously rhythmic, and beautifully and crisply played—though not of course by a school orchestra. It is the London Symphony in excellent form and generously responsive to the conductor. The Two Pieces for String Orchestra has a Rondino in what might be called a mildly neo-classical style, cleanly set down in logical linear lines. The rest of the disc, while of no great stature, is never less than eminently pleasing.

★ ★ ★

MESSIAEN — Et Exspecto Ressurectionem Mortuorum. Groupe Instrumental a Percussion de Strasbourg and the Domaine Musicale Orchestra conducted by Pierre Boulez. Couleurs de la Cite Celeste. Yvonne Loriod (piano). CBS Stereo SBR 235 364.

Et Exspecto was commissioned in 1964 by the then French Minister for Fine Arts, Andre Malraux. The orchestration is for 18 woodwind instruments, four trumpets, six horns, four trombones, tuba and bass saxhorn. Added percussion includes three sets of Mexican bells (cencerros), a set of tubular bells, six gongs and three tamtams. A formidable combination to capture on disc. I'm afraid I must report that the result is not wholly satisfactory. The composer stated that he wrote it for performance in vast spaces — in churches, cathedrals and so on — and while it might sound well in such spacious surroundings, such is not the case in a sitting-room, or even a large music room. There is a fair amount of congestion in some of the sound and one listener, myself, grew a little tired of the reiterated sonorities of the percussion group.

The work is not difficult to follow — in Messiaen terms, that is — and admirers of that composer, of whom I am one, should have no trouble even during a first hearing. But I must confess that I found the final result very noisy indeed, offering clamour rather than glamour. But even the din doesn't succeed in hiding the work's massively broad conception. And a great deal of trouble must have gone into the engineering, under the composer's supervision.

The Couleurs de la Cite Celeste was composed a year earlier, in 1963, and uses a much smaller combination, though those employed are much the same as those in the later piece — woodwind, brass, and tuned percussion. It differs, too, in that there is an important piano part set against the orchestral background, played with her usual excellence here by the composer's wife, Yvonne Loriod. The word "colour" in the title is a truthful description of the work's characteristics — a kaleidoscope of orchestral and pianistic sonorities. I prefer it to the longer first work reviewed here and must warn the general run of buyers that unless they are familiar with Messiaen's work they will find much to surprise and perhaps shock them, in both pieces. However, it is difficult to imagine Messiaen's fast growing audience able to resist acquiring this interesting disc.

★ ★ ★

SCHUBERT — Symphony No. 9 in C Major (The Great). Stuttgart Classical Philharmonic Orchestra conducted by Karl Munchinger. Decca Stereo SXL6427.

There have been several fine recordings of this symphony issued over the years among which my favourite, for a long time, has been Barbirolli's. But this new one gave me so much pleasure that I cannot see any reason for recommending the one at the expense of the other. Barbirolli's reading was notable for its flexibility. One can say exactly the same about Munchinger's. Like all such fine performances there are passages in the one that many might prefer to what is offered in the other. But both, in their own ways, are utterly convincing and a bar by bar description of them would be as unprofitable as it would be tiresome. The Stuttgart Classical Philharmonic is not well known on disc, at any rate in Australia, but shows evidence here of being a very fine organisation indeed.

The Stuttgart Opera has for many years been one of the very best in Western Germany, which makes its standard very high indeed. The only opera I have seen in that city was Strauss' Elektra, and I found it a completely overwhelming experience. The long Schubert C Major demands much more refined playing. Its scoring is much more transparent, solo passages much more exposed. And here again there is nothing of refinement lacking in the playing of the Stuttgarters. If you don't own the Barbirolli do not hesitate to acquire this. If on the other hand the Barbirolli is already in your library, I can see no very good reason for acquiring the new one. Confronted with both I am at a loss to choose one at the other's expense.

Classical cassettes . . .

TCHAIKOVSKY — Symphony No. 5 in E Minor. Concertgebouw Orchestra conducted by Wolfgang Sawallisch. Hamlet (Symphonic Poem). New Philharmonia Orchestra conducted by Igor Markevitch. Philips CPC0047.

This issue is good tonally with a very slight hum audible only during silences. While Tchaikovsky tempts some conductors to indulge in emotional extravagances Sawallisch is not one of these. Indeed some listeners might think that his reading is a mite too straightlaced. At any rate he takes no liberties with the script. The first movement might be best described as standard, with a nice romantic-sounding horn in the second, though there is an occasional bar where this treacherous instrument's intonation is not square in the middle of the note. The Waltz is a little wooden rhythmically, but the finale goes with plenty of elan. The Dutch strings have a fine bloom in the long legato passages throughout the work. The minor faults of the performance are too slight to deny its recommendation as well worth having.

The Hamlet fill is as unusual as it is

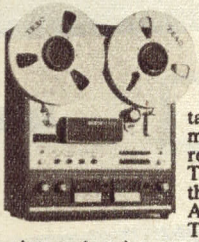
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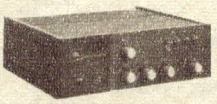
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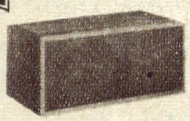
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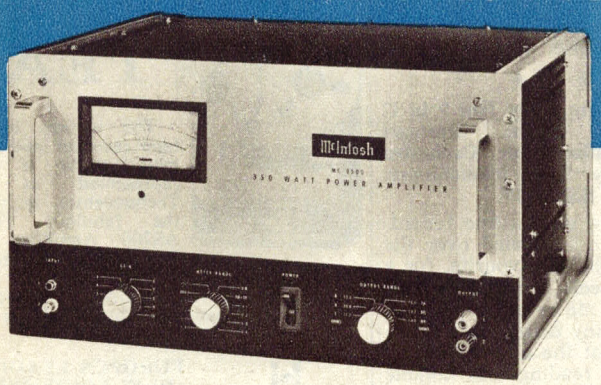
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welcome. It is one of the composer's least hackneyed pieces and here the playing of the New Philharmonia under Markevitch is more unbuttoned and spirited. To those who haven't a good disc version of either work this cassette can be safely recommended.

★ ★ ★

BRAHMS — Symphony No. 4 in E Minor. Berlin Philharmonic Orchestra conducted by Herbert von Karajan. Tragic Overture. Berlin Philharmonic Orchestra conducted by Lorin Maazel. DGG 923076.

A slight hum is noticeable in this recording, but the scarcity of pauses go a long way towards covering it up. I was disappointed with Karajan's treatment of the first movement. It lacks urgency and the wide sweep given it by some other conductors. There is lovely playing in the second movement, though the beat is always a little square. It also has the merit of being drawn more tightly together than the opening movement. The other two movements are fine — the lumbering rumbustiousness of the first theme of the Scherzo contrasted against quieter, more graceful passages. The final Passacaglia offers some mildly surprising changes of tempo but they are always effective, though how they might stand up to repetition I am not at all sure.

Maazel's playing of the Tragic Overture is violently dramatic but he urges it along with exhilarating zest. The overall result might be dramatic rather than tragic, but at any rate you won't meet any longueurs, despite some unusually forceful tempo changes. Happily Maazel's passion never provokes untidiness in the playing of this magnificent orchestra — either technical or emotional. The sound is first rate.

★ ★ ★

WAGNER — Siegfried Idyll. Prelude and Liebestod (Tristan and Isolda). Preludes to Lohengrin and The Mastersingers of Nuremburg. Berlin Philharmonic Orchestra conducted by Rafael Kubelik. DGG922 028.

Again some slight background hiss at the beginning of the Siegfried Idyll but it is soon forgotten under the spell of the really beautiful playing of this seraphic music. The only fault — and I stress that is a minor one — is that the woodwind is occasionally recorded so close that it momentarily throws the rest of the orchestra out of balance. The Lohengrin Prelude has just the right ethereal quality with lovelv sounding high strings that are very wiry. The Mastersingers Overture is splendidly played — faultlessly in fact — but I found the sound a trifle dry.

The playing of the Tristan Prelude is beyond praise. Langour mounts into passion the whole wonderfully sustained and moving inexorably to its superb climax. The sound is satisfyingly rich but needs a small treble boost to hear it to best advantage. The hypercritical might find it a shade congested in an occasional bar in the Liebestod, and the oboe tone slightlv coarse during the last bars. I would stress, however, these are only minor quibbles and the average listener should be more than happy with this cassette.

An All-Australian Record

CORROBOREE BALLET SUITE. (John Antill). The Sydney Symphony Orchestra conducted by John Antill. His Master's Voice (E.M.I.) stereo OASD 7554.

E.M.I. and the Australian Performing Rights Association have collaborated in producing this record as part of the Cook Bi-Centenary celebrations. Although the jacket mentions only the major work included "Corroboree" (played by the Sydney Symphony orchestra) this takes only one side. The second side has the Melbourne Symphony playing Percy Grainger's "Green Bushes"; and the Adelaide Symphony playing Michael Hurst's "Traditional Overture," the "Queensland version" of "Waltzing Matilda" (with the Adelaide Singers), and, to end the selection, Michael Hurst's "Swagman's Promenade."

The second side needs little comment. Michael Hurst seems to be a dedicated anti-modern where his music is concerned, and his "Traditional Overture," with its Elgarian themes, could have been written in the first years of the century. His "Swagman's Promenade" is similar in style (and presumably in intent) to Sir Henry Wood's "Sea Songs" suite which is played at the conclusion of every season of the London Promenade concerts. Hurst's work was written for the Sydney Proms. It consists of arrangements of Australian traditional songs, including the inevitable "Waltzing Matilda." Percy Grainger's piece is a passacaglia based on the traditional English tune. It is handled with his accustomed skill, with snatches of melody woven expertly into the fabric of the main tune.

John Antill's "Corroboree," either in the complete score version, or in the suite as presented here, should be in the record collection of every Australian who appreciates classical music — even if they do not normally favour the modern classical idiom. It is a fascinating work, full of lively rhythms and interesting orches ral effects, but more importantly, it is clearly recognisable as having a unique Australian character. In the informative notes which our Classical Record reviewer, Julian Russell, has written for the record, we are told: "The scoring of "Corroboree" is for a large symphony orchestra with a much augmented percussion section, featuring, among others, such exotic 'instruments' as the bull roarer. The suite from the ballet recorded here comprises the Welcome Ceremony, Dance to the Evening Star, Rain Dance, Morning Star Dance, procession of the Totems and Closing Fire Ceremony."

The performance by the Sydney Symphony is easily the best on this disc, confirming their position as Australia's premier orchestra. They outshine their interstate colleagues in every department, and John Antill, conducting his own work, handles the orchestra extremely well. The Melbourne group make a brave effort at handling the intricacies of Percy Grainger's scoring, but sound a little out of their depth. The three works played by the S.A. make no great demands technically, and they make pleasant light listening. As an all-Australian effort, bearing in mind its intentions, it is worth a place in your record collection. (H.A.T.)

N.B. This record would normally come within the scope of our classical record reviewer, Julian Russell. As mentioned in the review, Mr Russell has written the notes for the leaflet which accompanies the record, and feels it would be inappropriate for him to review the disc.

MUSSORGSKY — RAVEL. Pictures from an Exhibition.

RAVEL — Bolero.

Berlin Philharmonic Orchestra conducted by Herbert von Karajan. DGG923 018.

This cassette has splendid recorded tone — clear, rich, and with an unusually wide dynamic range. If you haven't yet heard a really first-class example of this form of tape recording, try this one. You may well be surprised at the quality of the reproduction. Listen to the slow cumulative power of the climax in "Bydlo." In "The Old Castle" you have none of the brash reediness that so often spoils the saxophone solo. You will also hear some ravishing quiet playing on the strings. There is sharp characterisation in the portrait of the rich Jew and his obsequious companion ("Samuel Goldenberg and Schmuyle") and utterly beguiling delicacy in the "Children Playing in the Tuilleries Garden." Superb accuracy elates the listener in "The Ballet of the Unhatched Chickens," and disciplined bustle in "The Market Place at Limoges." And the brass in "Catacombs" is as majestic as all get out.

I found I had to increase the volume a little to play the second track, but that adjusted, everything was again fine. The low tuba notes in "Baba Yaga" come off splendidly. Two minor criticisms — I thought the "Promenade" theme often a trifle too stately in tempo. The idea of moving comfortably from picture to picture is replaced by a suggestion of "museum feet." And "The Great Gate Of Kieff" is more than majestic. It comes pretty close to the ponderous. But one can easily imagine it generating plenty of applause in a concert hall. Karajan uses the inspired Ravel orchestration of the suite — so much better than Stokowski's later, infinitely more crude exercise.

For some reason or other, while the "Pictures" are outstanding in their absence of background noise, the "Bolero" starts off with a good deal of hiss. I didn't enjoy it nearly as much — I mean the playing — as that in the longer work. True, Karajan retains a

(Continued on page 189)

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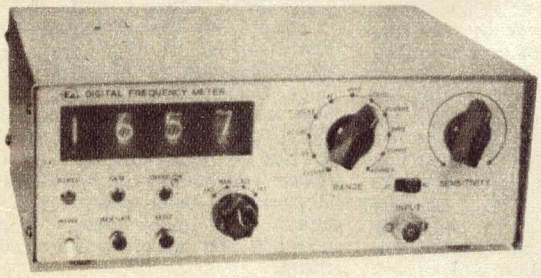
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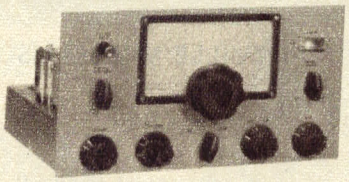
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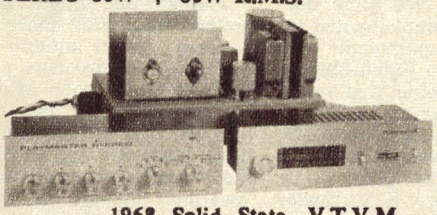
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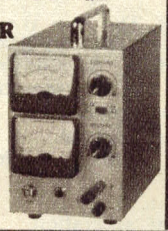
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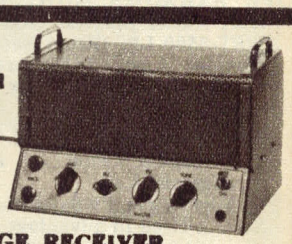
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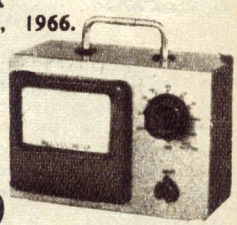
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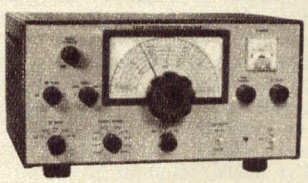
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Devotional Recordings

CLIFF BARROWS NOW! With the Kurt Kaiser Singers. Stereo, Word WST-8500-LP. (From Sacred Productions Aust., 181 Clarence St., Sydney, and other capitals.)

Interest: Modern Gospel music.
Performance: Fine — and fine arrangements.
Quality: Virtually flawless.
Stereo: Used to advantage.

I couldn't help but contrast this album with those which were presented for review in this devotional section, when it first began. Arrangements and performances were, at best, routine and the recording quality seldom better than mediocre. Here the combined and dedicated talents of Cliff Barrows, Kurt Kaiser and Ralph Carmichael have produced an album of Gospel music that, far from not having to suffer from comparison with commercial standards, tends to set new standards of presentation. The singers alone are quite outstanding but they are complemented by an ear-catching accompaniment that varies all the way from a liquid-like celeste-sound to driving guitar that really smacks the loudspeaker cones.

The treatment is modern but the sound should have universal appeal: I Heard About — The New 23rd. — Be Thou My Vision — Love Is Surrender — Let Us Break Bread Together — Pass It On — Medley, Nobody Knows, By The Riverside — A Quiet Place — There's More To Life — Kum Ba Ya — I'll Tell The World — Speak Lord In The Stillness.

An outstanding album that you can play at full volume, then play it right through again as pleasant background. (W.N.W.)

★ ★ ★

WE WILL ANSWER. The New World Singers. Stereo, Word WST-8447-LP. (Available from Sacred Productions, Aust., 181 Clarence St., Sydney and other capitals.)

Interest: Gospel folk sound.
Performance: Musically fine, but . . .
Quality: Excellent.
Stereo: Plenty of separation.

The jacket notes introduce the New World Singers as a group of five young people, college graduates who have travelled the United States, Europe and the Orient under the auspices of Youth For Christ International. Not surprisingly, their ability with voice and guitar is quite outstanding and, without being an expert in this field, I'd rate them above most other such groups I've heard, religious or secular.

Their first six numbers are intended apparently to involve the audience by comment on everyday people and circumstances: Feelin' Groovy — Mighty Big Ways — Ol' Blue — Who Am I? — Sounds Of Silence — Who Will Answer? "Ol' Blue" is obviously intended to get a laugh; "Who Will Answer" sets the tone for the title "We Will Answer" and for the tracks on side 2: What The World Needs Now — His Love — The Man — He's Everything To Me — You Can Tell The World — I Know Where I'm Going. In the two numbers "He's Everything To Me" and "You Can Tell The World," the group really drives things along.

Then why the "but . . ." in my assessment of performance? Simply because there is so much emphasis on the vocal and instrumental sound, as such, that diction is left way behind. One gathers from the jacket and the titles the basic theme but, unless you happen to know the numbers, that's about as far as you'll get.

But enough said. I've alerted those who set store by the words or who don't like teenage protest anyway. But my guess is that Gospel-oriented teenagers who hear the album will vote it among the best yet. (W.N.W.)

★ ★ ★

LIVING MELODIES FROM LAUNCESTON, TASMANIA. Mono, Crest, CP-12-28. (Available for $5.25 from A. A. Austin, St. Giles Home, Amy Rd., Launceston 7250.)

Interest: Gospel program from Launceston.
Performance: Dedicated amateurs.
Quality: Average.

Though one might be tempted to pretend otherwise, there is a vast gulf between gospel albums produced by professional musicians and others like this one, by a group of amateur artists, however popular and dedicated they may be. It is the old story of imperfections which are not all that apparent in the friendly atmosphere of a Gospel meeting, but are all too obvious to the non-involved listener, in the home, concentrating only on the sound.

And yet it may be argued that artists who are motivated only by a desire to express their faith have something to say beyond the polish of the professional situation. You must be the judge.

The sixteen tracks, a mixture of vocal and instrumental numbers, and presented by a variety of artists, would take more space than is available here to list in detail. However, they are all standard items that one would expect to hear in Gospel meetings and presented in much the way that guest artists present them on such occasions.

If you want to hear the album for yourself, or have a personal interest in artists from the Launceston area, you might like to know that profits from the sale of the disc are being directed to assisting needy children. (W.N.W.)

★ ★ ★

RICHARD PURVIS at the Grace Cathedral Organ. Stereo, Word WST-9033-L.P. (Available from Sacred Productions Aust., 181 Clarence St., Sydney and other capitals.)

Interest: Magnificent pipe organ.
Performance: Masterly.
Quality: Excellent.
Stereo: Used to advantage.

I had to rely on the notes to tell me that the Grace Cathedral is on California Street, San Francisco. However, I didn't have to be told that, in such a location, the noise of the cable trams forced the recording of this album into the small hours of the morning; and that, even then, the seldom silent fire (and other) sirens posed a continuing problem.

But the effort was abundantly worthwhile. The organ is a huge 100-rank Aeolian Skinner, rebuilt in 1959 and provided with a new 5-manual console in 1967. It provides a vast resource in the variety of sound available: Massive, romantic, delicate, traditional and modern.

Cathedral organist Richard Purvis is obviously very much at home at the huge console. Playing items which he

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has personally composed or arranged, he manages not only to generate a variety of moods but also to exploit very skilfully the many voices of his beloved instrument.

The track titles: Fanfare — Brigg Fayre — Les Petite Cloches — Greensleeves — Thanksgiving — Nocturne — Supplication — Of Moor And Fen — The Cuckoo.

Incidentally, Grace Cathedral has a reverberation time of 8 seconds but very careful microphone placement has kept the reverberation just nicely in the background, enriching but not clouding the sound. In fact, all round, I found this a most enjoyable record and I am sure others will find it so, who have an interest in cathedral organs. (W.N.W.)

Instrumental, Vocal and Humour . . .

CARMEN, arranged for orchestra by Andre Kostelanetz, and played by the Andre Kostelanetz Orchestra. C.B.S. (Australian Record Company) stereo SBR 235362.

Interest: See title.
Performance: Polished.
Quality: Excellent.
Stereo: Good spread.

One of the surprises of the recent C.B.S. release "Bizet's Greatest Hits" was the ease with which Andre Kostelanetz and his Orchestra held their own against such powerful forces as the New York Philharmonic and the Philadelphia Orchestras, all of whom played excerpts from the "Carmen" music. Consequently I was not the least bit surprised by the excellence of this performance of substantially the whole "Carmen" score. While smaller than a full symphony orchestra, the Kostelanetz orchestra is nevertheless a sizable body of players, and they have obviously been carefully drilled. Their playing has a precision and polish which many a full-sized orchestra could envy. Of the music itself, there is little one can say, except that it is entirely delightful — as I said recently "some of the finest melodies ever penned." The sound is clean with the bright (almost over-bright) quality of modern American recordings. (H.A.T.)

★ ★ ★

THE EXOTIC RIMSKY-KORSAKOFF. The Kingsway Symphony Orchestra and Chorus, conducted by Camarata. Decca Phase 4 Stereo (E.M.I.) PFS 4177.

Interest: Russian light classics.
Performance: Good standard.
Quality: Excellent.
Stereo: Good arrangement.

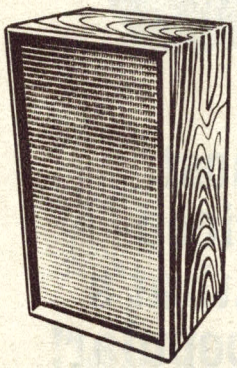
Rimsky-Korsakoff wrote a wealth of glorious melodies, and since he was also a very skilful orchestrator his tunes are always extremely "well dressed." A number of the tunes presented here are among the most often played: Flight of the Bumble Bee — Hymn to the Sun — Gypsy Song and Fandango, from "Capriccio Espanol" — Song of India — Dance of the Tumblers, from "The Snow Maiden" — Procession of the Nobles, from "Mlada." Lesser known items included are Wedding Cortege, from "Le Coq D'Or — Hopak, from "May Night" —

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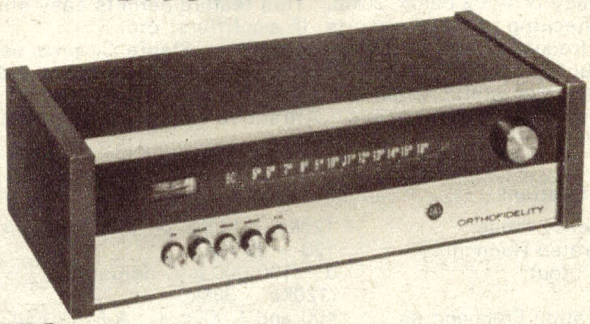
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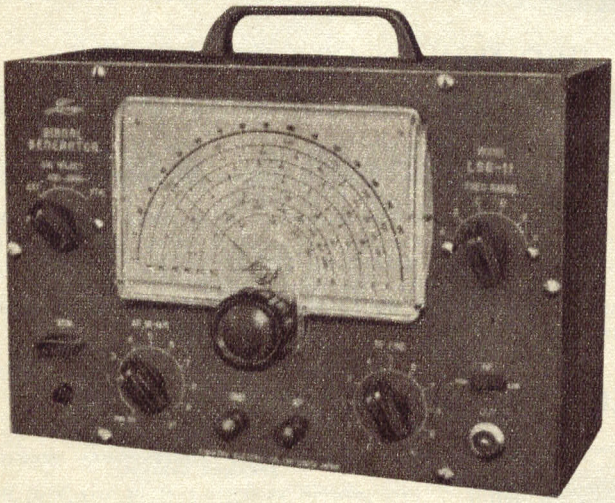


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The Rose Enslaves the Nightingale. The last named is one of Rimsky's beautiful songs, sensuous and languorous, with a sinuous melody. I liked Camarata's approach to these appealing tunes. He sets out to extract the last ounce of "schmaltz" from this already highly perfumed music, and for my taste this approach is perfectly valid. The Phase 4 sound is, as usual, above reproach. (H.A.T.)

★ ★ ★

CLASSICAL MINIATURES No. 3. Franck Pourcel and his Orchestra. Columbia (E.M.I.) Stereo SOEX 9496.

Interest: As per title.
Performance: Fine.
Quality: Very good.
Stereo: Normal.

Every encounter I have had with Franck Pourcel on disc has been a pleasant experience, and this one is no exception. I assume this one was, like Nos. 1 and 2 in the series, originally released on the $5.50 label, although it did not come my way. This reissue at $2.50 makes it a very good buy. The selection will have great appeal to lovers of light classics; the band is certainly one of the best light orchestras playing today, and Franck Pourcel is a skilful arranger. These ingredients add up to a very pleasant disc. It only remains to list the tunes: Hungarian Rhapsody No. 2 (Liszt) —Intermezzo from "Goyescas" (Granados) — Farandole from "L'Arlesienne" (Bizet) — Turkish March (Mozart) — Nocturne No. 2 in E flat (Chopin) — "Minute" Waltz (Chopin) — Sleeping Beauty Waltz (Tchaikowsky) — Ritual Fire Dance (Falla) — March from "The Love of the Three Oranges" (Prokofiev) —Claire de Lune (Debussy). (H.A.T.)

★ ★ ★

BRANDENBURG CONCERTO No. 5, played by the Jacques Loussier Trio, with the London Philharmonic Orchestra conducted by Jacques Loussier from the piano. Decca (E.M.I.) stereo PFS4176.

Interest: Swung Bach.
Performance: Unique.
Quality: Excellent.
Stereo: Well spread.

After several years of playing the smaller Bach compositions as a trio, Jacques Loussier and his two fellow artists join forces here with a full scale symphony orchestra to present their highly individual rendering of the Brandenburg Concerto No. 5. The orchestra, and the principal players (Neville Taweel, violin; Lawrence Kennedy, flute) play their scores absolutely straight, while the Trio swing and improvise. At the conclusion of the concerto, the Trio revert to their unaccompanied style to present Air on the G String and Prelude No. 2 in C minor.

Play Bach fans will surely want to add this interesting disc to their collections. However, in an experiment like this, with no precedent, one's reactions are purely personal. I had some reservations about the success of the performance, and I must say I prefer the group in their trio role. An orchestra playing straight with soloists swinging just does not sound right to me. If in doubt, try to hear a section before buying. One need have no reservations about the sound quality, which is excellent. (H.A.T.)

World Record Club Organ Series

ORGAN WORKS OF JOHANN SEBASTIAN BACH, (Vol. 1) played by Lionel Rogg at the Silbermann Organ, Arlesheim. A Harmonia Mundi recording, released exclusively in Australia through the World Record Club. Stereo S/4477.

Interest: As per title.
Performance: Magnificent.
Quality: Excellent.
Stereo: Normal.

This is the first release in a series of 18 to be made available in Australia through the World Record Club, featuring the brilliant young Swiss organist Lionel Rogg playing the works of Bach. So much enthusiastic praise has been heaped upon Mr Rogg by music critics and record reviewers that organ enthusiasts will not need to be told of his faultless technique, and immaculate performances. If they have not previously heard a Rogg performance, one playing of this fine disc will surely convince them that the superlatives used to describe them are not out of place. The works included here call for little in the way of comment: There is the Passacaglia and Fugue in C minor BWV582; Toccata and Fugue in D minor BWV565; Fantasia and Fugue in G minor BWV542; Fantasia and Fugue in C minor BWV537. All four are from Bach's Weimar period, and it is generally recognised that the fine organ he had available at that time had a bearing on the great organ works he composed at Weimar.

The magnificent Silbermann organ at Arlesheim (built 1761 by Johann Andreas Silbermann) owes its existence to the religious wars following the Reformation. Arlesheim itself is an unimportant village, but it became the seat of the Bishop of Basle. Forced to flee his city, he built the Arlesheim cathedral, and had the organ installed. Fully restored betwen 1959 and 1962, the organ has a fine bright tone and sounds very smooth in its operation. It must have been a joy for Rogg to play this fine instrument in its current state of perfection. A full specification is given on the record sleeve.

The recording, made in 1968, is of excellent quality. (H.A.T.)

APOLLON MUSAGETE (Stravinsky). The Ramat-Gan Chamber Orchestra, conducted by Sergiu Comissiona. Concert Hall Record Club, Synchro Stereo SMS 2295.

Interest: Neo-classic Stravinsky.
Performance: Excellent.
Quality: Good modern recording.
Stereo: Compatible.

The name of Stravinsky on a record cover is enough to send any middle-of-the-road music lover running for cover. Such musical cowardice is quite unnecessary in the case of "Apollon Musagete." This work has an ethereal classical beauty which is immediately rewarding, and is one which seems increasingly lovely with subsequent hearings. This club disc is probably the only budget-priced one available at present. I must confess I had not heard of the orchestra, and I was very surprised at the high standard of their playing, which will stand comparison with any other group. Presumably they are an Israeli group but I am willing to be corrected. Judging by the high quality sound, this is a new recording, not a re-issue. Roussel's "Sinfonietta" which is used as a filler is a rather dry work, mercifully short, and in my opinion was a poor choice for this duty. But in the case of "Apollon Musagete," I have no hesitation in recommending it as a work worth hearing. (H.A.T.)

★ ★ ★

SEMPRINI PLAYS CHOPIN, with the New Abbey Light Symphony Orchestra conducted by Vilem Tausky. Studio 2 Stereo (E.M.I.) TWO 274.

Interest: Light classical program.
Performance: Adequate.
Quality: Excellent.
Stereo: Well spread.

Admirers of Rubinstein and Horowitz, and similar great virtuosi of the piano, will know that this disc is not for them. Rather it is for those who find pleasure in the type of light music program exemplified by TV's "The Magic of Music." Semprini has had such a program going in England for the B.B.C. for many years, and is something of a specialist in this type of program. We have already had earlier discs he has made of the music of Tchaikowsky and Grieg, and "The World's Most Beautiful Melodies" and those who bought and enjoyed those will surely find this one just as pleasing. It has the same format: arrangements for piano and orchestra, and piano solos.

The program is, of course, "popular": Waltz in C-sharp minor—"Revolutionary" Study — Nocturne in A-flat, Op. 32, No. 2 — Mazurka in B-flat, Op. 7, No. 1 — "Tristesse"

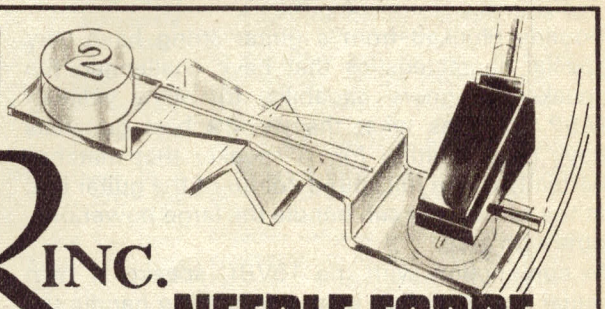
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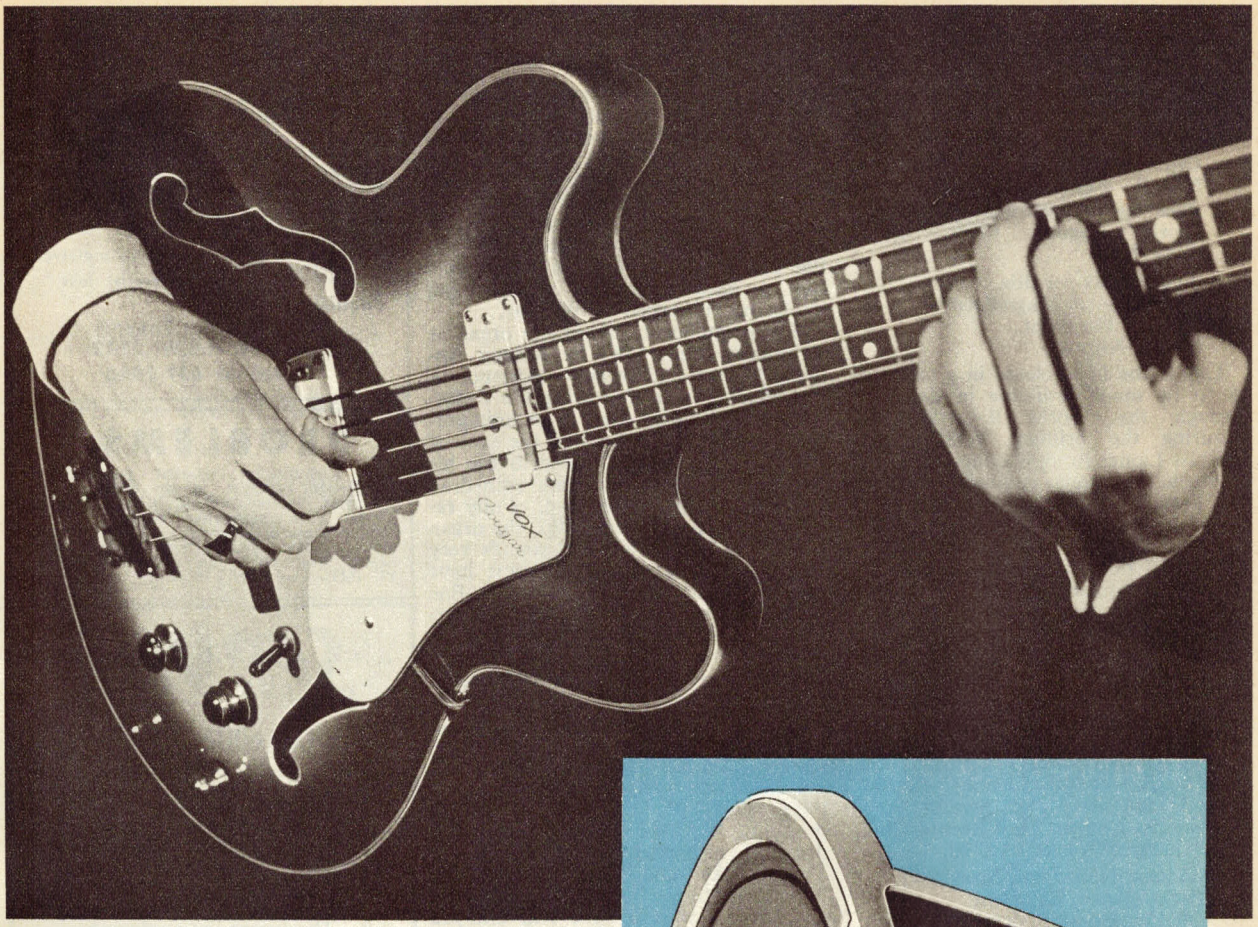
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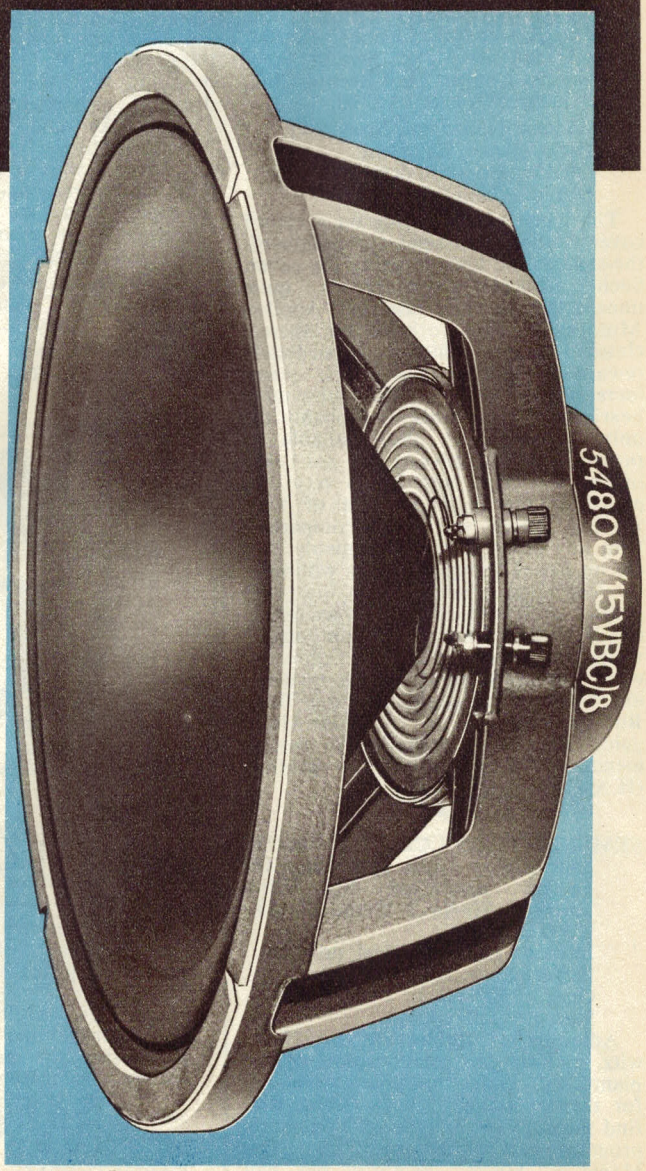
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Study — "Military" Polonaise — "Raindrop" prelude — Fantasy Impromptu — Prelude in E minor, No. 4 — Mazurka in C-sharp minor — Grande Polonaise Brillante. The arrangements by Semprini are pleasing, and ensure that he dominates throughout, so that the orchestra is required to do little more than provide a sympathetic background. The recording in the Studio 2 process is of excellent quality. (H.A.T.)

★ ★ ★

VIVA ESPANA Gran Orquesta de Profesores Solistas. Studio 2 Stereo (E.M.I.) TWO 287.

Interest: Spanish light music.
Performance: Very competent.
Quality: Very good.
Stereo: Well spread.

Apart from the fact that the music is played by "a hand picked orchestra of Spain's best musicians," to quote the sleeve note, and was recorded in Madrid, there is little to distinguish it from numerous other discs of popular Spanish music. It could be argued that this recording should have an air of authenticity, but frankly I did not notice any such feature. Certainly the various numbers are nicely played, and the tracks include a number of popular Spanish tunes which do not normally find their way into other performances, but in general one need not regard this performance as particularly "Spanish."

The program includes the Spanish standards which always come with discs of Spanish light music. Espana Cani—Granada—Maleguena (Lecuona) — La Violetera — Valencia — La Paloma — El Gato Montes. Besides these, there are the following less well known tunes: El Porompompero — Maria Dolores — En "Er" Mund — La Luna y el Toro — Lo Celos y el Viento. These pleasing tunes make a refreshing change from the over-performed numbers listed above. In summary then, a pleasing mixture of the familiar and unfamiliar, nicely played, and well presented in E.M.I.'s excellent Studio 2 Stereo recording system. (H.A.T.)

★ ★ ★

PERSUASIVE PROVOCATIVE PERCUSSION. Terry Snyder and the All Stars. Stateside (E.M.I.) stereo SESL 9619.

Interest: Mood music.
Performance: Relaxed and restful.
Quality: Very good.
Stereo: Slightly gimmicky.

This disc is an amalgam of tracks from the very successful "Provocative Percussion" and "Persuasive Percussion" originally released a few years ago on Enoch Light's Command label. I thoroughly enjoyed the original records, and this enjoyment was not diminished in hearing this reissue. However, I must point out that there appear to be two schools of thought concerning this type of disc. Some folk just cannot take to it. So unless you are

Fantasia: three record set

FANTASIA. The music of the Walt Disney cartoon feature film, with the Philadelphia Orchestra, conducted by Leopold Stokowski. Disneyland (E.M.I.) stereo STER.101/3. Three record boxed set, price $11.85.

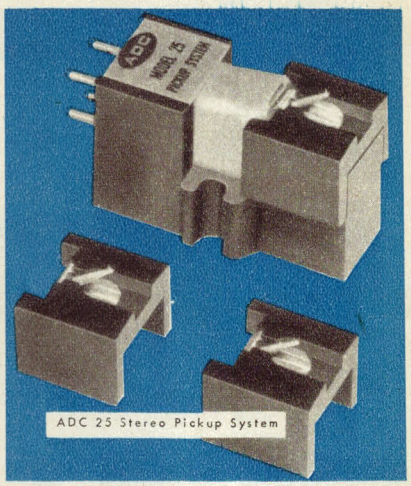
Interest: See above.
Performance: Controversial (see review).
Quality: Astonishingly good.
Stereo: Genuine stereo, good spread.

People who take their classics seriously have never forgiven Stokowski for the liberties he took with the various works included in "Fantasia" and for many years tended to look down their noses whenever the conductor's name or his work were mentioned. Nevertheless, Stokowski achieved what he set out to do — he interested a great many people in classical music who previously might not have had the opportunity or inclination to listen to it. And despite the critics, millions found great enjoyment in listening to the Stokowski versions of these familiar classics, and in fact are still finding enjoyment in them. This is why, nearly 30 years after they were recorded, they are still being issued on disc for the enjoyment of new generations of incipient classics lovers.

Although the music was originally recorded as long ago as the early 1940s, the sound quality and stereo stand comparison with modern day recordings. There is an interesting technical story behind the achievement of Disney Studio engineers, but it can be summarised only very briefly here. The recording was made as a multi-channel optical sound track, on 35mm film, using nine separate channels and microphones. These nine tracks were subsequently mixed and re-recorded on three tracks. A fourth track was used to control dynamic range of each of the three sound tracks independently. At that time, cinemas were not equipped to present high quality stereo sound. Some theatres were specially equipped to take advantage of the system, but most cinemas at that time used the normal sound track which was also available on the film. The system was far in advance of cinema sound techniques current at the time, and no doubt provided the impetus for the numerous similar techniques now in use.

I assume that most purchasers of this set will have seen the film, and will be familiar with the contents, but here is a list as a memory refresher: Toccata and Fugue in D minor (Bach) — The Nutcracker Suite (Tchaikovsky) — The Sorcerer's Apprentice (Dukas) — Rite of Spring (Stravinsky) — Pastoral Symphony (Beethoven — Dance of the Hours (Ponchielli) — Night on Bald Mountain (Moussorgsky) — Ave Maria (Schubert). Most of the pieces were severely edited and curtailed by Stokowski and it is this which offended those who know the works well. Also, it apparently upset some people that Stokowski ran the end of the "Bald Mountain" music into the "Ave Maria" without a break. Still, I do not imagine any of these people will be buying the set. What I do recommend it for is as an introduction to classics for young children, especially if they have seen the film. (H.A.T.)

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sure, try to hear some of it before buying.

The music is of the "lights down low, and relax" type, in gentle mood throughout. The percussion is restrained and unobtrusive, and the disc is cut at low level with restricted dynamic range throughout to maintain the somnambulistic mood. The tunes are a collection of gently flowing melodies too: I'm in the Mood for Love — Whatever Lola Wants — Misirlou — I Surrender Dear — Orchids in the Moonlight — I Love Paris —My Heart Belongs to Daddy — Tabu — The Breeze and I — Aloha Oe — Japanese Sandman — Love is a Many Splendoured Thing. Very pleasant for late evening listening, if you enjoy the style. (H.A.T.)

★ ★ ★

FILM MUSIC—ITALIAN STYLE. The Sunset Strings. Arranged and conducted by Mort Garson. Sunset (Festival) stereo SLS 96081.

Interest: Italian film music.
Performance: Well played.
Quality: Good recording.
Stereo: Normal.

I liked this disc on its first release about two years ago, and commented favourably on the attractive, lively arrangements. Now it has the added attraction of being available at about half the previous price — $2.95 — on the Sunset label. The tunes are all originally from Italian films; some have achieved international fame, while others have not. Here they are: Love Theme from "La Strada" — I'll Set My Love to Music — La Dolce Vita — More — Rossanna's Theme — Anna — Non Dimenticar — All — Funny World — Arrivederci Roma — You Know — Theme from "Fellini's 8½." Despite the title, the Sunset Strings is a full orchestra, with woodwinds. brass and percussion. Originally released on the Liberty label, the disc has been very well recorded. (H.A.T.)

★ ★ ★

SIX HOURS PAST SUNSET. Henry Mancini, piano, with orchestra and chorus. RCA Victor, Dynagroove stereo LSP-4239.

Interest: Mainly for "squares."
Performance: Unexciting, but pleasant.
Quality: Very good.
Stereo: Well spread.

Henry Mancini's amiable style of music is undemanding on either the listener or the performers. Pleasant melodies are framed in lush arrangements in which mellow strings play the major role. Not very exciting perhaps, but a lot of people like it, and Mancini's name on a record is enough to make it a success. Mancini proves that he is also a competent pianist in this selection by adding touches of piano here and there in a fluid, unflashy style. A female choir is also used in some tracks to sing wordlessly—a style which I personally do not like. And that about sums it up, except for the track titles: Softly As I Leave You — Midnight Cowboy — Traces — Natalie — Didn't We — For the Road — Six Hours Past Sunset — Theme from "The Fox" — Quentin's Theme — Girl Talk — Moonlight Sonata. The Dynagroove sound is of the usual high quality, with good stereo spread and definition. (H.A.T.)

ACCORDION NIGHTS. Jack Emblow, with orchestra conducted by Pete Moore. Stereo, Columbia Series 250, SOEX-9468.

Interest: Really orchestra plus accordion.
Performance: A polished group.
Quality: Very clean.
Stereo: Normal.

If you didn't know Jack Emblow before, you certainly will after having read the jacket notes by Nigel Hunter. In brief, Jack Emblow is a professional on the London circuit, who has provided the accordion sound for countless recordings and broadcasts, without necessarily being mentioned by name. He has done soundtracks with Henry Mancini, has had his own sextet and been featured in albums as "Adriano."

He appears in this album with an orchestra which includes four trombones, a strong quartet, an augmented rhythm section and, for some numbers, a female vocalist. Talent is in generous supply and this is much more a pleasant album of orchestra-with-accordion, rather than the other way round.

The 12 tracks: Most Beautiful Girl In The World — Paradise — Speak Low — Charade — Big Deal — The Look Of Love — What Now My Love — I Had To Fall In Love With You — Spring Will Be A Little Late This Year — There Is A Time — Isn't It Romantic — Mischa. Pleasant sound, good value. (W.N.W.)

★ ★ ★

GREATEST HITS. Herb Alpert and the Tijuana Brass. A & M Records (Festival) stereo SAML-933,706. Available in mono.

Interest: Tijuana Brass collection.
Performance: Should have appeal.
Quality: Very good.
Stereo: Mainly "third channel" variety.

Since they first burst upon the entertainment scene about six years ago, Herb Alpert and the Tijuana Brass have made pretty close to a dozen discs. This "Greatest Hits" re-issue is long overdue, and I am sure it will be a great success commercially. The group's first big hit, "Lonely Bull," takes pride of place as the opening track, followed by Spanish Flea — Getting Sentimental Over You — Love Potion No. 9 — Never On Sunday — Mexican Shuffle — Taste of Honey — Tijuana Taxi — South of the Border — America — Whipped Cream — Zorba The Greek. What more is there to say? If you are a Tijuana Brass fan, you will know if this selection is in line with your idea of the group's best track and will make your decision accordingly. The sound quality of A & M records has been consistently good and this one is no exception. (H.A.T.)

★ ★ ★

THE LATIN TOUCH OF PEPE MERTO. By Toshiyuki Miyama and The New Hard Orchestra. Stereo, Crest International, CRT INT-001. (From Crest Record Co., 291 Tooronga Road, Tooranga, Vic.)

Interest: "Latinised" hit tunes.
Performance: Very professional.
Quality: Completely clean.
Stereo: Wide spread.

A real international effort, this. Pepe Merto was born and trained in the Philippines, his particular "thing" being the re-arrangement of popular

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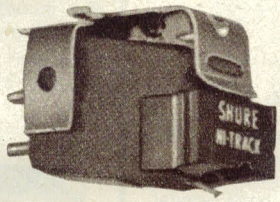
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hit tunes into Latin Rhythms. This particular group of Pepe Merto arrangements is played by a Japanese orchestra, recorded by Nippon Crown in Tokyo, manufactured in New Zealand by E.M.I. and released in Australia through Crest!

Into cha-cha, bossa nova, mambo and racombia rhythms, Pepe Merto has squeezed a dozen popular tunes, including "Hello Dolly"—"Yesterdays" —"I Love Paris"—"Volare"—"Sayonara" and "South Of The Border." His ability to adapt and rearrange the tunes is never in doubt, nor is the ability of the orchestra to handle them, but my own feeling was that most people would prefer them the way they were, leaving the Latin rhythms to tunes that started out that way. Still, if you're curious about Latinised hit tunes, this album will satisfy the feeling. (W.N.W.)

★ ★ ★

WHAT A WONDERFUL WORLD. The Glorious Trumpet of Gus Galbraith. Compatible stereo, Crest International CRINT-101. (From Crest Record Co., 291 Tooronga Rd., Tooronga, Vic.)

Interest: Trumpet melodies.
Performance: Smooth.
Quality: Normal.
Stereo: Normal.

Gus Balbraith has a name but, as far as the jacket is concerned, no other identity. The album was apparently released under the Gallo label, re-issued in New Zealand and released here by Crest.

The titles certainly include some favourites: Sailor — Be My Love — Wonderland By Night — What A Wonderful World — Elizabethan Serenade — Morgan — Love Is Blue — Always — Lil Marlene — Song of Kransdraai — Fraulein — Eyes Of A Woman In Love.

Backed by a smallish orchestral group, Gus Galbraith plays the numbers smoothly and pleasantly — but "Glorious" is a big adjective for a trumpeter to live up to! As I said, it's smooth and pleasant. (W.N.W.)

★ ★ ★

FAREWELL MR BLACKPOOL. Reginald Dixon at the Organ of the Tower Ballroom, Blackpool. Stereo, Columbia, SCXO-6387.

Interest: Farewell to Blackpool.
Performance: Facile but . . .
Quality: Excellent.
Stereo: Adds dimension.

In the jacket notes, Reginald Dixon recalls that it was in 1930, after only a year's experience or so as an organist, that he auditioned at Blackpool, playing his time honoured solo "I Do Like To Be Beside The Seaside." Since then, apart from a break during the war, he has played at Blackpool, seven days a week, for several months of the year. And, of course, he has broadcast regularly and made many recordings.

His dexterity at the keyboards is amply demonstrated in this farewell performance but, particularly through side 1, much of the music is in strict (and hurried) tempo. This will probably bring back nostalgic memories to Blackpool holiday makers who have danced to that kind of music but, for others, it will seem rather mechanical.

Side 2 is more divorced from the ballroom atmosphere and, to judge from the lack of applause at the end of the final number, was recorded without an audience being present.

All told, there are 15 tracks, some of them medleys, with titles far too numerous to list. But rest assured, they are the well known numbers that Dixon must have played countless times.

Organ enthusiasts will probably want this farewell performance, but my guess is that we will hear more and better Reginal Dixon albums, when he gets away from the job-of-work atmosphere of the Ballroom and into more discriminating concert situations around the world. (W.N.W.)

★ ★ ★

SOUNDS EXCITING. Ken Higgins, piano. Crest International stereo CRINT-102. (Sound and Film Enterprises, 291a Tooronga Road Tooronga, Vic., 3146.)

Interest: Cocktail piano.
Performance: High standard.
Quality: Excellent.
Stereo: Normal.

Who is Ken Higgins? I confess the name is new to me, and with no sleeve note to offer information I can only speculate, particularly as the origins of this disc are not indicated. It is clear from the first track that he is a specialist in the style known as "cocktail piano," a smooth, relaxed and rippling style, using brush swept drums and bass as support, and my guess is that he is British, and this disc originates from the U.K. The program comprises current and recent hits, mostly in medley form, and since there are 22 titles represented it is not possible to give them all, but here is a selection: Somethin' Stupid — Guantanamera — Lara's Theme — Alfie — Georgie Girl — There's a Kind of Hush — What Now My Love — Love is Blue — If I Were a Rich Man — Spanish Flea.

That would be just about all one could say about this disc except for one thing — Ken Higgins' playing is of a very high standard indeed, demonstrating the many delightful touches and finesse that distinguishes a true artist from a mere performer. If you favour the cocktail piano style, you should try to hear this one. The recording is of excellent quality. (H.A.T.)

★ ★ ★

GREAT TENOR ARIAS, sung in Italian by Charles Craig, with orchestra conducted by Michael Collins. Music for Pleasure, stereo MFPA 9034.

Interest: Lyric tenor.
Performance: Delightful.
Quality: 1959 vintage, but still good.
Stereo: Ersatz.

I confess I do not remember any previous recordings by Charles Craig, and I was quite astonished to hear his remarkable, beautifully controlled tenor voice in this low-priced disc. I was even more surprised to find that this disc was made in 1959. A check through record catalogues revealed his participation in only two more recordings. Why an artist of this calibre is not recording regularly is one of those mysteries of the recording industry for which there appears to be no answer. Perhaps if he had changed his name to Carlo Craigini he might have been more successful. The generous 14 tracks include such popular items as Your Tiny Hand is Frozen —Questo o Quella —La Donna e Mobile — A Furtive Tear — None Shall Sleep, and others from Aida, Girl of the Golden West, Tosca, Manon Lescant, Pagliacci, Faust, and so on. A first class performance, with the 1959 sound still remarkably good, and excellent value at $1.99. (H.A.T.)

★ ★ ★

OL' MAN RIVER. Paul Robeson. Encore (E.M.I.) mono only OELP 9605.

Interest: Unique bass voice.
Performance: Classic tracks
Quality: Good remaster.

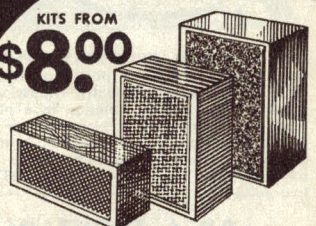
These tracks made many years ago by Paul Robeson have turned up on numerous LP discs, and whether there is still a market for them is debatable. I have them all already, some of them more than once, but I still obtained considerable pleasure in listening to this unique bass voice once again, and this particular reissue has been rather better remastered than the others. At $2.50 it is certainly worth having. The 12 tracks are: Canoe Song — Land of My Fathers — Just a Wearyin' for You — Deep River — Mighty Lak a Rose — Fat Li'l Feller —Trees — Mah Lindy Lou —Shenandoah — My Old Kentucky Home —Ma Curly Headed Baby —Ol' Man River. As I mentioned already, the tracks have been well remastered, but don't expect hi-fi. (H.A.T.)

NEW BALLADS. Rod McKuen. Arranged and conducted by Don Costa. Warner Bros (Australian Record Company) stereo WS 1837.

Interest: Folk singer.
Performance: Routine.
Quality: Very good.
Stereo: Prominent "centre channel."

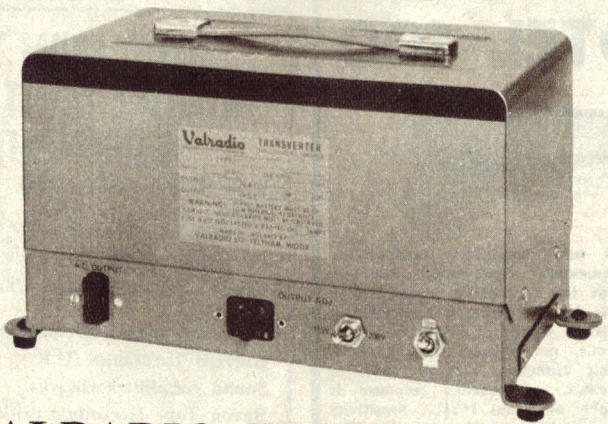
Husky-voiced Rod McKuen does not rate as a singer in my book, but his throaty talking style apparently has tre-

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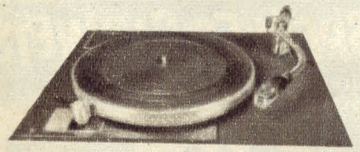
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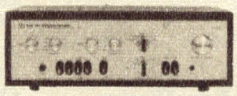
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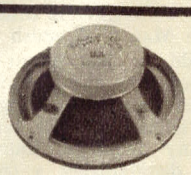
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CHILDREN'S SONGS OF MANY LANDS. Hilde Gueden, soprano, with the Vienna Volksoper Orchestra, conducted by Georg Fischer. Decca (E.M.I.) stereo SXLA 6424.

Interest: For the small fry.
Performance: Charming, but too mature.
Quality: Good standard.
Stereo: Normal.

As the title implies, this is a disc for the tiny tots, but I am sure many grown ups will feel a flush of nostalgia when they hear the particular songs they knew in their childhood. "Songs from many lands" is a bit of an exaggeration, as only four countries are represented — Germany, Britain, France and Italy. Side one has 16 German songs, not all of them strictly children's songs — a few, such as "Guter Mond, du gehst so stille" have achieved the status of popular folk songs. Others, such as "Die Blumelein sie schlafen" have achieved popularity outside the German borders. Eight of the most familiar children's songs are in the British selection, and since these will probably have the main interest to most Australian buyers, I list them in full: Sing a Song of Sixpence — Hickory Dickory Dock — Hush-a-bye Baby — Oranges and Lemons — Baa Baa Black Sheep — Three Blind Mice — I Had a Little Nut Tree —Bye Baby Bunting — The Mulberry Bush.

Three of the five French songs are also very familiar items: Frere Jacques — Sur le Pont D'Avignon — Au Clair de la Lune. I did not know any of the four Italian tunes, but they are all charming little melodies. All told then, no less than 35 songs. I do not imagine any small child will listen right through, but the small fry in my household listened spasmodically and uttered squeals of joy whenever they recognised a tune. Hilde Gueden's rather sophisticated operatic soprano is possibly a little too mature sounding for this material, but she sings charmingly. (H.A.T.)

mendous appeal to a great many people. He is certainly cashing in on his present popularity and the rate at which he is turning out new songs is little short of astonishing. I believe that till now he has sung only his own material, but in this disc he has included Leo Ferre's "And Tonight" and one number for which he wrote the lyrics to Jacques Brel's music — "I'm Not Afraid." I don't believe any of the numbers on this disc has achieved Top 40 status, but for the record, here they are: As I Love My Own — All I Need —Thank You for Christmas — I Looked At You a Long Time—Resolution—Before I Loved No One — Rock Gently —Philadelphia — Gone With the Cowboys — Tomorrow and Today — In Some One's Shadow — Hit 'Em in the Head with Love — A While More With You. Not McKuen's best effort. (H.A.T.)

★ ★ ★

CHANSONS. Francoise Hardy. Vogue (Festival) stereo SVL-933705. Available in mono.

Interest: French ballads.
Performance: Likable.
Quality: Very good.
Stereo: Prominent "centre channel."

Francoise Hardy fans certainly cannot complain that they are being neglected by Festival. This must be something like the tenth disc to be issued since Festival took over the Vogue label last year. This is fine in its way — M'selle Hardy is always nice to hear, with her gentle singing style and her pensive questioning type of song. However, there is a noticeable tendency for Vogue to use the same tracks in different releases, and at least half of the tracks included here have been used previously. The titles: La Maison Ou J'ai Grandi — Voila — Le Temps de L'Amour — Comme Tant D'Autres — Qui Aime-t-il Vraiment — Oh Oh Cheri — Le Premier Bonheur du Jour — Ton Meilleur Ami — J'Aurai Voulu — L'Amour d'un Garcon — Je Suis D'Accord. As usual, Francoise uses only light orchestral support, dominating the action all through with her vocals and guitar accompaniments, and sings exclusively in French. One of these days a record company might think to offer translations, but that time has not yet come. (H.A.T.)

★ ★ ★

SPANISH ALBUM. The Sandpipers. A and M (Festival) stereo SAML-933,753. Available in mono.

Interest: Spanish versions of popular ballads.
Performance: Pleasantly styled.
Quality: Very good.
Stereo: Normal.

The pleasing style of harmony which this young Latin American singing trio project in their performances has won for them a wide following in all parts of the world, but a disc sung entirely in Spanish does seem to restrict the interest to some extent. Since most of the songs originally had English lyrics, I can only assume that the main target for this release was the Spanish speaking countries. The selection consists of: Let Go — Wave — All My Loving — Love is Blue — To Put Up With You — That Night — Born Free — Pretty Flamingo — Yellow Days — The More I See You — A Man Without Love. As usual with this group, orchestral support is nominal and restrained, with guitars playing a major role. Nicely recorded, it makes pleasant listening, and can be recommended if you do not object to the Spanish lyrics. (H.A.T.)

★ ★ ★

THE SANDPIPERS' GREATEST HITS. The Sandpipers. A and M (Festival) stereo SAML-933,707. Available in mono.

Interest: As per title.
Performance: Good selection of tracks.
Quality: Very good.
Stereo: Normal.

This re-issue of some of the best tracks the Sandpipers have recorded has a much wider interest than the one reviewed above, particularly for those who have not already acquired the group's previous releases. It begins with "Guantanamera" with which the Sandpipers first won recognition, and

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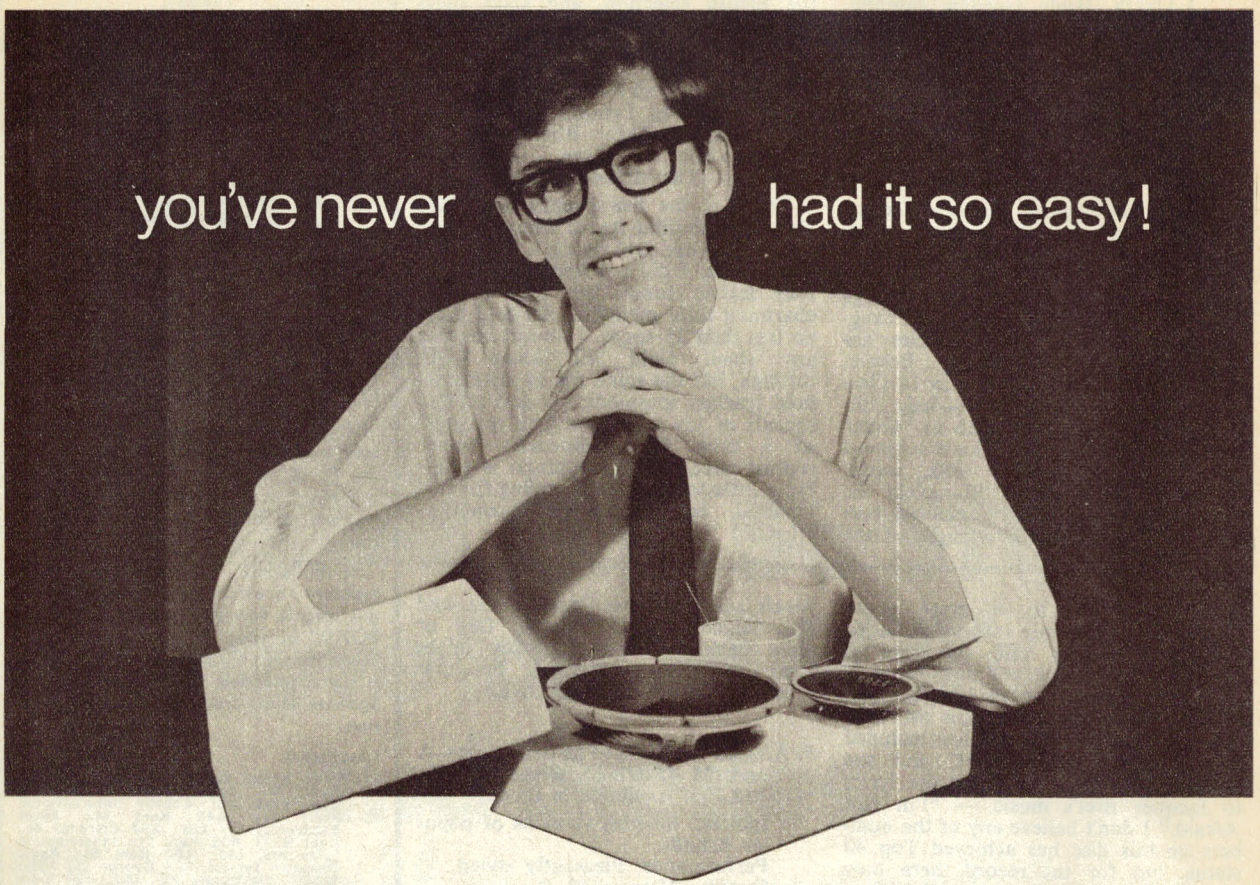
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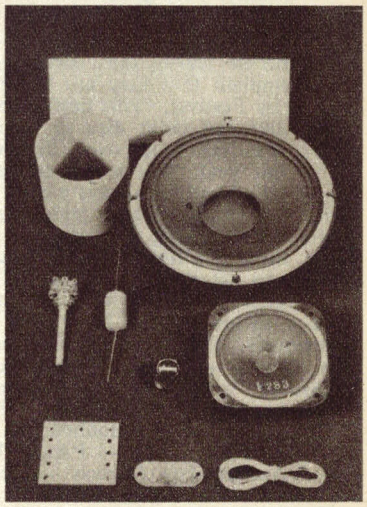
here is a completely new Rola speaker system- in kit form!

Now you can easily make up your own high efficiency, wide range speaker system at low cost! Plessey Rola has released a new kit containing two newly developed loudspeakers, all necessary electrical componentry and details to construct the small 17″ x 10½″ x 8¾″ overall enclosure. You get: A Plessey Rola C60 woofer and C3GX tweeter, a special tunnel port, hook-up wire, cross-over condenser, 50 ohm potentiometer, control knob, component mounting board, external terminals and construction details — all securely packed in polystyrene. **The completed 0.625 cu. ft. system has a frequency response from 50 Hz to 19 kHz and will handle 10 watts RMS.**

C60 Woofer
A new highly compliant, high efficiency bass speaker offering optimum performance in small enclosures. Response is from 35 Hz to 7,500 Hz±6dB. The specially treated heavy mass cone achieves sharp cut-off at the 5,000 Hz cross-over point. The 1 lb. 11 oz. magnet assembly with air gap flux density of 12,000 gauss minimises transient distortion.

C3GX Tweeter
A new curvilinear cone tweeter with flat response from 1,500 Hz to 19 kHz±6dB. The cone is designed to achieve a sharp, low frequency cut-off. With suitable cross-over this speaker can be used in a 10 watts RMS system.

kit components



PLESSEY
Rola

Plessey Rola Pty Limited
The Boulevard Richmond Victoria 3121
Telephone 42 3921 Telex 30383
NSW PO Box 2 Villawood 2163
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AR31

follows on with All My Loving — And I Love Her —Quando M'Innamoro — Misty Roses — Cancion de Amor — Angelica — Enamorado — Cuando Sali de Cuba. One would have thought by now that A and M would have identified the members of the group by name, and indicated which of them has the fine counter tenor voice which adds such a distictive character to the group's performances, but anonymous status has been preserved. This is probably the best selection of tunes on one disc the group has had released to date, but it is a pity that there are only ten tracks, with a total playing time of under 30 minutes. This seems a bit light on for reissue material. (H.A.T.)

★ ★ ★

THE WORLD OF BRITISH COMEDY. Mono, Decca Series 250, PA-39.

Interest: As per title.
Performance: Accomplished entertainers.
Quality: Good.

Perhaps we should begin by listing the contents of this album: The Great Bell (Marty Feldman) — Ten Guinea Cruise (Frankie Howerd) — Cold Porridge (Spike Milligan) — Eeh Ah Oh Ooh (The Goons) — The Sunday Ben (Benny Hill) — Pontius Kak-Story (Spike Milligan) — Hand Up Your Sticks (Kenneth Williams) — Holy Smoke (Spike Milligan) — The Ballad Of Bethnal Green (Paddy Roberts) — The Missing Page (Tony Hancock) — The Great Man Story (Spike Milligan) — Father And Son (Peter Cook and Dudley Moore).

If you like this sort of material, you'll maybe roll on the carpet; if you don't, it will bore you to tears. If you're an average listener, the album as a whole will produce periods of boredom punctuated with a few giggles. Very much a matter of taste. (W.N.W.)



"We've Finished."
(TV Times)

Music for Pleasure Releases

The pick of the latest Music for Pleasure releases to reach us is **"Nelson Riddle Swings in Stereo."** (MFPA-8134). The Nelson Riddle Orchestra, in the tradition of American Big Bands, are all highly trained musicians. You might think that one Big Band sounds like any other, but they do not all have the advantage of an arranger with Mr Riddle's expertise. Listen to his arrangement of "The Green Leaves of Summer," where the scoring features the unlikely yet very effective combination of harmonica and guitar, to see what a really skilful arranger can do. I judge this disc to have been recorded about five years ago, and the sound is of good standard. Tracks also include: Lisboa Antigua — Younger Than Springtime — Drive In — Volare — De Guello; and six others, including a number of themes from TV shows.

Another disc which can be recommended is **"The Italian Voice of Al Martino"** (MFPA 8136). Mr Martino wraps his fine Italian tenor round a selection of traditional and modern Italian songs, such as Maria Mari — Torna — Chitarra Romana — Al Di La — Torna a Surriento (12 tracks in all). It is hard to judge the age of the recording, but the sound is dated, and the stereo sounds artificial.

Two discs which are superficially similar are **Smooth**, featuring the Mike Sammes Singers (MFPA 8135); and Great Film Themes, No. 5, with the New Hollywood Orchestra and Chorus (MFPA 8139). The Hollywood group sound like studio artists assembled especially for this recording, sight-reading their charts competently but without much enthusiasm. Their selection includes Singin' in the Rain — Chim Chim Cheree — Buttons and Bows — Getting to Know You — Put the Blame on Mame (11 tracks in all). This is a 1969 recording, with good modern sound.

The Mike Sammes singers are a different proposition entirely. They sing with a verve and joie de vivre which is quite infectious — in fact they really sound as though they are enjoying what they are doing. Their selection comprises show tunes and numbers which were popular in 1964, when these tracks were recorded: This Could Be The Start Of Something Big — The Surrey With the Fringe on Top — Guys and Dolls — Girl From Ipanema — Lollipops and Roses; plus seven more.

In **Deuces Wild,** popular Frankie Laine presents a C and W program, with emphasis on gambling, including such numbers as The Hard Way — Camptown Races—Luck be a Lady—Get Rich Quick—Moonlight Gambler—Ace in the Hole. (12 tracks in all). The recording is presumably a few years old now, but the sound is still good, and the disc is excellent value for Frankie Laine fans.

MFP's classic offering this month does not have much to recommend it, unless you are a fervent Welshman. Titled **Finlandia** (MFPA 9035), it is a new recording by the National Youth Orchestra of Wales, playing a rather strange assembly of music: Fanfare for a Special Occasion (Walton) — Welsh National Anthem — Welsh Dances, 2nd Suite (Hoddinott) — Finlandia (Sibelius) — Fantasia on Welsh Nursery Tunes (Grace Williams) — Trumpet Voluntary (Jeremiah Clarke) — Carnival Romain (Berlioz). While one may praise the efforts of a group of young people in reaching the standard exhibited here, quite understandably they are not in the same class as the great orchestras usually found on disc. I think you would have to have a special interest in the orchestra or the music to make this a proposition. This is also a new recording, of good modern standard. (H.A.T.)

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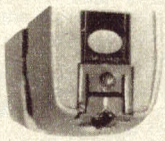
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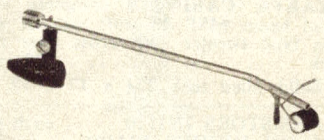
MICRO



MA-77 Mk. II Static Balance Tone Arm — high sensitivity arm with split and revolving counterweight for easy balancing adjustment. Anti-skating device eliminates inside-force distortion. Oil dampened arm lift incorporated. $44.50.



VF-3100E — with elliptical diamond stylus; VF-3100/5 — with conical diamond stylus. Both track effectively at 1.5 gm. Stylii are replaceable. VF-3100 has established a new performance standard for lower priced magnetic cartridges. Prices: 3100/5, $19.50; 3100E $24.50; 2100/5, $14.50.



MDA-3 Dust Bug — Take good care of your discs . . . picks up dust automatically as the record plays, $4.20. Ask also about the Micro D5B-1 shock absorber. No hi-fi buff should be without one.

Encel's is where professionals and amateurs both are cared for to their complete satisfaction. You have the largest choice, the best advice from fully trained sales advisers, highly qualified service technicians using the most extensive electronic test equipment. All this, and the keenest prices in town!

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TUDOR RADIO

L. E. CHAPMAN
ESTABLISHED 1940

103 ENMORE ROAD, ENMORE, N.S.W.

PHONE 51-1011

NEW POSTAGE RATES PLEASE ADD EXTRA

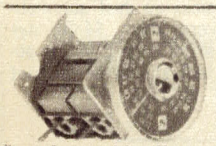
Knobs long shaft, push on. Dozen **$1.20**
Knobs for concentric shaft. Dozen **$1.20**
250 mixed screws. BA, Whit., self-tapper bolts, nuts, etc. **$1** bag plus 25c post.
Crystal microphones, good quality, ideal tape recorders, etc. **$2.80.**
Transistor speaker transformers, single ended, 5 watt. **$1.50.**
Pick up shielded Wire .. **20 cents** yard.

SPEAKERS

MSP 8-inch dual cone **$6.50**
M.S.P. 12 inch dual cone **$9.50**
MSP 7 x 5 15 ohm **$4.00**
SPEAKER 3¼ ohm 4 inch **$2.50**; 6 inch M.S.P. Dual cone 6 or 8 ohm **$6.50**
Rola 6 x 4 15 ohm **$3.50**
Rola 5 x 3 15 or 27 ohm **$2.50**
MSP 6 x 9 15 ohm **$5.00**
3-inch single cone 15 ohm **$4.20**
MSP 12-inch 8 ohm **$8.50**
MSP 8-inch dual cone, 8 ohm .. **$6.50**
MSP 12-inch-3.5 ohm **$6.00**
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Pots, Diodes, Transistors, Speakers, Tuners, etc.

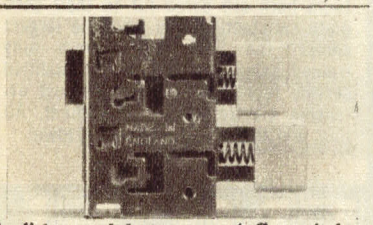
SPEAKER CABINETS complete with radial beam MSP 20 watt speaker and horn type tweeter with cross over network .. .. **$70 each**
Solid oiled teak 23½ x 17 x 12.

TRANSISTORS 2N1110 .. .. each **40c**
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DIODES OA79 .. .. **40c**
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SMALL 2-GANG TUNING CONDENSERS
Complete with direct drive scale **$1.75**

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English push-button on/off switches, **75c** each. Pack and post **10c.**

MIXED RESISTORS, 3.5 and 10 WATT I.R.C., **25 for $2.**

TRANSISTOR AMPLIFIERS. Peak stereo in oiled teak cabinets 3½ watts per channel **$39**

Curled expanding shielded wire approx. 7 yards **$1.50**
Miniature valve sockets 7 and 9 pin **15 cents** each.
Speaker Crossover network Condensers 2 MFD — **60 cents.**
Philips IFT's 455KC ..... **75c** each
Aerial and oscillator coils .. **50c** each

Transistor IFs, medium size, **75c** each

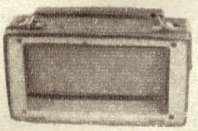


PORTABLE PHILIPS RECORD PLAYER
$7.75 6 Volts.

Speaker transformers 15,000 and 25,000 to 3 ohms 6 watts ....**$1.50** each
5,000 to 3 and 15 ohms .. **$1.25** each

POTS

1 meg. 2 pole switch **95c**
100K switch 2 pole log **50c**
10K carbon or wire wound **50c**
1.5 linear **50c**
½meg log **50c**
250 Dual Ganged Log Pots. .. **$1.25**
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50K Lin **50c**
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2 meg log 2 pol **$1.25**
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200K 1in **50c**
250K log **50c**
2K 1in slotted **25c**
50 ohm **50c**
250K 1in **50c**
100K 1in **50c**
½meg 1in **50c**
50 log switch **75c**
1 meg dual ganged log **$1.25**
2 meg 1in **50c**



$1.00

Transistor case, leather, 7 x 4½ x 3. Pack and post 30c.



STEREO AMPLIFIER KIT SETS
TU 10, 3.5 watt per channel .. **$19**
TU 11, 3.5 watt per channel, has facilities for tape and microphone channels **$23**
TU 12, 5 watt per channel .. **$22.00**
TU 13, 5 watt per channel, with TU 11 facilities **$27**
Each kit set includes valves and all components. Front face plate, if required, **$1** extra.
Single stage amplifier kit set:
5 watt per channel **$22.00**
Transistor ear plugs .. .. 3 for **$1.00**
Tag strips, mixed types .. Dozen, **60c**
Switches, oak 4 position .. **50c** each
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3¼ AMP. FUSES **$3.50** 100.

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3 in one		
50	250	415
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75 cents each.

SOLID STATE STEREO TAPE RECORDER
Oki 300 10 transistor **$130** pack and post $1.50.
HITACHI FM AM SOLID STATE STEREOGRAM
16 watts per channel magnetic cartridge balanced tone arm cost **$425**, sell **$225.**
B.S.R. 4-SPEED GRAMOPHONE MOTOR AND PICK-UP $12.50.
Pack and Post 60 cents.

METAL RECTIFIER, 150 watt, ½ amp, **$1 each.**

TV aerial lead in .. .. .. **10c** yard
Tuning Condensers, 2 gang or 3 gang —**$1** each.

2 amp fuses .. .. .. **$3.50** per 100
Transistor plastic outer case, **50c** each
Stereo pick-up arms, with Xtal, **$6.00** ea.
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Pilot lamp holders .. .. **60c** per doz.
100 Mixed Knobs including TV channel changers **$10.00**
3¼ amp Fuses .. .. .. **$3.50** per 100
10 for **50c**

AMPLIFIERS SOLID STATE
8 watts R.M.S. per Channel .. **$65.00**

STEREOGRAM CHASSIS
7 valve microphone and tape recorder connections **$50.00**

Morganite and IRC resistors. At least 33 values. Suit transistors, radios, TV etc., **$2.00** per 100. Pack and post, **25c.**
100 mixed condensers, micas, ceramics. tubular. Fresh stock.
$2.00. Pack and post **25c.**
50 + 24, 350 vw + 100 mf 25 vw, **75c** each
30, 30mf 300 vw 350vp .. **75c** each
Many others. Invaluable for service.

2 meg. Lin Pots **50c**
R.C.A. 7 INCH TAPE SPOOLS 75 cents



SPEAKER CABINET, 16 x 10 x 8½ COMPLETE WITH BACK SUIT 6in or 8in SPEAKER, **$10**

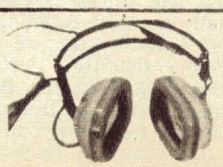
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18-4294, 28-4536 .. .. **75 cents** each

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SWITCH WAFERS
20 cents each.

B.S.R. Record Changers Ua 25. **$25.00**
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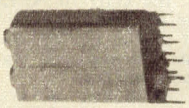
PHILIPS E.H.T. TRANSFORMERS, 110 DEG., **$5.**
M.S.P. E.H.T. TRANSFORMERS, 40773 BK9, **$4.50.**



Stereo Head Phones, good quality, **$9.00**

NEW VALVES

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12AT7	$1.25	6CK5	$1.25
12Ax7	$1.75	3OAE3	$1.50
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6BW8	—	50EH5	$1.50
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12AH8	$1.25	6BA8	$1.50
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12AQ5	$1.25	EA50	$1.25
12AV6	—	6BD7	$1.25
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6AT6	—	6AN7	$1.75
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TV IF COILS, IDEAL FOR COIL FORMERS .. .. $1 dozen



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13 x 6¼ $5.00
10 x 6 x 4½ $3.50
12½ x 8¼ x 6 .. .. $5.00

General Portable TV 9 inch cabinets. **$12.**

General 9 inch TV picture tubes. $25



Car radio push button tuner .. $4.50
Pack and post 30c, Interstate 60c.

DIAL DRUMS, 5 inch, 3½, 3¾, 50c ea.



TV POWER TRANSFORMER, $8.
300 mil. Two 6.3 windings, 200 volt secondary for Bridge Type Rectifier.

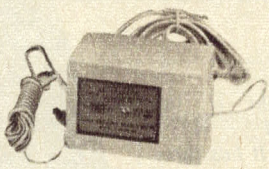


50 M CHOKE $1.
Pack and Post 30 cents, Interstate 60 cents.
300M Choke $2.50.

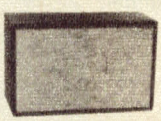


SPEAKER CABINET, 9½ x 9½ x 5½, **$4.**
Suit 8in Speaker. or 6in.

M.S.P. MODEL 2MBC TWEETER SPEAKER. RANGE 5KHZ TO 20KHZ. NEW RELEASE, $4.50.

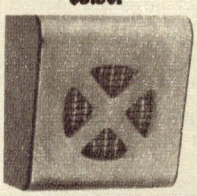


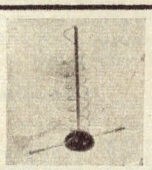
BATTERY SAVER, 6 or 9 volt DC 100MA $8.50; 300MA, $10.00.



SPEAKER ENCLOSURE, complete with 8in M.S.P. dual-cone speaker, 8 or 15 ohm **$15.80**
Cabinet without speaker **$10**
Cabinet size 16 x 10 x 8.

TRANSISTOR EXTENSION CABINETS
Complete with 5-inch speaker and lead. **$3.50.**





INDOOR TV AERIALS $1.50.
Pack and Post 25c.

STEREO AMPLIFIER 10 watts per channel solid state AT6 Garrard record changer, oiled teak cabinet, complete unit **$125**
Same unit with Garrard 3000 changer, **$115.**

TAPE RECORDER COUNTERS $1.75

POTS

1 meg. Dual Ganged Log $1.25
1 meg. Dual Ganged Lin $1.25
½ meg. Switch Pot double pole log 75c

6 VOLT PILOT LIGHT, screw in .. .. **ea. 10c**

RESIN CORE SOLDER 5 yards 75c

N.E.C. Cassette tape recorder cost $89. Sell new **$59.00**

Tab pots 500 ohm 1in .. .. .. 20c ea

Electrolytic Capacitors
8MFD 450 WK 550 surge. **4 for $1.00**

CAR RADIOS, SOLID STATE, PUSH-BUTTON 8—6 VOLT. $45.

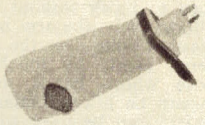


Ducon 2 pole dual concentric switch pots log 500K CT 100K 1 meg **75c**

STEREO SPEAKER LEAD, 10 cents yd.



DISCATRON CABINETS $2 EACH.



GARRARD PLUG IN STEREO CARTRIDGE, $6.00

TRADED-IN RECORD-CHANGERS. GOOD ORDER. $12 EACH.

SOLID STATE AMPLIFIER IN OILED TEAK CABINET, COMPLETE WITH MA70 B.S.R. RECORD-CHANGER, $85.

RADIOGRAM CABINET FOR STEREO, 3ft 5in x 14in x 15in. LEGS SUPPLIED. $15.

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TRADE REVIEWS AND RELEASES

Automatic single record player

British Merchandising Pty. Ltd. recently submitted for review a Garrard AP75, an automatic single record playing unit which is one of the most popular in the Garrard range. The AP75 features a balanced arm, anti-skating compensation and hydraulically damped lowering of the arm.

For the person who does not want a fully automatic record changer but requires the convenience of automatic play without having to manually lower the arm, a player of this type is probably the ideal compromise. It enables any record to be played from start to finish without touching the arm. Alternatively, the arm may be moved to the desired point over the record and then lowered gently by touching a lever, For those whose hands do not shake, the arm can be lowered manually. In short, the AP75 can be used with the convenience of an automatic player or as a manually operated turntable.

In appearance, the unit follows the current trends. The pressed steel baseplate is finished in black with a chrome-edged control panel. The turntable rubber mat has a brushed aluminium insert. The overall finish is quite good although this reviewer would prefer to see less plastic used in such a device, which should be as robust as possible.

The turntable itself is a zinc diecasting with a diameter of 10¼ inches. The motor is a 4-pole induction type which is magnetically screened and resiliently mounted. The drive system is the usual stepped pulley and idler whel mechanism. There are three speeds, and the idler wheel is disengaged when the unit is switched off. The output signal from the cartridge is shorted out when the unit is going through its change cycle, by a switch operated from the main cam, so that no "clicks" or other noises are fed to the amplifier.

The balanced arm is made from a length of extruded aluminium of rectangular section. The counterweight is set by sliding it to the desired setting with the aid of a knurled wheel. Tracking force is adjusted by means of a dial on the side of the arm pivot. The dial is graduated from 0 to 6 grams in ¼ gram steps. The calibrations are accurate to within ¼ gram. Anti-skating compensation is applied by adjusting a sliding weight on a small plastic lever which is attached to the arm pivot.

Effective length of the arm (stylus to pivot) is about 8¼ inches. Tracking error will depend on the particular cartridge used, since there is no means of adjusting stylus overhang. Cartridges are easily mounted on the slide-in plastic cartridge-mounting plate. The stylus overhang could be optimised for a particular cartridge if the user was willing to drill and tap the plate but most users will not be equipped to undertake this task.

The operating controls consist of three small levers. The Auto lever initiates the automatic play cycle. It can be moved to "Stop" at any time. The manual lever switches the motor on or off and is used to operate the lifting and lowering facility. The speed selector also selects, automatically, the size of disc to be played.



At right is the Garrard AP75 player. It has three speeds, a balanced arm and anti-skating compensation.

In operation, the Garrard AP75 functions smoothly and quietly. The cartridge was lowered quite gently at 33-1/3 rpm in the automatic mode but was dropped rather abruptly at the higher speeds of 45-rpm and 78rpm. In contrast, the hydraulically damped lowering device used for manual cueing is quite smooth in action but it appears to be inoperative when the unit is used in the automatic mode. By way of explanation, the arm is lowered by a subsidiary cam driven by the main cam when the unit is in the automatic mode. When the arm is lowered using the cueing facility it is allowed to fall under its own weight but is damped by a hydraulic cylinder. Some automatic record changers allow the two lowering functions to be used in tandem so that the cartridge can be lowered very gently at all times.

Rumble was better than —30dB using the W & G 25/2434 test record, a figure which is adequate for most cartridges. However, induced hum from the motor and mains wiring may be a problem with some magnetic cartridges.

We found that the player mechanism worked reliably at all stylus forces above 1 gram. Below this, it depended on the setting of the anti-skating compensation as to whether the mechanism would "trip" or not. As such the unit is probably suitable for use with all but the highest quality cartridges.

In listening tests, with the unit set up with a combination of other good quality equipment, we found the rumble level to be quite satisfactory and no switching transients from the motor were evident.

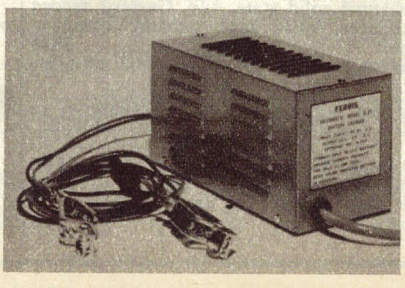
We found that even deliberately hamfisted operation did not unduly affect the operation of the player. All attempts we made to jam the mechanism failed. This is particularly reassuring, since record players in the past have been notoriously easy to jam, especially at parties. If a record players is to be used by children one that is easily jammed should be avoided at all costs; it will almost certainly be jammed during the children's first listening session. With the Garrard AP75, however, the doting parent need have no fears for the mechanism, although he may be wise to install an economy cartridge.

In short, the Garrard AP75 fulfils well the purpose for which it is intended. It is suitable for all but the highest quality cartridges and it provides a high degree of operating convenience.

Garrard equipment is available from most retail outlets of high fidelity equipment. The Garrard AP75, less cartridge and mounting base, retails for $86.30, including tax. The unit submitted for review came from British Merchandising Pty. Ltd., 49-51 York St., Sydney, N.S.W., the Australian distributors for Garrard equipment to the retail trade. (L.D.S.)

Ferris 15ST Buzzamatic Battery Charger

The Ferris 15ST Buzzamatic Battery Charger is a compact unit measuring 7¼ x 3-3/8in x 4in. The pressed metal case is 20-gauge steel finished in durable silver hammertone enamel. It is intended for charging 12V lead acid batteries from the 240V AC mains. The charge rate is a maximum of 5 amps which is reduced according to the state of charge and general condition of the battery.

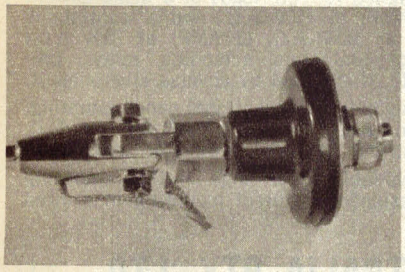


Full wave rectification is used and the unit emits a "buzzing" sound to indicate that charging is taking place. The unit has been approved by the N.S.W. Electricity Authority (Approval No. N154). The retail price is $18.90. Inquiries to Ferris Bros. Pty. Ltd., P.O. Box 36, Brookvale, N.S.W. 2100.

Amateur VHF Aerial

A. W. Barrs Pty. Ltd., manufacturers of a wide range of radio aerials, are planning to produce a VHF communication aerial suitable for the 6 metre amateur band.

The new aerial will be similar to the current standard models designed for the low band communication channels, but extended in length to accommodate the lower frequency. There are, in fact, two standard models in the current range, one featuring an elbow base (pictured) designed to fold back on striking an obstruction, and the other a spring loaded base, which reverts automatically to the upright position after striking an obstruction. The 6 metre version will be available on either base.



A feature of these aerials is that, while the length is readily adjustable to suit the exact frequency, they do not suffer from the losses which often occur in simple telescopic designs. There is only one sliding junction in these aerials, and this is secured with a domed hexagon locking nut, thus ensuring effective contact.

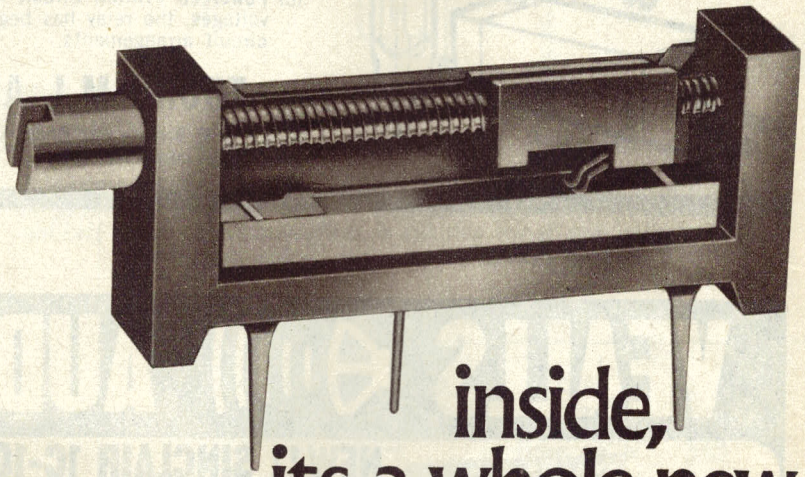


The aerials are high-quality commercial units designed for hard wear. If damaged, all spare parts are readily available.

Further details, prices etc., from the makers, A. W. Barrs Pty. Ltd., 99 Crown Street, Sydney.



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For further particulars please contact your nearest distributor.

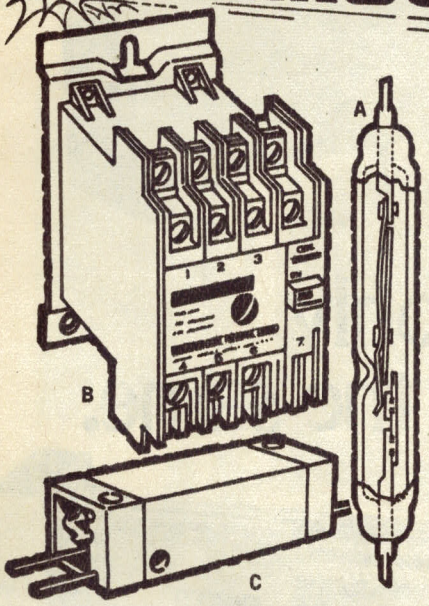
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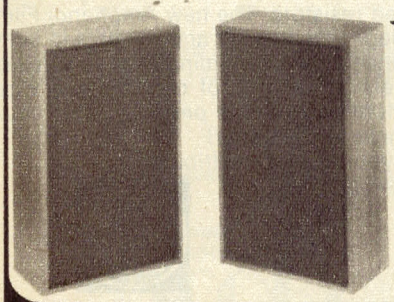
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Ducon Capacitor For CD Ignition

The Ducon Division of the Plessey Component Group recently released a capacitor specifically designed for high discharge currents as occur in the storage capacitor used in capacitor discharge ignition systems.

Designated 5S10A, the capacitor is an oil-impregnated paper type housed in steel can. It has a capacitance of 1 microfarad, a voltage rating of 1,000 volts DC and has been tested at discharge currents of up to 50 amps.

The dimensions of the can are 3-1/8 x 1 x 1¾in and the unit is normally supplied with solder-lug terminals. As an alternative, the same capacitor with a different type number can be supplied with screw terminals. The capacitors are supplied with mounting clamps.

Recent capacitor discharge ignition systems published in this and other magazines have specified a polyester or polycarbonate capacitor as the storage unit. Experience has shown, however, that these types of capacitor are not entirely suitable and can be expected to give limited service.

When the thyristor is triggered in a C.D.I. system the resultant discharge current is limited mainly by the impedance of



the coil, comprised of its small inductance and primary resistance. Measurements have shown that this discharge current has a peak value in excess of 20 amps. Conventional plastic dielectric capacitors are not intended for this type of service and neither are most paper types.

Polyester and polycarbonate capacitors used in C.D.I. systems have been found to run hot, particularly at high spark rates. At least one manufacturer advises that polyester capacitors should not be used where the rate of voltage change, dV/dt, exceeds 10V/uS. In a typical C.D. system where the voltage is 300 volts the discharge will last for about 2 microseconds resulting in a dV/dt somewhere in the vicinity of 150V/uS.

Thus the storage capacitor should be of a type specifically intended for high discharge currents. The 5S10A from Ducon would appear to be ideal.

The 5S10A should be available from most parts suppliers. Inquiries regarding price and other information should be directed to Ducon Division, Plessey Component Group, P.O. Box 2, Villawood, N.S.W. 2163.

HIGH-POWER DIELECTRIC LENS

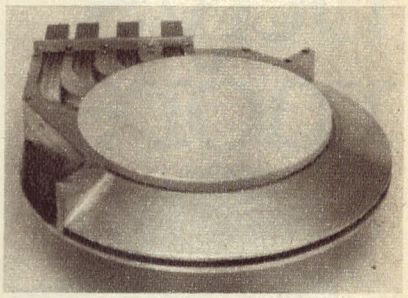
A dielectric lens antenna system capable of withstanding average powers up to 10KW and having extremely low loss and high thermal resistance has been developed by the Corning Glass Works, U.S.A.

The high power capability results from the use of a foam glass lens which has a melting point of over 900 degrees Centigrade and can withstand constant temperatures up to 500 degrees Centigrade. Corning states that most current designs of dielectric lens antennas are generally for low-power applications because the lenses are constructed of organic materials with low melting points.

The lens is mounted in an aluminium housing which provides shock absorption and forced air cooling. The housing includes a 1/8in thick window to seal the lens from the exterior and to act as a structural member to contain the lens during shock loading. The unit is fed via flexible waveguides to allow connections which are capable of deflection.

Circularly symmetric lenses are available in a constant dielectric or Luneberg configuration. Because of the symmetry the Corning system is ideally suited for multi-beam systems as used in direction finding or in navigation, radar and electronic warfare systems.

Designed primarily for X-band applications, each antenna utilises four beams to cover a 90-degree arc in the horizontal plane. Individual beamwidth is approximately 10 degrees. Two 90-degree antenna units can be placed side by side to produce 180-degree coverage. A horn flare results in a beamwidth of about 25 degrees in the vertical plane. The antenna system has been designed and tested to meet military specifications for shock and vibration. It weighs 57 pounds and measures 18 x 18 x 4in thick.

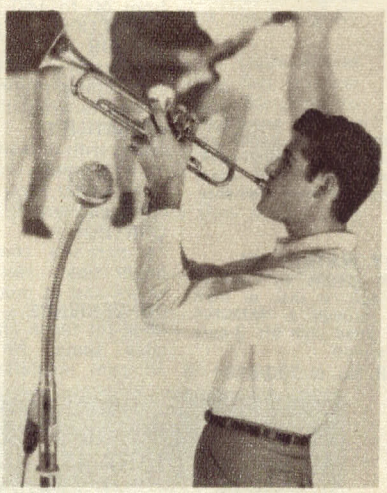


The top plate of the aluminium housing removed to show the foam glass lens used in the Corning dielectric lens antenna system.

Further information about this dielectric lens antenna system is available from the Optical Products Department, Corning Glass Works, 1202 Plaza Building, Australia Square, Sydney, 2000.

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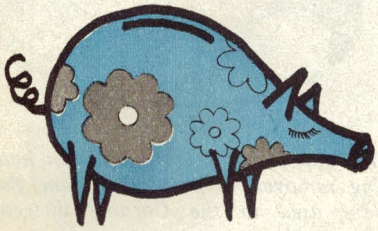
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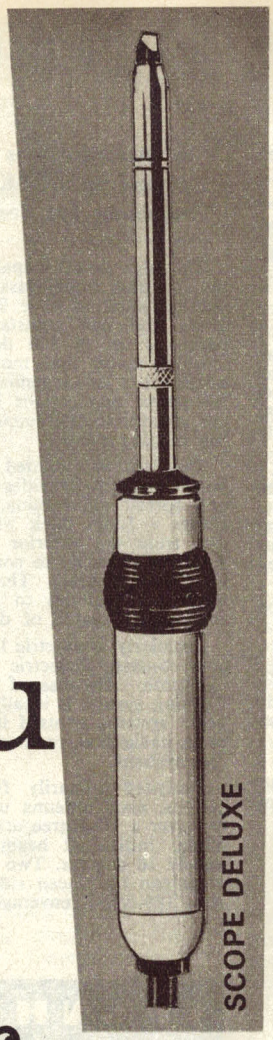
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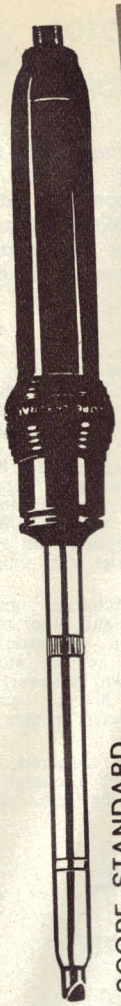
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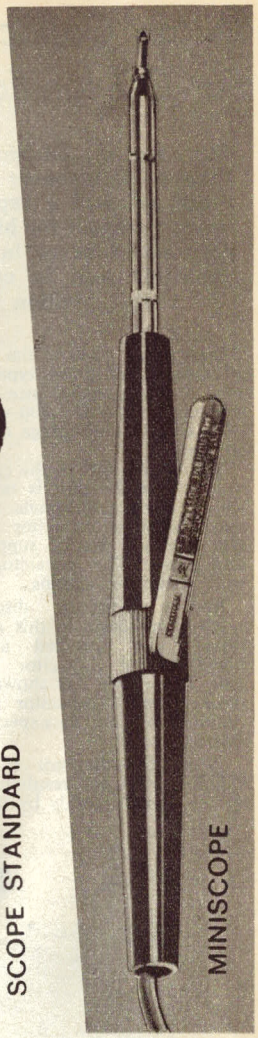
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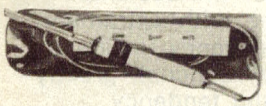
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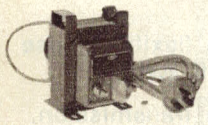
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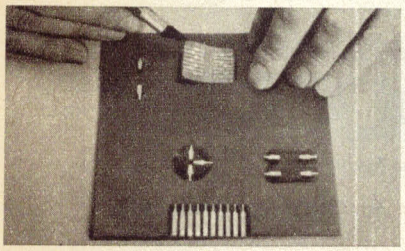
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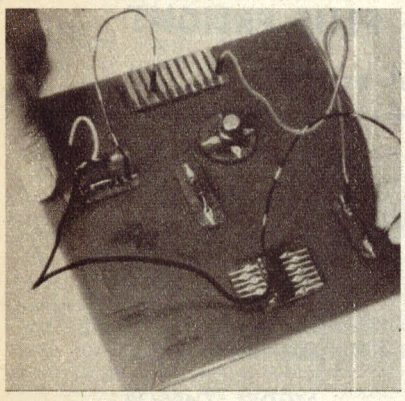
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PC Board Design Aid

Bishop Graphics of the U.S.A. has introduced a series of pressure-sensitive copper component patterns, pads and conductor paths for prototype printed wiring board design and circuit development.

Known as Circuit Zaps, they are of precision-etched 1oz copper on 3.5 mil glass epoxy film, backed by pressure-sensitive adhesive. They are produced in grid-centred patterns for the commonest 70 cans, IC dual in-lines and flat packs, and connector strips. Conductor paths are .031in wide, as are the parallel paths, elbows and tees. Natural connector fillets are designed into all patterns.





Circuit Zaps are laid down on a standard epoxy board in the same way as pressure-sensitive drafting aids. Holes are then drilled for inserting Zap stakes with a specially designed tool. Zap stakes are terminals which can be connected by jumper wires. For RF work or to replace jumper connections by permanent paths, pressure-sensitive conductor paths are used. Permanent connections are made by dot-soldering at each terminal

Further information is available from the Australian agents, Circuit Components (A'sia) Pty. Ltd., P.O. Box 70, Bexley, N.S.W., 2207.

Darlington Amplifier

The Semiconductor Products Division of Motorola Australia Pty. Ltd., has recently released a new complementary Darlington silicon power transistor with a Vceo (sus) rating of 80V and a continuous collector current rating of 5 amps. The minimum Beta as a collector current of 3 amps is 1,000. The transistors are available in PNP and NPN types, both in a TO-3 encapsulation. Maximum power dissipation is 90 Watts.

The PNP device has type number MJ901 and the NPN device has type number MJ1001. They are available ex stock in Australia. Detailed information may be obtained from the nearest sales office of Cannon Electric (Australia) Pty. Ltd. or the Semiconductor Products Division of Motorola Australia Pty. Ltd., Regent House, 37-43 Alexander Street, Crow's Nest, N.S.W., 2065.

MULLARD'S GOLDEN JUBILEE



This year, 1970, marks the 50th anniversary of the foundation of the world-wide Mullard organisation. The main celebrations will take place in September, the actual anniversary. The original company, The Mullard Wireless Valve Co. Ltd., was founded in the U.K. in 1920 and occupied floor space rented from the founder's former employer. The founder, Mr Stanley Mullard, now well into his 80s and still a member of the board, initiated business with high-power transmitting valves. From this beginning the Mullard enterprise has developed into one of the U.K.'s biggest electronic component companies, employing around 17,000 people.

Mullard

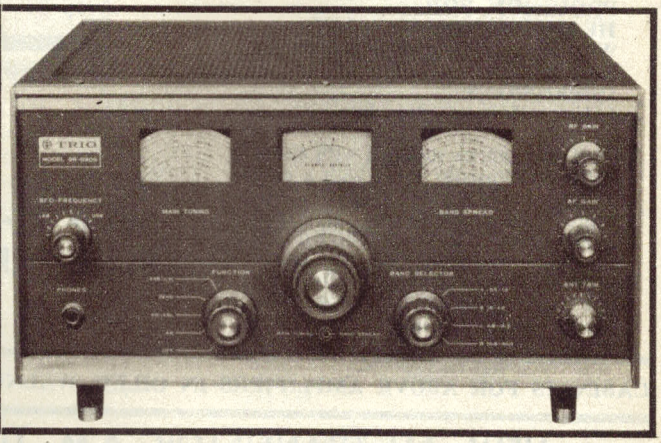
Coincidental with the celebrations is a change in the familiar Mullard emblem to a modern one designed for easy reproduction and legibility on all Mullard products, even to tiny devices. The type face used for the company name is also changed with the same object. The Jubilee theme is a rose, a fragrant pink hybrid tea rose. A quantity of the Mullard Anniversary Rose bushes will be distributed throughout Australia to garden-loving Mullard supporters.

TRADE RELEASES—in brief

MUIRHEAD LTD., Laker Estate, Kent House Lane, Beckenham, Kent BR3 4BE, England. **Miniature reference cell, type K-391-A.** Specially developed to meet the needs of manufacturers of high precision measuring equipment, the K-391-A offers high stability with complete portability. Measuring only 70mm x 11mm inclusive of its tubular thermal shield, the unit is an unsaturated cell with miniature single limb construction and with complete hermetic sealing by glass fusion. It can be mounted or transported in any position and its wired ends enable it to be soldered into any circuit. The thermal shield obviates the need for elaborate precautions against thermal gradients caused by local heat sources.

The EMF manufacturing tolerance is 1.0190 to 1.0193V at 25°C. Each cell is supplied with a test certificate stating its EMF to the nearest 10uV. The operating temperature range is from 0 to 50°C with a temperature coefficient (from 10 to 40°C) of less than —3V/°C.

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Weston electronics PTY LTD
SYDNEY, AUSTRALIA
(A unit of Jacoby Mitchell Holdings Ltd.)
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Cables and Telegraphic Address: 'WESTELEC, Sydney. Phone: 40 1212

CONSULT YOUR LOCAL RADIO DEALER, OR
MAIL THIS COUPON today
Please forward free illustrated literature and specifications on Trio equipment.
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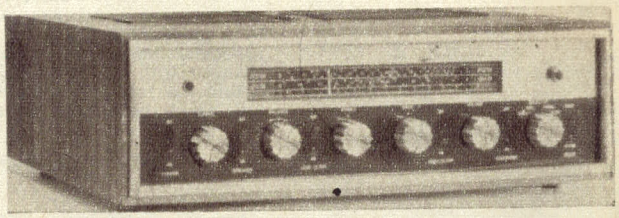
NEW ALL TRANSISTOR STEREO AMPLIFIERS WITH IN-BUILT A.M. TUNER

ULTIMATE IN DESIGN—LONG DEPENDABILITY

USING ALL SILICON TRANSISTORS

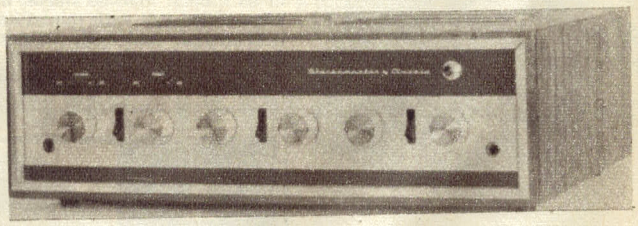
36 WATTS—RMS

SPECIFICATIONS:
18 watts per channel R.M.S. Total output 36 watts R.M.S.
FREQUENCY RESPONSE:
From 20 cycles to 20,000±1db.
HARMONIC DISTORTION:
Less than 1 per cent at rated output.
HUM AND NOISE:
Aux. 70db. Mag. 50db.
INPUT SENSITIVITY:
Mag. 3mv. Aux. 200mv.
SPEAKER IMPEDANCE:
8 ohms.
EQUALISED:
Mag. RIAA.
TONE CONTROLS:
Bass, 50 c/s ± 12db. Treble 10 kc/s 12db.
LOUDNESS CONTROL:
50 c/s 10db.
SCRATCH FILTER:
(High filter) at 10 kc/s 9db.
RUMBLE FILTER:
(Low filter) at 50 c/s 5db.
PROVISION FOR TAPE RECORDER:
Record or play-back with din plug connection.
PROVISION FOR HEAD PHONES:
With headphone/speaker switch on front panel.
DIMENSIONS:
16½in x 5½in x 11in deep.
TUNER:
This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1,600 K.C. Calibrated dial available for all States.
THE CIRCUIT INCORPORATES regulated power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.



MODEL C300/20/T

$125.00 PLUS FREIGHT
(Cabinet extra)



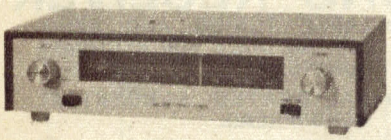
MODEL C400/20

$99.00 PLUS FREIGHT
(Cabinet extra)

AMPLIFIER ONLY. Specifications as above but with the added feature of front panel switch which allows selection of two speaker systems.

CABINETS FOR ABOVE AMPLIFIERS IN OILED WALNUT OR TEAK WITH METAL TRIM $10.00 EXTRA.

NEW ALL-TRANSISTOR A.M. TUNER WITH PRE-AMPLIFIER



Suitable for use with all valve transistor Hi-Fi amplifiers, tape recorders or P.A. amplifiers.

SPECIFICATIONS

Frequency coverage 530 to 1600 K.C. bandwidth 9 K.C. Inbuilt aerial, provision for external aerial. 240 volt A.C. operation. Dimensions 10¾ x 6in x 3½in. Output variable from 50mv to 700mv.

$44.00 Post and Packing, N.S.W., $1.50.

CLEARANCE OF VALVE AMPLIFIERS WITH TUNERS BASED ON THE PLAYMASTER 106 AND 118 FROM $80.

POWER OUTPUT: 9 watts per channel R.M.S. FREQUENCY RESPONSE: 20 to 20,000 cycles incorporating Ferguson O.P.412 grain oriented output transformers. VALVES USED: 4-6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2 silicon diodes.

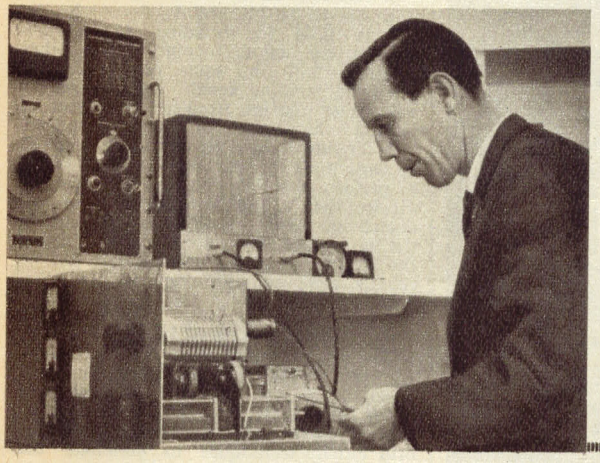
CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145

SSB FOR FLYING DOCTOR

As reported in the June, 1970, issue of "Electronics Australia," the Royal Flying Doctor Service will be required to change over to single-sideband operation within the next five years. Since that article was published, details of the new SSB network have been released in a statement by the Minister for Supply, Senator the Hon. Sir Kenneth Anderson, on June 24.

The Department of Supply has let a contract for $406,000 for communications equipment for the R.F.D.S. to Electronics Instrument and Lighting Co. Pty. Ltd. (EILCO) of Adelaide. The contract is for the design, supply and installation of base stations for a high-frequency single-sideband communications network. (Electronics Instrument and Lighting Co. Pty. Ltd., P.O. Box 67, Norwood, S.A., 5067.)



A development technician tests a prototype SSB transmitter at the Norwood, S.A., plant of EILCO.

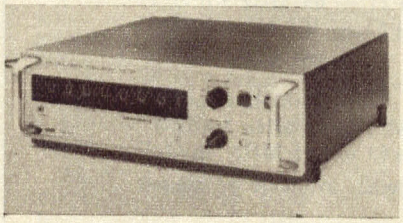
PLESSEY DUCON PTY. LTD., P.O. Box 2, Villawood, N.S.W. 2163. **MOS static shift registers, types MP220B and MP225B.** The MP220B can be programmed on a package pin to be either 56 or 80 bits long. It features an equivalence gate so that data in the final bit can be compared with external data and an appropriate output derived. The device is available in either flat pack or DIL package. The MP.225B is a 10-bit static shift register in a TO-5 package. Common features are: data stream select logic on the input to facilitate recirculation of data; operate from DC to 1MHz over a temperature range of —20 to +70°C; interfacing with TTL requires a minimum ot discrete components; completely compatible with the MP100 series MOS logic.

N-channel GaAs field effect transistor, type GAT 1. The device is intended as a UHF low noise amplifier, particularly as a front-end amplifier in L-band radar and communication systems. Features include: high transconductance, typically 6mmho at 900MHz; low input and feedback capacitances, about 1pF and 0.15pF respectively; low noise characteristics, typically 3.5dB at 1.5GHz; common source power gain, minimum 10dB at 1GHz; operational to 1.5GHz; absolute maximum rating at 25 degrees C include drain-source voltage 5V, source-gate voltage 15V and total power dissipation 300mW; power supply required, source-drain 5V and gate 12V; housed in a four-lead TO18 package.

DC/DC convertors. A range of models is available to change low DC voltages of between 6 and 60V (in multiples of 6V) to DC voltages of about 5 to 10KV. A typical use is to provide the EHT for a CRT in a transistorised instrument. Two standard models are available: the X29/3507 can produce output voltages of up to 8KV with power up to 0.5W (an input of 30V at 60mA gives an output of 6KV at 75uA); the X29/3511 can provide any output voltage up to 10KV (an input of 12V at 600mA gives an output of —1.3KV at 1mA and another of +8.5KV at 75 uA). Larger units for higher voltages and power are under development.

McMURDO (AUSTRALIA) PTY. LTD., 19 Carnish Road, Clayton, Vic. 3168. **IERC heat dissipator/retainer.** Intended for dual-in-line IC packages with up to 14 leads, the unit consists of a retainer clip, a conduction base and a heat dissipator. The conduction base fits between the circuit board and the bottom of the IC case or socket, closing the air gap and making thermal contact to the bottom of the case or socket. The retainer clip is then inserted over the IC case and the hardware secured or the assembly soldered in. A temperature reduction of 16 degrees C at a dissipation level of 700-mW is claimed. If additional temperature reduction is required, a standard IERC staggered fingered heat-sink/dissipator is placed between the circuit board and the conduction base.

RACAL ELECTRONICS PTY. LTD., 47 Talavera Road, North Ryde, N.S.W. 2113. **Digital frequency meter, model 801M.** Designed to meet the most demanding frequency measurements ranging from specialised low frequency applications to communications and telemetry in the higher frequency bands. It is designed to military standards and has passed the most stringent environmental tests, including sound and dust penetration, dry and damp heat, and low temperature exposure.



Features include: frequency range 10Hz to 125MHz with direct gating throughout; gate times of .01, 0.1, 1.0 and 10 seconds; input impedance 1M; sensitivity 10mV; precision plug-in frequency standard stable to 2 parts in 10^9 per day; full remote control and programming facilities; an outlet on the front panel provides power supplies for the Racal Active Probe 819 which increases the sensitivity to 1mV over the entire frequency range with an input impedance of 1M.

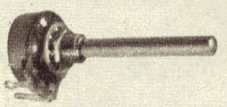
ASTRONICS AUSTRALIA, 161-173 Sturt Street, South Melbourne, Vic. 3205. Agents for Rohde and Schwarz, West Germany. **IC tester, Semitest III.** Checks the

PHILIPS 400 V.W. POLYESTER CAPACITORS

0.001 MFD	10c	0.033 MFD	15c
0.0022	10c	0.047 "	15c
0.0033	12c	0.068 "	17c
0.0047	12c	0.082 "	19c
0.0056	12c	0.1 "	19c
0.0068	12c	0.22 "	27c
0.01	12c	0.33 "	36c
0.022	14c	0.47 "	43c

SEMI-CONDUCTORS
New, Guaranteed

AC125	74c	OA90	26c
AC126	76c	OA91/1N60	17c
AC128	70c	OC44	48c
AC127/128	$1.50	OC71	48c
AC187/188	$1.90	OC72	48c
AF116N	70c	OC74N	80c
AD149	$1.65	OC81	60c
AD161/162	$2.75	2N5459	$1.10
BC/108	50c	2N3638	50c
BC/109	50c	2N2926	75c
BF115	60c	EM401	36c
BDY20	$2.00	BA100	34c
BC177	75c	BY100	60c



POTENTIOMETERS
(2-inch shaft) (Low noise)
STOCK RANGE: 1k, 5k, 10k, 25k, 50k, 100k, 250k, 500k, 1m and 2m.
Log and Linear: 35c each.
Switch Type. 75c each (log only).
Dual Gang (Log or 1in): $1.45 each.
MINIATURE PRE-SET POTS: Same range as standard pots above. 15c each or 10 for $1.30.



1W RMS AUDIO AMP
(employs TAA300 I.c.)
Complete with printed circuit board and associated components. Output impedance: 8 ohms. 9V operation Input sen: 2.5 mV Includes connection data and guarantee.
Kit form: $5.30; wired $5.80.

SPECIALS FOR THIS MONTH
★ 20 lug per side tag board: 48c.
★ Twin cone 12PX ROLA 12" 8 ohms speakers $18.00. Post 75c.
★ Shielded cable: Single 14c per yd. Double: 28c per yard.



Type 3 Type 21

SLIDE SWITCHES
Type 3: 2 positions single pole 15mm. long 16c each or 10 for $1.30.
Type 21: 2 position 2 pole 35mm long 23c each or 10 for $1.95.

PART PAKS
Pack 56: Contains 3 resistors of 57 valves between 10 ohms and 1m, totalling 171. All 5 P.C. types. 1/4W: $4.75; 1/2W $4.95



MINIATURE VOLUME CONTROL
Universal 16mm type. 5k ohm with on-off switch.
30c each or 10 for $2.50.

DESPATCH: All orders are received at 9 a.m. at the P.O. and despatched to meet the 1 p.m. clearance the same day. This gives you a 4-hour service.

POSTAGE: Add 10c packpost fee to all orders, unless stated otherwise.

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DEE WHY, N.S.W. 2099.
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not all quartz crystals are the same

Modern UHF and SSB communications equipment calls for frequency stabilities and tolerances that were almost unheard of outside of the laboratory a decade ago.

In order to provide Design Engineers in the communications industry with quartz crystals to meet this challenge, Hy-Q Electronics has developed a range of high stability units capable of maintaining a frequency over a temperature range of +5°C to +55° within ± 5 parts per million (5 Hz in every MHz).

At present these are available in limited quantities for Design Engineers and pre-production purposes. However, when the demand for production quantities arises the full production facilities of Hy-Q's modern crystal plant will be available to meet the demand.

The new range of crystals—known as the "DELTA" Line will be available in the frequency range 4 MHz to 105 MHz in HC6/U, HC18/U and HC25/U holders as shown.

DELTA LINE CRYSTALS

QC6	HC6/U	4 to 105 MHz 4 — 21 MHz Fundamental +21 — 63 MHz 3rd O/T +63 — 105 MHz 5th O/T
QC18	HC18/U HC25/U	10 to 105 MHz 10 to 21 MHz Fundamental +21 to 63 MHz 3rd O/T +63 to 105 MHz 5th O/T

Prices and delivery details available on request.

Australia's largest independent crystal manufacturers.

Write for details.

Hy-Q Electronics Pty. Ltd.

10-12 Rosella Street,
P.O. BOX 256,
Frankston, Victoria, 3199.
Telephone 783 9611.
Area Code 03.
Cables: Hyque Melbourne.
Telex 31630.

AGENTS:

NSW: General Equipments Pty. Ltd., Artarmon. Phone: 439 2705.
SA: General Equipments Pty. Ltd., Norwood. Phone: 63 4844.
WA: Associated Electronic Services Pty. Ltd., Morley. Phone: 76 3858.
NT: Combined Electronics Pty. Ltd., Darwin. Phone: 6681.
TAS: Hobart Radio Clinic, Hobart. Phone: 34 3884.
QLD: Douglas Electronics Pty. Ltd., 322 Old Cleveland Rd., Coorparoo. Phone: 97 8222.

HQ01

functioning of integrated logic circuits, such as RTL, DTL, DTLZ, TTL and ECL circuits, whether bipolar or MOS types. In addition to checking gate operations, the unit can check storage-type logic circuits, such as RS and JK flip-flops, shift registers, recorders, counters and frequency dividers. Adapters with up to 16 terminals can be inserted into the basic adapter of the set for each type of case, i.e., dual-in-line, TO-5, or flat pack. With an additional cable it is possible to test ICs mounted on circuit boards.

EMERSON AND CUMING INC. Canton, Mass. 02021, U.S.A. **Eccoetch.** An etching fluid for bonding fluorocarbon plastics, e.g. teflon, together or to other materials with the same ease and with the same bonding agents, e.g. epoxies, as with other plastics. Application consists of cleaning the surface of the fluorocarbon, and dipping it into Eccoetch for 5 to 10 seconds until the exposed surface displays a uniform light brown colour. This indicates that a sodium compound in Eccoetch has reacted with fluorine atoms on the surface of the fluorocarbon exposing the carbon chain to which bonds can be readily achieved with conventional adhesives.

AURIEMA (AUSTRALASIA) PTY. LTD., 443 Kent Street, Sydney, 2000. Agents for Western Microwave Laboratories, U.S.A. **Wideband detector-amplifier, model DPW-10.** Totally integrated, it combines microwave integrated and hybrid circuit techniques to eliminate the bias and RF interface problems between detector and amplifier, and to provide a dramatic size reduction. Features: frequency range 1 to 12GHz; useful to 15GHz; size 1-1½in x 1-1½in x 9/16in; minimum tangential sensitivity —50dBm; video gain 20dB typical; video bandwidth 20 to 5000 KHz; other video gains and bandwidths available; RF input for 1dB compression —12dBm typical.

HEWLETT-PACKARD AUSTRALIA PTY. LTD., 22-26 Weir Street, Glen Iris, Vic. 3147. **Dual-output DC power supplies, models 6227B and 6228B.** Each unit houses two identical high-quality 50W supplies in one package. The two supplies can be operated independently or one can track the other. The output of the slave supply matches that of the master within 0.2% ± 2mV Model 6227B is rated 0-25V and 0-2A, while the 6228B is rated at 0-50V and 0-1A. The tracking mode can be used to double the output voltage giving a 0-50V, 0-2A supply using the 6227B or a 0-100V, 0.1A supply with the 6228B.



Features common to both models: can be operated as a constant-voltage or a constant-current supply; each side has independent overvoltage protection; in the tracking mode, and overvoltage in either side trips both protection circuits; completely convection-cooled; can operate in ambient temperatures from 0 deg. C to 55 deg. C; load regulation is ±(.01% + 1mV) for constant-voltage operation or ±(.01% + 250uA) for constant-current operation for a change in load current or voltage, respectively, equal to the rating of the supply; line regulation is ±1mV or ±100uA for line voltage change from



Printed circuit lacquer

The latest addition to the Electrolube range of aerosol products is PCL (printed circuit lacquer). It covers printed boards and equipment to be protected with a thin even coat of lacquer. As the lacquer acts as a solder flux, it is unnecessary to remove the coating before replacing a faulty component. After soldering, the area round the solder joint can be resprayed.

Inquiries should be addressed to the Australian distributors, Richard Foot (Aust.) Pty. Ltd., 63 Hume Street, Crow's Nest, N.S.W., 2065.

103.5 to 126.5V or from 207 to 253V; ripple and noise (DC to 20MHz) is less than 250uV or 250uA and less than 4mV or 2mA peak-to-peak under any load conditions within ratings.

PLESSEY COMMUNICATION SYSTEMS PTY. LTD., P.O. Box 69, North Melbourne, Vic. 3051. **TeleCourier radio paging encoder, model TK-1.** This latest addition to the TeleCourier range has a built-in keyboard and is specially designed for small businesses. The encoder generates a coded signal, selected on the keyboard, which causes a single pocket receiver to alert its wearer visually and audibly that he is wanted on the telephone. The TK-1 handles up to 19 receivers and one call at a time. It complements the existing range of TeleCourier encoders which handle up to 576 receivers and several simultaneous calls.

DISTRIBUTORS CORPORATION PTY. LTD., 24 Johnston Street, Fitzroy, Vic. 3065. Agents for Singer, U.S.A. **Noise and field intensity meter, model MF-105A.** Measures the frequency and magnitude of radio interference in accordance with the latest commercial and military requirements. It is a single conversion superhet receiver with built-in sensitivity calibrator and indicating meter used with external pick-up devices. Features: 5 plug-in tuning units to cover 14KHz to 1GHz; provision for X-Y plotting; outputs for "Pandapter" or spectrum analyser use; other units are available to cover 20Hz to 26.5GHz.

BELLING AND LEE (AUST.) PTY. LTD., Canterbury Road, Kilsyth, Vic. 3137, has added seven new items to the company's range of electronic components. These are as follows: Miniature terminal with 2mm sockets, 33c each; Miniature free plug, 2mm, 9c each; Miniature stacking plug, 2mm, 28c each; Miniature chassis socket, 2mm, 19c each; Size 0 free in-line fuseholder, 7A, 16c each; Miniature lampholder to take 5mm tubular L.E.S. cap lamps, 53c each. All items are available from stock.

RUTHERFORD ELECTRONICS PTY. LTD., P.O. Box 30, North Balwyn, Vic. 3104. Agents for National Semiconductor Corporation, U.S.A. **Eight-pin silicone moulded package, the "Mini-DIP."** It has a 50 p.c. size advantage over the standard 16-pin package. Two of the new mini-DIPs will fit a standard 16-pin dual in-line socket. The National moulding process, the silicone material, the conformal coating of the die, and the special lead frame construction are said to increase moisture resistance and reliability, and to make the package less prone to failure during exposure to harsh environments than the plastic package. Temperature cycling tests,

PRINTED CIRCUIT BOARDS
See:
SUMMIT ELECTRONIC SYSTEMS
Advertisement in this issue.

100 tips for superior soldering

Adcola Australia lead the world with over 100 different standard tips, covering the entire field of production and servicing. Micro-miniature and instrument work; printed circuits; heavy tag, chassis and wire soldering. All are sealed to prevent seizing in the barrel.
Each tip is matched to one of the seven long-life, fast-heating Adcola 'M' Series soldering tools — from ¾ oz. to 5 ozs. — each of which is available in at least three temperature ranges.
Benefits — swift work, durable joints, no damage to components, no joint embrittlement, lower soldering and maintenance costs. When it comes to soldering, the best tip is Adcola.



ADCOLA

Selection is simple; from our brochure. Yours for the asking.

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RA5

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PLESSEY SL403A INTEGRATED CIRCUIT



3 watts R.M.S. 7.5 load. As used in all our audio amp kitsets. Full technical data with each.
$10.50, post 25c.

Miniwatt value and transistor Data book. Latest (7th) edition $3.05
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We have a large range of Mullard publications in stock.

COMPUTER BOARDS

Containing a variety of NPN and PNP germanium transistors and a host of other components, these 4in x 2½in boards are supplied with free technical information on all parts. Each board has a minimum of four transistors.

	PRICE POST
100 Boards	20c ea. 50c
25-99 Boards	25c ea. 25c
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1-9 Boards	35c ea. 10c

Stocks are running low. To avoid disappointment, order now.



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Discharge Ignition by Summit.
A MODEL TO SUIT EVERY MOTOR.
Six Months' Guarantee.

Deluxe $39.95
Competition (higher output) $48.00
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BC 108 Transistor 40c
BC109 Transistor 45c
EM404 Diode 25c
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SALES CENTRE OPEN
8.30 A.M. TO 5.30 P.M.
MONDAY TO FRIDAY

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AT66
20Hz-20KHz plus or minus 2db
Tracking weight .5-2.5 grams.
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Simple fitting instructions included.

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PK3 Printed Circuit Kit Board. Make your own P.C.B. . . . . $3.50, post 25c.
Peak Stereo Amplifier 3.5W per channel $34.50, post $1.00.
Garrard Auto. Record Changer with stereo ceramic cartridge . . $42.80, post $1.00.
Battery charger 6V-12V with meter and leads . . . . . $17.50, post $1.00.
Jemco US100 Multimeter. AC DC volts and current resistance ranges $29.50, post 50c.

Pre-Pak Electronics Kit Sets. For more details of the following kits, see our advt. E.A. July 1970 or send SAE to our mailing address.

AUDIO AMPLIFIER KITS BASED ON THE PLESSEY SL403A I.C.

Kit MA1 Basic amplifier 3W R.M.S. . . . . $12.50 post 10c.
Kit MA2 with case and volume control . . . $14.50 post 25c.
Kit MA3 Deluxe with bass, treble controls . . $15.90 post 25c.
Kit MA4 Deluxe with built-in power supply . . $23.90 post 50c.
Kit SA1 Deluxe stereo amp 8 plus 3W R.M.S. $46.00 post 50c.
Kit PS5 Power supply suit amplifier Kits . . . $6.40 post 25c.
Kit MP1 Mono magnetic pre-amp . . . . . $4.90 post 25c.
Kit MP2 Stereo magnetic pre-amp . . . . . $9.80 post 25c.

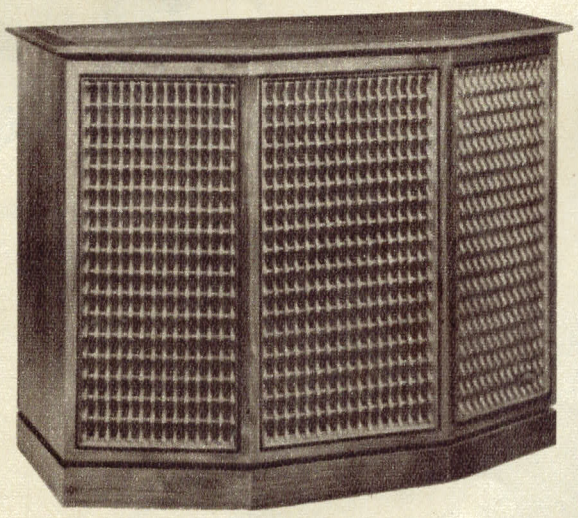
KITS FOR THE SERVICEMAN

P.S.1 Regulated variable power supply . . . $27.50 post 50c.
P.S.3 General purpose power supply . . . . $5.95 post 50c.
P.S.4 eGneral purpose power supply . . . . $7.90 post 50c.
A.01 High performance audio oscillator . . . $14.50 post 25c.

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C.D2 Positive earth.
W.1 Windscreen wiper control . . . . . $6.95 post 10c.
W.2 Positive earth.

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5 days to build the new Symbiotik™ driver that combines the use of aluminium with a new polyamide material in the diaphragm assembly to handle 2 times more power.

6 days to wire, adjust, calibrate, test and recalibrate the precision, two-section 500 Hz crossover network.

7 days to build the new Dynamic Force 15-inch woofer that includes a 4-inch voice coil wound with 110 feet (33.5 meters) of pre-flattened ribbon copper wire plus a new high-flux-field 18-lb magnetic structure.

8 days to cast, grind, prime, insulate and paint the massive 25-inch, cast aluminium sectoral horn that distributes mids and highs over a wider angle.

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temperature shock tests, pressure pot tests, moisture resistance tests, life tests, and mechanical stress tests have shown the silicone moulded package stands up better than the plastic package.

An operational amplifier, the LM301AN, is the first of several linear devices that will be available in the mini-DIP in the near future. Among others coming out soon are the LM307N and LM741CN, general purpose operational amplifiers, and the LM703LN, IF amplifier. The LM301AN is now available at $4.85 each in small quantities.

INFORMATION ELECTRONICS LTD., 42 Mort Street, Braddon, A.C.T. 2601. **Display/entry terminal IE33.** The first proprietary product to be marketed by the company, this computer input-output terminal with a CRT display, is offered at the relatively low price of $2,595. It can be used alone as a replacement for existing teletype machines, or in a multiple-terminal cluster with a multiplexer. It can be used in data communications networks and with any computer capable of accepting teletype inputs. It has a fully electronic keyboard, does not need a modem, and can accept a slave display at a minimal cost.

SIEMENS INDUSTRIES LTD., 544 Church Street, Richmond, Vic. 3121. Agents for Siemens AG, West Germany. **Helium neon lasers, type LG661.** A 5mW modulated HeNe laser intended for optical alignment. Typical applications are in mining, tunnel boring, land surveying, etc. A

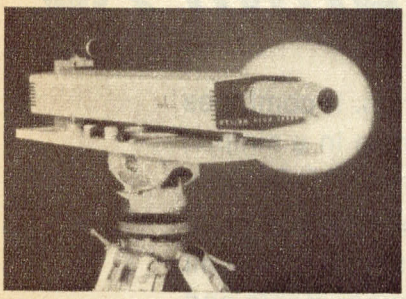
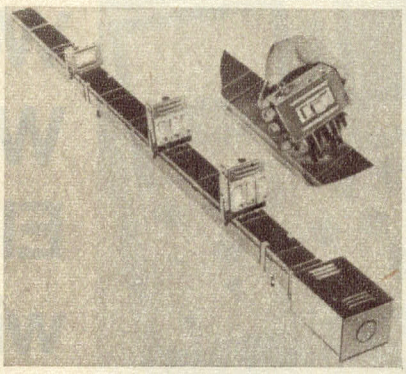


photo-electric receiver can be used to control the cutting edge or direction of machinery to an accuracy of up to 1mm at a distance of 200M from the laser. Beam-forming lenses and beam splitters, surve
ing tripods, rotatable
forms, telescopic len
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multiplication and division. The digital operation results in exactly reproducible mathematical operations, giving accurate solutions of differential equations for control system work. The element can be used with shift registers of any length, and its inputs are protected against static damage.

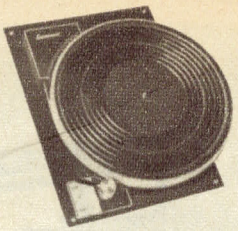
VASS ELECTROBAR DISTRIBUTORS PTY. LTD., 69-71 Marrickville Road, Marrickville, N.S.W. 2204. **Electrobar plug-in busway.** Electrobars are rigid box sections 12ft in length that can



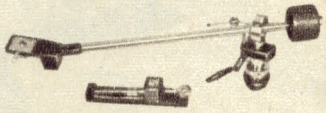
be coupled together to any required length to form a long fuse board, power-take-off to machines, lights, etc. Entry is by means of fused plug-in boxes that can be inserted in the electrobar at any point throughout its length.

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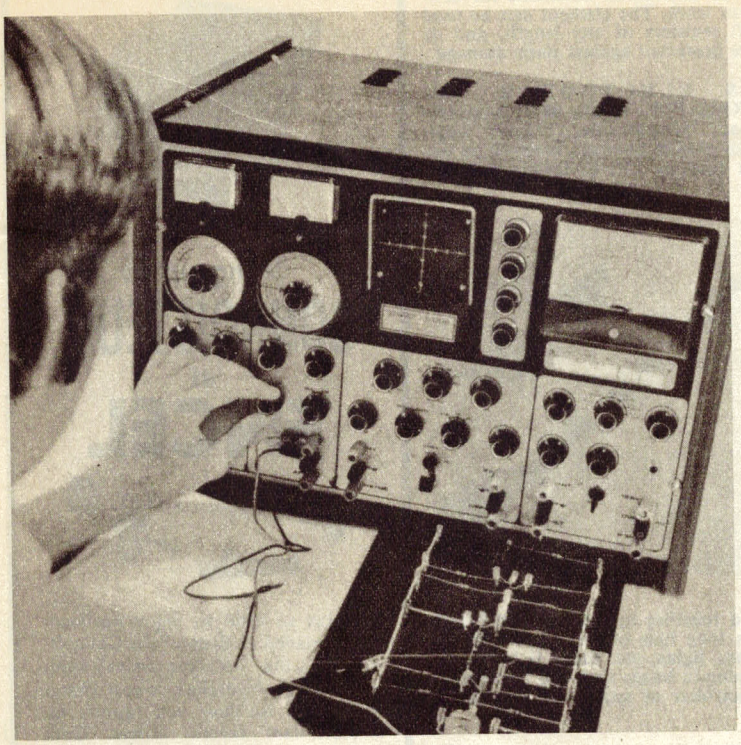
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TECHNICAL BOOKS AND PUBLICATIONS

Digital computer "architecture"

DIGITAL COMPUTER DESIGN, by F. G. Heath. Published by Oliver and Boyd Ltd., Edinburgh, 1969. Soft covers, 5½in x 8½in, 194pp., many diagrams. Price in Australia, $6.30.

The third volume in Oliver and Boyd's recently commenced series "Electronic and Electrical Engineering Texts," which is designed to provide undergraduate engineering students with up-to-date subject texts at a modest price. The author of this volume is Professor of Digital Processes at the University of Manchester Institute of Science and Technology.

Perhaps the best way to describe the content and treatment of the book is to say that it has been written to give the student an introduction to digital computer "architecture." Although mainly intended for those engineers who will ultimately be concerned with the design of either modules or hardware systems, it is written with the belief that such people should have at least a basic knowledge of software and of complete hardware-software systems.

In keeping with this commendably far-sighted approach, the author has kept the inevitable section on logical and circuit design to a modest size, noting in his preface that there are many good books already available which cover this material. By doing this he has been able to devote more space than usual to a discussion of basic programming and software systems, and has also been able to provide a very valuable section dealing with the often glossed-over details of central processor design.

There are twelve chapters, headed: 1 — Introduction; 2 — Number Systems; 3 — Programming; 4 — Logic Design; 5 — Logic Assemblies; 6 — Memory Systems; 7 — Peripherals; 8 — First Considerations in Central Processor Design; 9 — Central Processor Design; 10 — Computer Control Systems; 11 — Computers for Real-Time Use; 12 — Special Digital Machines. Each chapter ends with a reference list and bibliography, while all except chapter 1 are also provided with questions for self-tuitional purposes. The book ends with two appendices dealing with design examples, and an index.

The book is written in a terse, concise style, and is very readable. It is well illustrated by diagrams and examples. Hence it would seem to this reviewer to be eminently suitable as an undergraduate text and reference, and also as a self-tuitional text for the engineer in industry wishing to move into the E.D.P. field.

The review copy came from Rigby Limited, who are the Australian distributors for Oliver and Boyd. We understand that copies are already in stock at all major bookstores. (J.R.).

Solid-state colour television

FUNDAMENTALS OF SOLID-STATE COLOR TELEVISION by W. C. Cook, Dip.E.E., Dip.R.E. Published by West Publishing Corp. Pty. Ltd., for Electronic Industries Ltd., 1970. Stiff paper covers, 100 pages 9¼ x 6 inches, illustrated by circuits and diagrams. Retail price in Australia $4.00.

In the preface, the author explains that the material in the book was originally prepared as a series of lectures intended for production and service personnel. It assumes a fairly substantial knowledge of monochrome television practice and seeks to bridge the gap between monochrome and the N.T.S.C. colour system. It then goes on to explain the PAL system as a development from the original N.T.S.C. concept.

First reaction of a serviceman encountering this book may possibly be one of pleasant surprise that the information he needs can presumably be presented in a modest 100 pages. What later becomes obvious, however, is that they are a very tightly packed 100 pages, with no words wasted.

Scanning the text, one gains the impression that it has been carefully planned and written and able to stand up to careful and methodical scrutiny. And that's the way the book will need to be read, digesting each paragraph before passing on to the next.

Chapter 1, "Standards and Definitions" is brief but useful.

Chapter 2, some 16 pages in length, outlines the basic transmission principles of a colour television system, indicating the nature of luminance and chrominance signals, their encoding and their addition to a normal monochrome type of signal.

Chapter 3, "N.T.S.C. Receiver Principles," is really the heart of the book. It breaks up into three sections dealing, in turn, with the shadow mask picture tube and the essentials of beam control, the major sections of a colour receiver, and the luminance and chrominance control circuits.

The remaining chapters deal with the PAL D System, with Setting-Up Procedure, and with Test Equipment, the last-named being relatively brief. An index rounds off a compact and useful book.

Our review copy came direct from the publishers, West Publishing Corporation Pty. Ltd., 1 Barrack St., Sydney 2000. (W.N.W.)

Pocket handbook

PHILIPS 1970 POCKETBOOK, published by N.V. Philips Gloeilampenfabrieken of the Netherands. Soft covers, 910 pages, 4½in x 5¾in. Price in Australia $1.62.

A fully revised edition of the preceding Pocketbook, this manual contains brief data on the majority of products manufactured by the Electronic Components and Materials Division of N.V. Philips Gloeilampenfabrieken in the Netherlands.

It is intended primarily as a reference guide for project and development engineers on the availability of components and, as such, covers a wide range of valves, semiconductors, integrated circuits, components and devices. Where comprehensive data on a particular product is required, it is suggested that reference be made to the company's Data Handbook system.

The book is divided into three sections, the first dealing extensivey with transmitting, receiving and special purpose valves, cathode ray and picture tubes, camera tubes and photoconductive devices. The second section is given to semiconductors and integrated circuits, covering diodes, AF, HF and VHF transistors, FETs, digital and linear IC devices.

The third section covers circuit components and materials and contains information on resistors, capacitors, circuit blocks, sub-assemblies for radio, audio and TV, magnetic material, memory products, crystals, microwave devices, power transformers and electromechanical components.

As suggested, the data on individual components is necessarily brief but,

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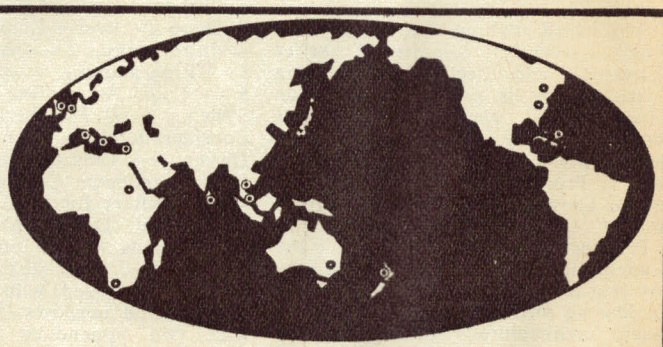
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even so, one would require a fairly large pocket to accommodate this handy manual. A useful book which should find a place in most electronic workshops and laboratories. Australian inquiries should be directed to the "Miniwatt" Electronics Division, Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064, or Philips offices in any State. (A.D.N.)

Application book

PHILIPS APPLICATION BOOK: RECTIFIER DIODES, published by the Technical Publications Department, NV Philips Gloeilampenfabrieken, Eindhoven, The Netherlands. Soft cover. 263 pages, 5¾in x 8¼in. Containing charts, graphs and line drawings. Available from Philips offices and leading booksellers in all States. Price $2.25 including sales tax, plus postage.

A reference manual dealing specifically with rectifier power diodes. As such, the type of book likely to find a place in the technical library of most electronic organisations.

The book does not deal with, nor provide data on, specific diodes as such but rather discusses the various application aspects of power diodes. In this regard it is an excellent treatise on the subject covering virtually every aspect of power diode use.

A brief survey of the chapter headings will make this point clear, commencing with a brief introduction or resume of solid state physics as it applies to two and three layer p-n junctions. This is followed by an examination of the specific forward and reverse characteristics with particular reference to surge and thermal considerations.

A complete section is devoted to pulse loading conditions and the effects of overload on diode characteristics. The subject of cooling is likewise covered in some considerable detail, several of the commonly used methods of heat transfer being examined together with an analysis of heatsink design and application.

Two sections are devoted to the problems of voltage transient and overcurrent protection followed by a study of the requirements of series and parallel operation. A survey of rectifier circuits covers both single and polyphase design with a complete listing of the various performance parameters.

The book is rounded off with two further sections on power diode application designs, including several battery chargers and industrial type control systems. A book recommended for the development engineer. (A.D.N.)

Materials

THERMOELECTRIC MATERIALS, by Marshall Sittig. Published by Noyes Data Corporation, Park Ridge, N.J., 1970. Soft covers, 8 3/8in x 10¾in. 235pp., many diagrams. Price in U.S.A. $35.

This is the latest release in the "Electronics Materials Review" series published by Noyes Data Corporation to supply those in production, management, research and development, and education with up-to-date information on current technology.

As with the other books in this series reviewed recently, Thermoelectric Materials is basically an in-depth review of the specific content of recent U.S. patents of relevance to the topic concerned. As such it is intended to provide a concise and accurate reference to the current state of the art, and one which should be considerably in advance of currently published texts and other reference literature.

The content material is grouped under forty-one headings, dealing in turn with selenides and tellurides, phosphides and sulphides, caesium compounds, metallic alloys and mixtures, semiconductor materials, silver and strontium compounds, and compounds of tin, uranium, zinc and zirconium. In each section the processes and techniques involved are discussed thoroughly and concisely, being in most cases illustrated by coded patent-form diagrams. Full details are given of the individuals and companies associated with each patent.

Although an initial examination of the book tends to give the impression that its relatively high price is unjustified, further examination shows that the cost should be amply justified, by the wealth of concise practical information presented. The somewhat unpretentious appearance is merely the price paid in achieving publication in the minimum time. Hence the book should be found of considerable interest and value not only to those in research and development situations, but also to lecturers and students involved in engineering courses at both graduate and undergraduate levels.

The review copy came directly from the publisher, whose address is Noyes Building, Mill Road at Grand Avenue, Park Ridge, New Jersey 07656, U.S.A. (J.R.)

Systems

COMPUTER-BASED LIBRARY AND INFORMATION SYSTEMS, by J. P. Henley. Published by Macdonald and Co., London, 1979. Hard covers, 5½x 8¼ in., 84 pp. Price in Australia $5.45.

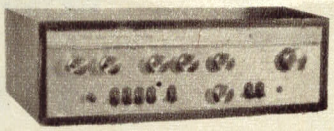
This is the twelfth volume in Macdonald's "Computer Monographs" series, and is written to bridge the gap between those involved in library work, or taking courses in librarianship, and the computer specialist. At the same time it seeks to provide sufficient basic information about the requirements of library and information retrieval situations to interest computer systems designers in this field.

For the benefit of those in library situations without prior knowledge of digital computers and their operation, a chapter is devoted to basic machine operation. This is chapter 2, which follows an introductory discussion of the need for automated systems in library facilities. Chapter 3 then examlines the requirements of library systems in greater detail, looking in turn at system objectives and the requirements of both staff and library users.

The fourth chapter looks at computer system considerations, examining hardware, software and the various

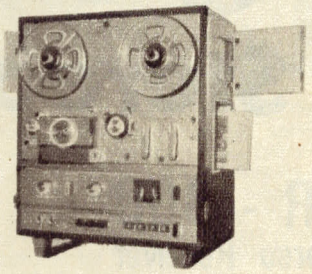
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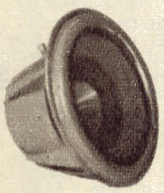
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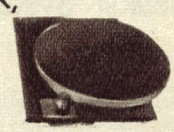
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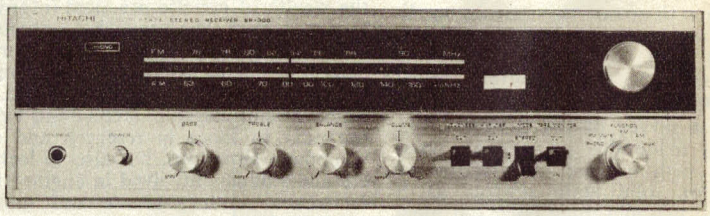
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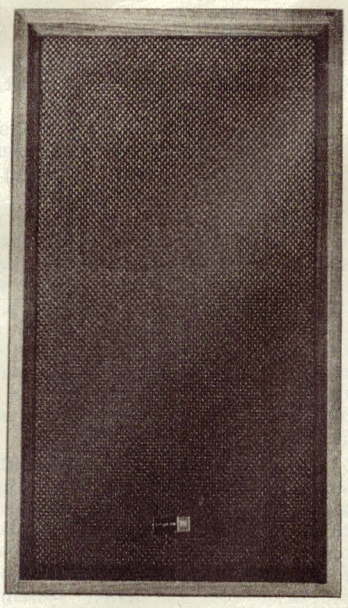
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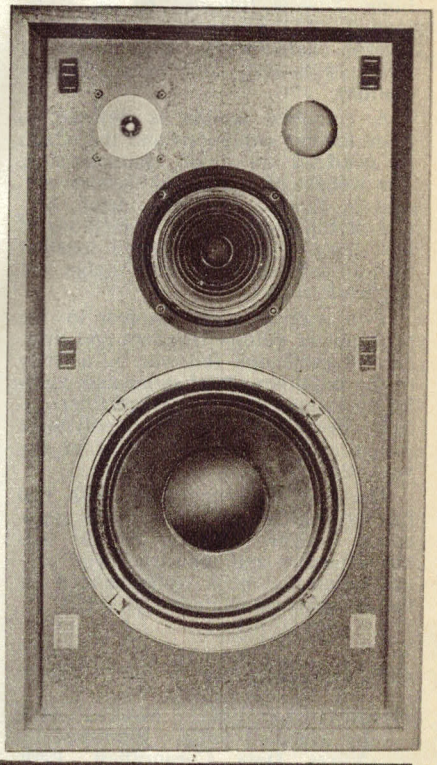
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153 Sturt Street, South Melbourne.
Cnr. Ingham Rd. & Echlin St., Townsville.
Homecrafts, Tas P/Ltd. 199 Collins St., Hobart.

types of program file structure possible. This then leads to chapter 5, which discusses the actual techniques of programmed information retrieval. Illustrations of the points made are given in chapter 6, which discusses specific demonstration programs written and tested by the author. The final chapter then turns to consider the broader aspects of machine-based system philosophy. The book ends with two appendices dealing with formatting and working systems information, an extensive bibliography and an index.

Throughout the book the text is concise and clearly written, and in the opinion of this reviewer provides a very well balanced introduction to the application of computer systems to library applications. It would thus appear to be of considerable potential interest and value not only to librarians and students taking librarianship courses, but also to trainee programmers and system designers interested in library applications.

The review copy came directly from the publisher, but it is understood from their Australian representatives, Novalit Pty. Ltd., that copies should be stocked in local bookstores by the time this notice is published. (J.R.)

FACTORY DESIGN AND LAYOUT

Commencing in August, 1970, the Division of Postgraduate Extension Studies, University of New South Wales, will offer a course of eight lectures and two seminars on "Factory Design and Layout" over Radio University, VL2UV, and through its tape correspondence service. Synopsis: Determination of physical facilities required for the product and its production volume; Location of the best site from those available; Aspects of factory building design; Principles of plant layout — consideration of materials, machines, operators, movement, storage, and services in planning the layout; Charting and visual aids in plant layout; Materials handling methods and equipment — mechanisation, use of unit loads, and containers.

Further information on this and other courses can be obtained from the Division of Postgraduate Extension Studies, P.O. Box 1, Kensington, N.S.W., 2033.

LITERATURE—in brief

STANDARDS ASSOCIATION OF AUSTRALIA, 80 Arthur Street, North Sydney, N.S.W., 2060, is seeking comment on the following draft standards from persons or organisations experienced in the relevant fields. Copies of the documents may be obtained, without charge, from the various offices of the association in all capital cities and Newcastle. Comments should reach the head office or any branch office not later than August 31, 1970.

Doc, 1548. Part II of the revision of Australian Standard C67-1963. Porcelain and glass insulators for overhead power lines (voltages greater than 1000V AC). Part I will deal with voltages below 1000V.

Doc. 1549. Part III of the revision of AS C67. Indoor and outdoor sub-station insulators for voltages greater than 1000V AC.

Doc. 1565. Part IV of the revision of AS C67. Stay insulators.

Doc. 1550. Electrical safety requirements for copper earthing conductors covered with polyvinyl chloride or copolymer (PVC).

Docs. 1557 to 1561. The first of a series of addenda to the five parts of AS C73. Rectangular copper enamelled magnet winding wire.

Doc. 1562. A draft revision of AS C159-1959 Ap., approval and test specification for electronic sound and vision equipment. Incorporates technical advances in the electronics industry, particularly in regard to TV receivers.

Doc. 1563. Outlines the electrical safety requirements for electrocardiographs which are additional to the general requirements.

Doc. 1564. Relates to the performance of direct writing electrocardiographs including the recording chart.

Doc. 1566. A draft standard code for safety in workshops in schools and colleges, essentially the text of British Standard 4163, reproduced without technical comment.

MINIWATT ELECTRONICS DIVISION, Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064, has published a quick reference brochure with an up-to-date listing of the company's zener diodes. It includes a zener diode selection guide, abbreviated data on preferred and non-preferred types, a replacement guide, and a maximum current chart for preferred types.

R/M INTERNATIONAL, P.O. Box 9140, Bridgeport, Conn. 06603, U.S.A., has available a brochure containing details on the properties and uses of the company's filled TFE compounds. TFE is an opaque, thermoplastic, tetrafluoroethylene resin with unusual but highly desirable properties for many applications. Its resistance against chemicals, heat and moisture is said to be superior to all other commercial plastics. Filled TFE compounds are supplied in tape, rod and tube forms, as well as machined to specific design requirements.

NATIONAL SEMICONDUCTOR CORP., U.S.A. has published a new MOS reliability report. The report includes details of a life test which covered a total of nearly 1.5 million device life-test hours with zero failures. The report states that this is equivalent to a failure rate of .06 per cent per 1,000 hours at 125°C at 60 per cent confidence. With the devices used in the test, the results are also equivalent to a total of 115 million bit life-test hours, or a failure rate of .0008 per cent per 1,000 hours at 125°C at the 60 per cent confidence level. The brochure also describes MOS device fabrication, production processing, quality control, and failure screening. Inquiries on company letterhead to Rutherford Electronics Pty. Ltd., P.O. Box 30, North Balwyn, Vic. 3104.

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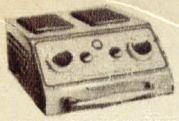
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684—65.P.10
685—65.P.12A
686—65.P.12B
694—66.R.2
704—67.P.2
707—67.P.3
708—67.A.3
709—67.P.4
711—67.A4
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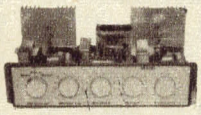
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748—69.D.10
754—69.C.11
749—69.C.12
761—70.TX.1



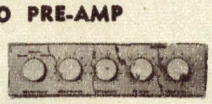
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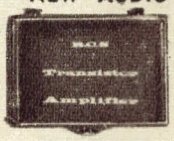
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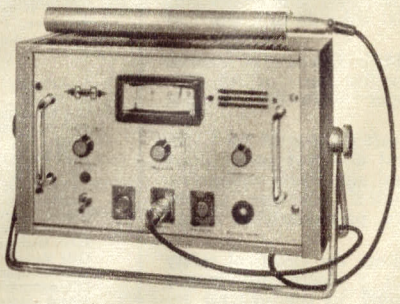
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HEAT TRANSFER AND FLUID FLOW DATA

A new subscription service to provide design engineers with up-to-date, thorough and concise information in the fields of heat transfer and fluid flow has been instituted by the General Electric Company in the U.S.A. Subscribers to this service will receive GE's Heat Transfer and Fluid Flow Design Data Books, two volumes totalling 500 pages which contain formulas, diagrams, curves, charts and specific design engineering information. The price is $275 (U.S.). Annual sets of additional and revised information (about 75 new and revised additional pages per year) will be available to subscribers for $75 (U.S.) a year.

For further information, write to Patent and Technology Marketing, General Electric Company, P. O. Box 43, Schenectady, N.Y. 12301, U.S.A.



INDUSTRIAL and DOMESTIC EQUIPMENT CO., P.O. Box 163, Dandenong, Vic. 3175, has available data sheets for the following Delco silicon power transistors. Applications should be under company letterhead. Types DTS-401 and 402, for use in television deflection circuits while operating from a 60V supply. Types DTS-701, 702 and 704, for use in television deflection circuits operating off the line.

NEWS BULLETIN, Vol. 3, No. 73, 1970. Published by A. F. Bulgin & Co. Ltd., U.K. Inquiries to R. H. Cunningham Pty. Ltd., 608 Collins Street, Melbourne, 3000. Contents: Collet fixing instrument control knobs; switched legended indicator; printed circuit mounting products; battery holders; moulded switches; tag strips and group boards; skeleton fuseholders; microswitches; fuses.

NEW TECHNOLOGY, No. 39, April, 1970. Published by the British Ministry of Technology and the Central Office of Information. It is obtainable from the Central Office of Information, Hercules Road, Westminster Bridge Road, London, SE1, England. Contents: Mintech and machine tool progress; Low-cost digital process control; Cutting industrial explosion hazards; High energy rate forming; News; Statistical indicators.

MULLARD OUTLOOK, Vol. 13, No. 2, March-April, 1970. Published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Viewpoint with Mullard; Mullard Vinkors to I.E.C. Standards: Four new high-Q varactor diodes; MOS digital integrated circuits; New 5mW Gunn oscillator; Short-lead TO-5s; Highlights of Faraday Lesture; digital integrated circuits, bistable (flip-flop) stages, part 1 — introduction and simple circuits; Improved lamp dimmer circuit; Mullard parametric amplifiers for radio astronomy; Mullard educational service; The numbers game; Introducing thyristors; Mullard technical handbook service.

TECHNICAL HIGHLIGHTS OF THE NATIONAL BUREAU OF STANDARDS 1969. NBS Special Publication 325, issued March 1970, 243 pages. Order from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. Price $US1.25 plus one-fourth to cover postage. This annual report covers NBS activities from July 1, 1968 to June 30, 1969. Its introductory chapter summarises the progress of a study into the impact of increasing world-wide usage of the metric system on the U.S.A.

Among the Bureau's activities noted in the report are: construction of two highly stabilised He-Ne lasers with frequencies in agreement to 1 part in 1011; improved calibration of laboratory standard microphones at frequencies down to about 1Hz; developing improved RF pulse power meters; development of super-purity aluminium with residual resistance ratios of up to 45,000; design and construction of a computerised scanning microscope image-processing system; calibration of the cameras used by Apollo IX; experimental work on a new measuring device for checking stray radiation from microwave ovens; studies of the magnetic behaviour of organometallic complexes; improved polarographic methods for simultaneously analysing low-level air pollutants; demonstration of the unique molecular structure of polywater; development of a torsion pendulum system for determining elastic properties and internal friction of dental materials; research on tyres, seat belts, braking systems, vehicle structure and other aspects of automotive safety.

ANALYTICAL SERVICES. Published by Johnson Matthey Chemicals Ltd., U.K. Inquiries to Matthey Garrett Pty. Ltd., P.O. Box 165, Kogarah, N.S.W., 2217. Describes the company's facilities for the analysis of materials from a wide variety of industries. In the laboratories devoted to the analysis of customer samples, more and more reliance is placed on the use of modern instrumentation techniques, including X-ray fluorescence spectrometry, emission spectrography, and atomic absorption spectrophotometry. More specialised still are the methods used for vacuum-fusion gas analysis and electron-probe microanalysis.

MINIWATT DIGEST, Vol. 8, No. 1, Jan./Feb., 1970. Published by the Miniwatt Electronics Division of Philips Electrical Pty. Ltd. 20 Herbert Street, Artarmon, N.S.W. 2064. Contents: Miniwatt FJ Family of TTL Integrated Logic Circuits, part 2 — describes some of the precautions to be observed when triggering gates and flip-flops in logic systems, and gives details of some of the FJ family; Magnetic Core Memories part 2 — planes and stacks.

COMMUNICATION SYSTEMS, No. 5. Published by The Marconi Co., U.K. Inquiries to Amalgamated Wireless (A'sia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113. Contents: Big space communications order; PCM for Hull; Receiver design breakthrough; New advances in data transmission; Strip line techniques in ground terminals; Mobile radio exhibition; Increased capacity for Angolan link; The Communication Systems story; Managing Director, Marconi Communication Systems Ltd.; Making big dishes; World Weather Watch communications; Eddystone Radio reorganisation of sales. ■

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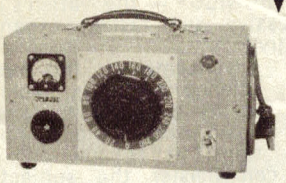
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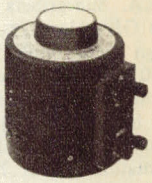
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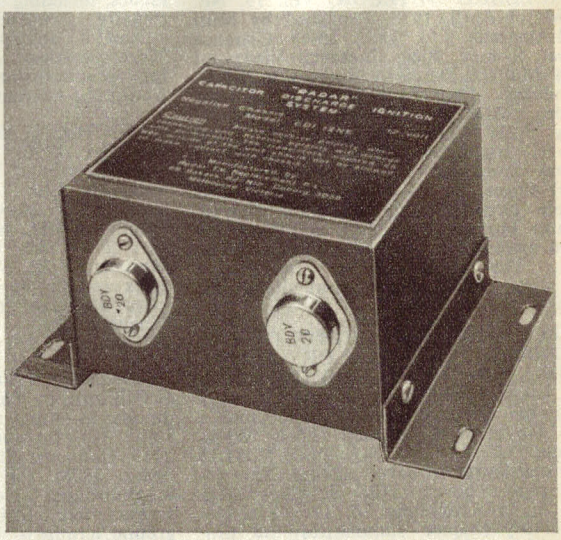
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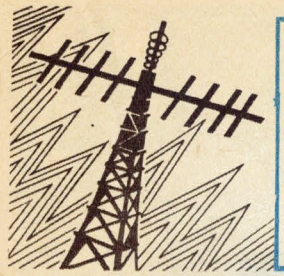
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AMATEUR BAND NEWS AND NOTES

Australis Oscar AO6 Project

Australian radio amateurs are to participate in plans for an amateur communication satellite to be launched in 1971.

by Pierce Healy, VK2APQ

Following the success of the first Australis Oscar satellite placed in orbit in February this year, a more ambitious project is being undertaken by the Australis project group. The project is being sponsored by the Wireless Institute of Australia and will form part of the AMSAT OSCAR VI project which is being co-ordinated by the Radio Amateur Satellite Corporation, an American amateur radio group.

The AMSAT group, headed by Perry Klein, K3JTE, is closely associated with the National Aeronautics and Space Administration of the United States, who made possible the Australis Oscar V pick-a-back launch.

The project will be an international effort. Australian, American and German amateurs will pool their knowledge and resources to produce an amateur communication satellite, offering intercontinental communication between amateur stations operating on the international VHF/UHF amateur bands.

The Australian contribution will be a multi-channel repeater which will accept signals from the 144MHz amateur band and retransmit in the 432MHz band. The German section will be a transponder which will acept 432MHz amateur band signals and retransmit in the 144MHz amateur band.

The American contribution will compromise the power supplies and other hardware, including solar cells, plus the space environmental testing and launching negotiations with the NASA authorities.

The Australian technical team is being led by Les Jenkins, VK3ZBJ, with Richard Tonkin as project co-ordinator. The cost of the Australian unit is estimated to be $5,000 which, it is anticipated, will be met from donations from amateurs. It is hoped support will also be forthcoming from commercial organisations associated with the electronic industry.

Already some divisions of the Wireless Institute have undertaken to underwrite a portion of the cost in order that construction can proceed. Over the past few months feasibility tests have been carried out using normal commercial specification components. Now that the systems have been proved it is hoped that finance will be forthcoming to purchase components suitable for space environment.

To clarify several technical aspects that cannot be resolved by correspondence, Les Jenkins will be visiting the United States during August. Discussions on antennae, frequencies to be used, power consumption and the integration of both the German and Australian units will take place.

The leader of the German group, Carl Meissner, will also be in the discussion at the AMSAT headquarters. Air fares to the United States will be met by the AMSAT-OSCAR project. Other expenses, including air fares from Los Angeles to Washington and return, incurred by Les will be met from Project Australis funds.

A fund to finance the Australian part of the project has been opened and those wishing to contribute are invited to send their contributions to:—

Project Australis,
P.O. Box 67,
East Melbourne, 3002,
Victoria.

Diploma 100 EAs-CW

The Spanish Amateur Radio Union de Radioaficionados Espanoles ("URE") is offering the "Diploma 100 EAs-CW" under the following conditions:

1. This diploma will be issued to any licensed radio amateur anywhere in the world who has worked and confirmed two-way CW contacts with Spanish stations on any authorised band.
2. According to their QTHs, applicants must contact different numbers of Spanish stations until they have scored 100 points as follows:

a. Applicants from Zones — 14, 15, 16, 20 and 3 must have received confirmation of 100 QSOs with Spanish stations. Each contact counts as one point.

b. Applicants from Zones—4, 5, 8, 9, 11, 17, 18, 21, 22, 34, 35, 36, and 37 must have received confirmation of 50 QSOs with Spanish stations. Each station counts as two points.

c. Applicants from all other zones must have received confirmation of 25 QSOs with Spanish stations. Each contact counts as four points.

The official "CQ-WAZ" Zone map will be used to determine the Zone limits.

Applications for the Diploma must be accompanied by a list of call signs in strict alphabetical order and contain complete details of QSOs made.

3. It is necessary to work at least three amateur bands and seven Spanish Districts.
4. Contacts with the same station on different bands will be counted if three days pass between the contacts.
5. The "URE" will accept certified lists only from applicants whose amateur radio societies have reciprocal arrangements.
6. Spanish applicants must send QSL cards when making application for the Diploma.
7. Despatch of Diploma and return of QSL cards will be free of any charge if the "URE" has reciprocal arrangements with the applicant's society. In other cases, applicants must send a sufficient number of IRC's to cover mail expenses.
8. Short-wave listeners may also apply for the Diploma in accordance with rules 3, 4, 5 and 6 if they have confirmation QSL cards for 100, 50 or 25 points. Moreover, a third of the stations heard and confirmed must be from different QTH's.
9. The Diploma will be issued in three different classifications, e.g., 100 QSOs, 50 QSOs and 25 QSOs in accordance with rule 2.
10. The following trophies wil be presented to the first applicants who gain each class of the Diploma: Two golden, two silver and two bronze medals from amateurs and short-wave listeners who gain the first Diplomas in the 100-CW section. Two gold medals for the amateurs who gain the first 50-CW and 25-CW Diplomas.
11. Decisions of the "URE" regarding the interpretation of these rules or any other matter relating to the Diploma shall be final.
12. QSL cards must be sent without any alteration; any alteration will result in disqualification of the applicant.
13. Contacts for the Diploma must be made since January 1st, 1966.
14. These rules supersede those published by the "URE" in May, 1969.

ODXRC AWARD

This award is being issued by the Okinawa Radio Club. The purpose of the ODXRC Award is to celebrate the ten years since amateur radio operators were given permission to operate from Okinawa. Moreover, it will perpetuate the fact that there was a "KR8" call sign prefix which will become redundant when Okinawa reverts to Japanese control in 1972.

Requirements of the award

1. The applicant must receive QSL cards from ODXRC members.
2. Applicants must certify that they have sent QSL cards to the ODXRC members contacted.
3. Applicants need not send QSL cards received but a certified extract from

News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W. 2200.

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their logs showing details of the contacts made.

4. No particular requirements apply to the type of emission, frequency used and date of QSO. However, cross band contacts will not be recognised.
5. Points required to gain the award are:
   a. QSOs on 3.5MHz and 7.00MHz will count two points, on 14MHz, 21MHz and 28MHz, one point.
   b. Contacts with the same station will gain points if the QSOs are on different bands.
   c. Applicants from JA, JD, KA and KR6/8 call areas must score ten points, all other applicants need only five points to gain the award.
6. Applicants from JA JD, KA and KR6/8 call areas must send 3 IRCs and all others 5 IRCs with their log extracts.
7. Applications should be addressed to: ODXRC Award, G.P.O., Box 96, Naha Okinawa, Japan.
   or to KR8BU, award manager, Misao Miyagi, 90 Daido Naha City, Okinawa, Japan.

   Member stations of the Okinawa DX Radio Club are—KR8-AG; AP; AX; BL; BU; BY; CA; CF; DE; DK; DU; EA; EI; GF; GV.

W.I.A. ACTIVITIES

As one means of financing the Australis Oscar V1 project, Federal Exceutive of the W.I.A. have for sale Great Circle Maps size 20 inches by 30 inches printed on heavy paper.These maps show the true distance and direction of every point on the surface of the earth from Australia.

These are indespensible for amateur radio operators. The cost is 60 cents each and may be obtained by sending to:— Maps P.O. Box 67, East Melbourne, Victoria, 3002. Payment must accompany order. There is no restriction on the number that can be ordered.

NEW SOUTH WALES

Work in the remodelling of the New South Wales Division's transmitting station VK2WI, at Quarry Road, Dural is progressing under the guidance of Bill Jenvy, VK2ZO. New transmitters are being installed and the operating facilities improved.

A VHF repeater operating on Channel 4, i.e. receive on 146.4 and retransmit on 145.6, is being installed at the site. To assist members who wish to use the repeater facilities arrangments are being made to procure suitable crystals for the various types of FM units being used.

Those operators wishing to avail themselves of this service should make enquiries from the Secretary, 14 Atchison Street, Crow's Nest, 2065. All that will be necessary will be to give details of the unit the crystals will be required for and the crystal frequencies will be calculated. The service should be able to provide these crystals at a much more attractive price than is normally available to amateurs. However, it is emphasised that the success of the scheme depends on a sufficient number of people being interested.

Central Coast Branch

Friday, June 19th was a very important occasion for the Central Coast Branch of the New South Wales Division. The first meeting was held in the new club room at Kariong. Attendance was excellent, being the best for many years.

The highlight of the evening was a lecture and demonstration of amateur television. George Collie, VK2ZCD gave the lecture then carried on with a demonstration. The proceedings at Kariong were televised, received by Horrie Lapthorn, VK2HL at Toukley, recorded on an Ampex video recorder, then retransmitted back to Kariong.

Assisted by Jack Jeffrey, VK2AJY, Horrie also transmitted live pictures from Toukley to Kariong. Club members present agreed that the quality of the transmission was excellent and equal to commercial standards.

AUSTRALIAN VHF CENTURY CLUB AWARD

OBJECTS

1.1 This Award has been created in order to stimulate interest in the VHF bands in Australia, and to give successful applicants some tangible recognition of their achievements.

1.2 This Award, to be known as the "VHF Century Club" Award, will be issued to any Australian amateur who satisfies the following conditions.

1.3 Certificates of the Award will be issued to the applicants who snow proof of having made one hundred contacts on the VHF bands, and will be endorsed as necessary, for contacts made using only one type of emission.

REQUIREMENTS

2.1 Contacts must be made in the VHF band (Band 8) which extends from 30 to 300 MH, but such contacts must only be made in the authorised amateur bands in band 8.

2.2 In the case of the authorised bands between 30 and 100 MHz, verifications are required from one hundred different stations at least seventy of which must be Australian. The amateur bands 50 to 54MHz and 56 to 60MHz will be counted as one band for the purposes of the Award.

2.3 In the case of the authorised amateur band between 100 to 200MHz, verifications from one hundred different stations are required.

2.4 It is possible under these rules for one applicant to receive two certificates, one for each of the authorised amateur bands nominated in Rules 2.2 and 2.3.

2.5 The commencing date for the Award is June 1, 1948. All contacts made on or after this date may be included.

OPERATION

3.1 All contacts must be two-way contacts on the same band, and cross-band contacts will not be allowed.

3.2 Contacts may be made using any authorised type of emission for the band concerned.

3.3. Fixed stations may contact portable/mobile stations and vice versa, but portable/mobile station applicants must make their contacts from within the same call area.

3.4 Applicants, when operating either portable/mobile or fixed, may contact the same station licensee, but may not include both contacts for the same type of endorsement.

3.5 Applicants may only count one contact for a station worked as a limited licensee with a Z call sign who is subsequently contacted as a full A.O.C.P. holder.

3.6 All stations must be contacted from the same call area by the applicant (except as below), although if the applicant's call sign is subsequently changed, contacts will be allowed under the new call sign providing the applicant is still in the same call area.
If the applicant moves to another call area, contacts must be made from within a radius of 150 miles of the previous location to qualify for award purposes. If the distance of the new location from the old exceeds a radius of 150 miles, a separate application for a new award must be made claiming only contacts made from the new location.

3.7 All contacts must be made when operating in accordance with the Regulations laid down in the "Handbook for the Guidance of Operators of Amateur Wireless Stations" or its successor.

VERIFICATIONS

4.1 It will be necessary for the applicant to produce verifications in the form of QSL cards or other written evidence showing that two-way contacts have taken place.

4.2 Each verification submitted must be exactly as received from the station contacted, and altered or forged verifications will be grounds for disqualification of the applicant.

4.3 Each verification submitted must show the date and time of contact, type of emission and frequency band used, the report and the location or address of the station at the time of contact.

4.4 A check list must accompany every application setting out the following details:—
   4.4.1 Applicant's name and call sign, and whether a member of the W.I.A. or not.
   4.4.2 Band for which application is made, and whether special endorsement is involved.
   4.4.3 Where applicable, the date of change of call sign and previous call sign.
   4.4.4 Details of each contact as required by Rule 4.3.
   4.4.5 The applicant's location at the time of each contact if portable/mobile operation is involved.
   4.4.6 Any relevant details of any contact about which some doubt might exist.

APPLICATIONS

5.1 Applications for membership shall be addressed to the **Federal Awards Manager, W.I.A., P.O. Box 67, East Melbourne, Vic., 3002,** accompanied by the verifications and check list with sufficient postage enclosed for their return to the applicant, registration being included if desired.

5.2 A nominal charge of 25c, which shall also be forwarded with the application, will be made for the issue of the certificate to successful applicants who are non-members of the Wireless Institute of Australia.

5.3 Successful applicants will be listed periodically in "Amateur Radio." Members of the VHFCC wishing to have their verified totals, over and above the one hundred necessary for membership, listed will notify these totals to the Federal Awards Manager.

5.4 In all cases of dispute, the decision of the Federal Awards Manager and two officers of the Federal Executive of the W.I.A. in the interpretation and application of these Rules shall be final and binding.

5.5 Notwithstanding anything to the contrary in these Rules, the Federal Council of the W.I.A. reserves the right to amend them when necessary.

VICTORIA

The Eastern Zone of the W.I.A. VK3 Division, held their Annual Convention at Moondang, near Moe, 80 miles east of Melbourne over the weekend June 6th and 7th, 1970. Visitors attending enjoyed glorious sunny weather.

A trade display preceded the annual meeting on the Saturday afternoon when the retiring president, David Godfrey, VK3AZM, reported that the Eastern Zone has never been so active in the various phases of amateur radio. There has been a tremendous increase in constructional, operating and social activity among the Zone members.

During the year ten more amateurs have joined the ranks, most of whom attended the A.O.C.P. classes conducted the previous year. Also, ten members have made the conversion from AM to SSB and made their re-appearance on the air.

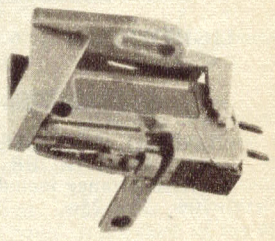
The election of officers for the coming 12 months resulted in the following appointments being made:

Zone president: Rodney Champness, VK3UG (ex VK0CR);
Vice-president: Greger Cox, VK3ZGC:
Secretary: Lee de Vries, VK3AXM;
Publicity Officer: George Francis, VK3ASV;
Zone WICEN Officer: Graham Colley, VK3QZ;
Official Zone Station: David Scott, VK3DY.

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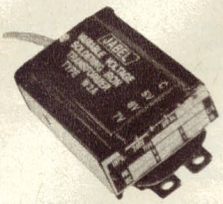
MIN in 4,6 and 12v-10watt.

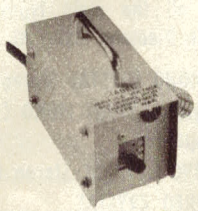


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JARL Awards for Amateurs and SWLs

The following Awards are offered by Japan Amateur Radio League (JARL) for proficiency and achievement of any Amateur and SWL in the world in his/her amateur life.

The applicant must submit QSLs fulfilling the conditions of the Award applied for, and a list showing the date and time (GMT) of QSOs, type of emission and frequency used, signal report, and locations of the stations contacted.

All claims for these Awards should be made by the submission of the QSLs, together with the list as mentioned above, and IRCs as listed below. If the list has been certified by the awards manager of an IARU member Society, confirmations (QSL cards) are not required to be sent.

Address for the applications: JARL Awards Manager, P.O. Box 377, Tokyo Central, Japan.

NUMBER of IRCs to be sent AJD (All Japan Districts): 10

WAJA (Worked All Japan Prefectures): 10

HAJA (Heard All Japan Prefectures): 10

JCC (Japan Century Cities): 10

ADXA (Asian DX Award): 10

HAC (Heard All Continents): 5

All contacts between amateurs or reported by SWLs must have been made on and after July 30, 1952. Any authorised amateur bands and type of emission may be used but no cross band contacts will be allowed. The applicant must have worked under local regulations.

All contacts must be with a "land station." Contacts with ships anchored or otherwise, and aircraft do not count.

All stations must be contacted from the same call area, where such areas exist, or from the same country in cases where there are no call areas.

Requirements:

AJD: QSO with all JA/JH/JR call areas, 1 to zero inclusive. SWL-AJD for SWLs.

WAJA: QSO with JA/JH/JR station in all (46 Japanese Prefectures shown in the attached list. HAJA for SWLs.

JCC: QSO with over 100 JA/JH/JR/ stations in different cities in Japan. JCC-200, -300, -400, -500, are also issued as separate Awards. A list of cities is available on request (3 IRCs needed). SWL-JCC for SWLs.

HAC: This Award is issued to any SWL who gets confirmation of amateur stations in 6 different continents, for his/her reception reports.

ADXA: This Award has been instituted to encourage radio amateurs in co-operation and friendship between Asia and other continents of the world. The ADXA, for confirmed contacts with 30 different Asian countries including JA/JH/JR (except KA) is available to licensed amateurs everywhere in the world.

LIST OF WAJA/HAJA

District JA1. Prefectures Tokyo, Kanagawa, Chiba, Saitama, Ibaraki, Tochigi, Gumma, Yamanashi.
JA2. Shizuoka, Gifu, Aichi, Mie.
JA3. Kyoto, Shiga, Nara, Osaka, Wakayama, Hyogo.
JA4. Okayama, Shimane, Yamaguchi, Tottori, Hiroshima.
JA5. Kagawa, Tokushima, Ehime, Kochi.
JA6. Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima.
JA7. Aomori, Iwate, Akita, Yamagtaa, Miyai, Fukushima.
JA8. Hokkaido.
JA9. Toyama, Fukui, Ishikawa.
JA10. Niigata, Nagano.

List of ADXA

AC3
AC4
AC(Bhutan)
AP(East)
AP(West)
BV/C3
BY/C
* C9
* CR8(Damao, Diu)
* CR8(Goa)
EP/EQ
* F18
(French Indo China)
*FN8
HM/HL
HS
HZ/7Z
JA/JH/JR
JD/KG61
(Ogasawara Is.)
JT
JY
KR6,8
MP4B
MP4Q
MP4M/VS9O
MP4T
OD5
TA
UA9
UD6
UG6/4J7
UC6/4J7
UH8
U18
UJ8
UL7
UM8
* VS 1/9M/9V1
(Singapore)
VS1/9M2, 4
(West Malaysia)
* VS2/9M2
(Malaysia)
VS6
VS9
VS9K
* VS9H
VS9M/8QA
VU
VU(And'n & Nic'r Is.)
VU(Laccadive)
XU
XV/3W8
XW8
XZ2
YA
YI
YK
* ZC6/4X1
1S9(Spratly Is.)
4S7
4W1
4X4/4Z
5B4/ZC4
8Z4
9K2
9K3/8Z5
9N1

* Effective contact only

The Eastern Zone "Activities Award" for 1970 was presented to George Francis, VK3ASV, as being the most active member in the Zone. A report was given by Max Crisp, VK3ZXM, on the Eastern Zone FM repeater now operating on Channel 4 from an experimental test site. The Eastern Zone "Wildcat DX Award" certificate design was examined and finally accepted by members as very satisfactory.

The guest speaker after the convention dinner was Mr Pat Giddings, District Radio Inspector, Sale, who gave an excellent talk on the problems arising from electrical interference in the zone area, and its control.

Max Crisp, VK3ZXM, displayed kits for a solid-state transmitter (10W) and receiver for the 146MHz FM frequencies. Later in the evening, George Francis, VK3ASV, assisted by Ken Sutcliff, demonstrated amateur RTTY using a Creed 7C teleprinter. This was followed by a discussion on VHF mobile antennas by Greger Cox, VK3ZCG and in particular his experiments with 7/8 wavelength type.

On Sunday, Allan Hyslop, VK3ZNB gave an informative talk on commercial mobile communications and Alf Chandler VK3LC spoke and played a tape recording on the Intruder Watch organisation.

Two field events which were held and were keenly contested were:

160 metre Hidden Transmitter Hunt:
1st David Andrews VK3YBY
2nd Lee de Vries VK3AXM
144MHz Hidden Transmitter Hunt:
1st Allan Hyslop VK3ZNB

The final event of the convention was a sale of disposal equipment.

The organising committee, on behalf of the Eastern Zone members, express their thanks to the trade houses who donated prizes for the convention; and the thanks of the visitors to the area goes to Don VK3YAX and Brian VK3BBB, who acted as talk-in stations for mobile operators.

Amateur television is a project for the coming year for Eastern Zone members.

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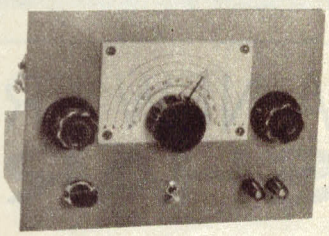
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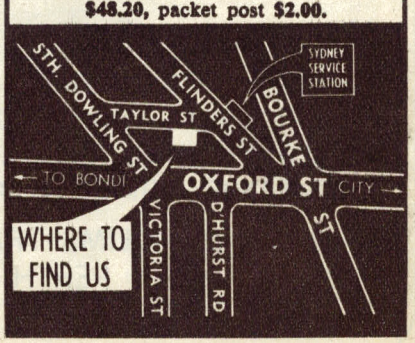


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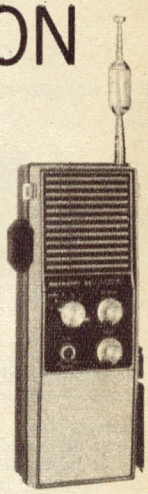
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WESTERN AUSTRALIA

A new club has been formed in Perth. The name chosen was the "29 DX Club," the "29" signifying Zone 29. Meetings are held on the fourth Tuesday of each month, usually at the QTH of one of the members.

The subscription for membership has been set at $1.00 per year. Further details may be obtained from the Club secretary, Allan Gibbs, VK6PG, 12 Munyard Way, Morely, 6062.

YOUTH RADIO CLUB SCHEME

At the end of June, 27 clubs in N.S.W. had registered with the Youth Radio Club Scheme. Members are reminded that Y.R.C.S. broadcasts are made from VK2AWI on the second and fourth Saturday in each month. These broadcasts are on the frequency of 7050KHz and commence at 3 p.m. Following the news session call backs will be taken from other Y.R.C.S. stations.

Maitland Radio Club: The club is proud to have won for the second time, the Institution of Radio and Electrical Engineers pennant award. The presentation night was held on July 24 in the C.W.A. hall, East Maitland.

Eleven members passed the examinations held on June 20 for the Y.R.C.S. Elementary and Junior Certificates. Four candidates gained honours, five credits and two passes. The club is conducting seven classes each week in radio and electrical theory as applied to amateur radio.

A telegraphy examination for members of the Morse code class was held for the speed of 5-w.p.m. Mr Brownlee, Postmaster at East Maitland, supervised the examination, successful members were Vicki McInnes, A. Counsell, D. Cross and Gary Watson.

The first overseas amateur radio operator to qualify for the Maitland City Award presented by the Maitland Radio Club was R. Finch, W6UWP, of Canoga Park, California, U.S.A. The first Australian to gain the award was Frank Boundy, AX2ZFX, of Newcastle.

The editor of the "M.R.C. News" reports that the number of subscribers is increasing each week and 120 copies per month are now being printed. The July issue contains a special article by Des Mills, VK2ZDN, giving details of a 432MHz converter to be used ahead of a domestic television receiver for the reception of amateur television transmissions now being regularly transmitted from the club on the 432MHz band.

Westlakes Radio Club: The Westlakes Radio Club celebrated its tenth birthday last month. It was one of the first Youth Radio clubs to be formed, and originally was known as the Booragul High School Radio Club. Classes were held initially twice weekly on Wednesday and Friday afternoons, and there were 13 members, two of them girls. After a few years, mainly because of the transfer of teachers from the High school the club went into recess. In 1964, premises known as "the old church" were taken over by a group of enthusiasts and the club was reactivated as the Westlakes Radio Club, in Railway Street, Teralba.

The club grew and late last year moved to larger premises in Teralba. It has been a very well organised and efficiently run club, and has gained several creditable firsts in the sphere of Youth Radio Club training projects.

Operating under the club's station call sign, VK2ATZ, members have participated in numerous contests and field events.

VICTORIA

Camberwell Grammar School: Three members of the Camberwell Grammar School Radio and Electronics Club who recently sat for the A.O.C.P. examination have been issued with their call signs. They are: Robert Wills, VK3BDS: John Frost, VK3ZZD: Alan Conrad, VK3YDA.

AUSTRALIAN DX CENTURY CLUB AWARD

OBJECTS

1.1 This Award was created in order to stimulate interest in working DX in Australia and to give successful applicants some tangible recognition of their achievements.

1.2 This Award, to be known as the "DX Century Club" Award, will be issued to any Australian Amateur who satisfies the following conditions.

1.3 A certificate of the Award will be issued to the applicants who show proof of having contacted one hundred countries, and will be endorsed as necessary, for contacts made using only one type of emission.

REQUIREMENTS

2.1 Verifications are required from one hundred different countries as shown in the Official Countries List.

2.2 The Official Countries List will be published annually in "Amateur Radio" and will be amended from time to time as required. Should a country be deleted from the Countries List at any time, members and intending members will be credited with such country if the date of contact was before such deletion.

2.3 The commencing date for the Award is January 1, 1946. All contacts made on or after this date may be included.

OPERATION

3.1 Contacts must be made in the HF band (band 7) which extends from 3 to 30MHz, but such contacts must only be made in the authorised amateur bands in band 7.

3.2 All contacts must be two-way contacts on the same band. Cross band contacts will not be allowed.

3.3 Contacts may be made using any authorised type of emission for the band concerned.

3.4 Credit may only be claimed for contacts with stations using regularly assigned Government call signs for the country concerned.

3.5 Contacts made with ship or aircraft stations will not be allowed, but land-mobile stations may be claimed provided their specific location at the time of contact is clearly shown on the verification.

3.6 All stations must be contacted from the same call area by the applicant (except as below), although if the applicant's call sign is subsequently changed, contacts will be allowed under the new call sign providing the applicant is still in the same call area. If the applicant moves to another call area, contacts must be made from within a radius of 150 miles of the previous location to qualify for award purposes. If the distance of the new location from the old exceeds a radius of 150 miles, a separate application for a new award must be made claiming only contacts made from the new location.

3.7 All contacts must be made when operating in accordance with the Regulations laid down in the "Handbook for the Guidance of Operators of Amateur Wireless Stations" or its successor.

VERIFICATIONS

4.1 It will be necessary for the applicant to produce verifications in the form of QSL cards or other written evidence showing that two-way contacts have taken place.

4.2 Each verification submitted must be exactly as received from the station contacted, and altered or forged verifications will be grounds for disqualification of the applicant.

4.3 Each verification submitted must show the date and time of contact, type of emission and frequency band used, the report and the location or address of the station at the time of contact.

4.4 A check list must accompany every application setting out the details for each claimed station in accordance with the details required in Rule 4.3.

APPLICATIONS

5.1 Applications for membership shall be addressed to the Federal Awards Manager, W.I.A., P.O. Box 67, East Melbourne, Vic., 3002, accompanied by the verifications and check list with sufficient postage enclosed for their return to the applicant, registration being included if desired.

5.2 A nominal charge of 25c, which shall also be forwarded with the application, will be made for the issue of the certificate to successful applicants who are non-members of the Wireless Institute of Australia.

5.3 Successful applicants will be listed periodically in "Amateur Radio." Members of the D.X.C.C. wishing to have their verified country totals, over and above the one hundred necessary for membership, listed will notify these totals to the Federal Awards Manager.

5.4 In all cases of dispute, the decision of the Federal Awards Manager and two officers of the Federal Executive of the W.I.A. in the interpretation and application of these Rules shall be final and binding.

5.5 Notwithstanding anything to the contrary in these Rules, the Federal Council of the W.I.A. reserves the right to amend them when necessary.

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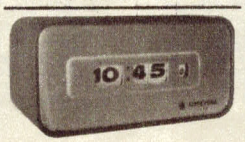
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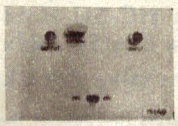
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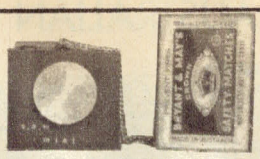


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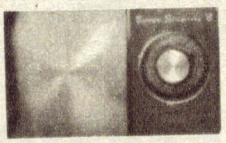
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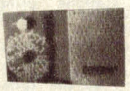


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The club station, VK3BCG is now operating on the 40-metre band every lunch time between 1230EST and 1315EST. The transmitter is a converted AT5 and the receiver a seven band A.W.A. Radiola which has been modified by the addition of a BFO and Q-multiplier, and with the RF stage improved.

Although the club has made 370 contacts since the station came on the air 11 months ago, members are disappointed that very few of the contacts have been with other club stations. Members would like to contact more club stations to exchange ideas and discuss subjects of mutual interest. A proposal to operate the club station on the 144MHz band is under consideration.

Work on the Y.R.C.S. certificate courses is progressing well under the guidance of Mr J. V. Treen, master-in-charge of the radio club. The boys give full credit for their success to Mr Treen who introduced a system of weekly tests which have proved very effective in preparing them for the examinations.

SOUTH AUSTRALIA

The annual general meeting of the Youth Radio Club Scheme in South Australia was held at Kadina on Saturday, June 20, 1970. There were 14 delegates in attendance representing Youth Radio Clubs from various parts of the State. The State supervisor, Reverend Robert Guthberlet, VK5OD, when welcoming delegates to the meeting, also congratulated John Allan, VK5UL on his election to president of the South Australian division, W.I.A. John has been Y.R.C.S. liaison officer for some time and in this office endeavours to visit clubs and assist in the formation of new ones.

Discussions at the meeting revealed that club activity this year was quite strong, through the efforts of an enthusiastic band of club leaders. Club membership varied from eight to 80 with an average of 20.

Delegates expressed concern that more was not being done to develop the Y.R.C.S. on a federal basis. Some of the suggestions put forward were: more interstate liaison; a regular federal conference; the possibility of an annual Australia-wide "on the air" youth radio hookup, using club stations wherever possible.

On the local scene it was decided that club leaders should be encouraged to prepare short tapes of their activities for possible inclusion in future W.I.A. news broadcasts. Also, those clubs with the facilities to do so, were set the task of developing their club stations to the point where they could join the Y.R.C.S. net in South Australia, which is held on a regular basis on the first Friday in each month. Those clubs without a station were encouraged to seek the assistance of a local amateur radio operator.

All office bearers were re-elected for the next 12 months. Members of the executive committee are as follows:

State Supervisor: Reverend Robert Guthberlet, VK5OD.
Liaison Officer: John Allan, VK5UL.
State Secretary: Allen Dunn, VK5FD.
Metropolitan Clubs Representative: Steve Johnston, VK5ZNJ.
Country Club Representative: Lloyd Douglas, VK5LL.

Those attending the meeting agreed that it had been most successful and leaders from new clubs were able to exchange ideas with those from the more established

Y.R.C.S. SW LISTENERS CERTIFICATE

Members of registered Youth Radio Clubs in South Australia may write to the State Secretary for details of this award. Any listener with a short-wave receiver capable of tuning two amateur bands and who has gained his Elementary Certificate, is eligible to participate.

ELEVENTH ALL ASIAN DX CONTEST

The purpose of this contest is to increase the activity of radio amateurs in Asia and to establish as many contacts as possible during the contest periods between Asian and non-Asian stations.

1. CONTEST PERIOD: 1000 GMT August 22, 1970, to 1600GMT August 23, 1970. (During the fourth weekend of August).

2. ENTRY CLASSIFICATIONS:
(a) Single-band single-operator,
(b) Multi-band single-operator,
(c) Multi-band multi-operator single-transmitter.
(Club stations can take part only in this section.)

3. BANDS: The following amateur bands may be used: 1.8, 3.5, 7.0, 14.0, 21.0, 28.0MHz.

4. TYPE OF EMISSION: CW only.

5. CONTEST CALL: Non-Asian stations call "CQ AA." Asian stations call "CQ TEST."

6. SERIAL NUMBERS:
(a) For OM stations: Five figures, RST report plus two figures denoting your age. (Example: if your age is 35 number will be RST35).
(b) For YL stations: Five figures, RST report plus two figures "Zeros" (Zero Zero).

7. POINT AND MULTIPLIER:
(a) For Asian stations: A contact with a non-Asian station will count one point, and a multiplier of one for each non-Asian country worked on each band, using the DXCC country lists.
(b) For non-Asian stations. A contact with an Asian station will count one point and multiplier of one for each prefix of Asian country worked on each band, using the WPX form.
(c) About JD1: The Ogasawara Islands (Bonin and Volcano Islands) belong to Asia, and Minamotorisima (Marcus Island) belongs to Oceania.

CALL: _____ ENTRY: ( ) Single Band ( ) Single Op. ( ) Multi Band ( ) Multi Op.

NAME: _____

ADDRESS: _____

BAND	QSOs	POINTs	MULTIPLIER	SCORE
1.8				
3.5				
7.0				
14.0				
21.0				
28.0				
TOTAL				

Transmitter Description and Power _____

Receiver _____

Remarks (Suggestions, Criticisms and Comments) _____

This is to certify that in this Contest I have oprated my transmitter within the limitations of my license and observed fully the rules and regulations of the Contest.

DATE: _____ SIGNATURE: _____

ABOVE: The summary sheet for the 11th All-Asian DX Contest. BELOW: A suitable form of log sheet. Contestants are requested to write in English using block letters.

CALL: _____ COUNTRY: _____

LOG For _____ MC BAND ENTRY: _____

(Use Separate log for each band.)

DATE	TIME (GMT)	STATIONs (Worked)	SERIAL NUMBERs SENT	SERIAL NUMBERs RCVD	MULTI	POINTs

8. SCORING:
(a) For Asian stations: The total score will be the sum of country multipliers of each band multiplied by the sum of the contact points on each band. Contacts between stations on the Asian continent will not be counted for contact points or country multipliers.
(b) For non-Asian stations: The total score will be the sum of prefix multipliers of each band, multiplied by the sum of the contact points on each band. Contacts between stations outside Asia will not count.

9. AWARDS: Certificates will be awarded for each section of the contest as follows:
(a) Multi-band single-operator. Certificates and plaques with medal go to the highest scoring stations in each continent. Certificates go to the third placed operator in each country.
(b) Single-band single-operator. Certificates and medals go to the highest scoring stations in each continent. Certificates go to the first placed operator of each country on each band.
(c) Multi-band multi-operator single-transmitter. Certificates and plaques with medal go to the highest scoring stations in each continent. Certificates go to the first placed station of each country.
(d) In addition, certificates go to the first placed operator of each call area of the United States in the section of multi-band single-operator.
(e) SPECIAL AWARD: In addition, a souvenir will be awarded to the highest scoring single operator on multi-band in each continent.
Depending on the number of contestants in a country, the contest committee will consider awarding more certificates.

10. LOG INSTRUCTIONS:
(a) Keep all times in GMT.
(b) In keeping a log, fill in prefix or country only the FIRST TIME it is contacted.
(c) Use a separate sheet for each band, and a tally sheet or report form.

11. RESTRICTIONS IN THE CONTEST:
(a) Only one contact per band with the same station will be permitted.
(b) No cross-band contacts are permitted.
(c) Different contacts on different bands at the same time are not allowed.
(d) Club stations can only take part in the section multi-band multi-operator single-transmitter. Contest number consists of RST report plus age of each operator.
(e) KA stations may not be contacted.

12. DISQUALIFICATION: Violation of the regulations of amateur radio in the country of the contestant, or the rules of the contest, or unsportsmanlike conduct, or taking credit for incorrect QSOs or multipliers, or duplicate contacts in excess of 2 per cent of the total made will be deemed sufficient cause for disqualification. The All Asian DX Contest Committee's decision shall be final in all cases of dispute.

13. REPORTING: All logs must be mailed to: J.A.R.L. Contest Committee, Central Post Office Box 377, Tokyo, Japan, to arrive not later than November 30, 1970. After rigorous judging the result will be announced by next March.
You may have contest results by enclosing one IRC with your log.

Following countries are available as Asia: AC1,2,5-0 — Bhutan; AC3 — Sikkim; AC4 — Tibet; AP — East Pakistan; AP — West Pakistan; BV — Formosa; BY — China; CR9 — Macao; EP — Iran; HL/HM — Korea; HS — Thailand; HZ/7Z — Saudi Arabia; JA/JH/JR — Japan; JD1 — Iwo & Ogasawara Is. (Bonin & Volcano Is.); JT — Mongoliaa; JY — Jordon; KR6,8 — Ryukyu Is.; MP4B — Bahrein Is.; MP4D,T — Trucial Oman; MP4M, VS9O — Sultanate of Muscat and Oman; MP4Q — Qatar; OD5 — Lebanon; TA — Turkey; UA/UK/UV/UW 9,0 — Asiatic R.S.F.S.R.; UD6 — Azerbaijan; UF6 — Georgia; UG6 — Armenia; UH8 — Turkoman; UI8 — Uzbek; UJ8 — Tadzhik; UL7 — Kazakh; UM8 — Kirghiz; VS6 — Hong Kong; VS9K — Kamaran Is.; VS9M/8QA — Maldive Is.; VU — Andaman & Nicobar Is.; VU — India; VU — Laccadive Is.; XU — Cambodia; XW8 — Laos; XZ2 — Burma; YA — Afghanistan; YI — Iraq; YK — Syria; IS9 — Spratly Is.; 3W8/XV5 — Vietnam; 4S7 — Ceylon; 4W — Yemen; 4X — Israel; 5B4/ZC4 — Cyprus; 8Z4 — Saudi Arabia/Iraq Neutral Zone; 9K2 — Kuwait; 9K3/8Z5 — Kuwait/Saudi Arabia Neutral Zone; 9M2 — West Malaysia; 9N1 — Nepal; 9V1 — Singapore; — South Yemen People's Republic.

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ones. There were several opportunities for friendly informal discussion, including a visit to VK5OD.

Y.R.C.S. Certificates have been gained at the following clubs:

Elementary Certificates:

Port Augusta Youth Radio Club: Kenneth Higginbottom (Honours), Eddy Davis (Honours), Christopher Gilbert (credit), Keith Hodshon (Credit), Susan Balog (Pass), Carmelo Nistico (Pass).

Susan Balog is the second girl in South Australia to gain a Y.R.C.S. Certificate.

Junior Certificate:

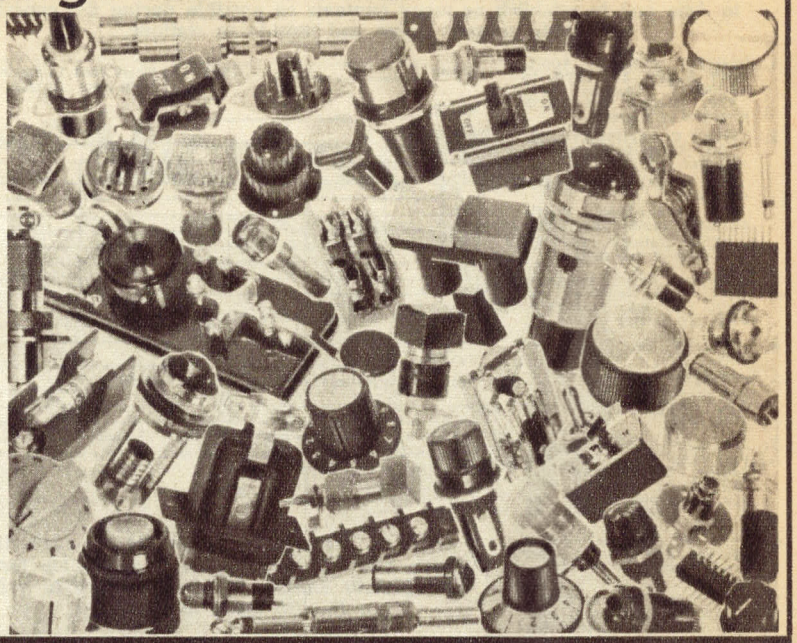
Elizabeth Youth Radio Club: Andrew Melville Smith (Pass.)

Port Augusta Youth Radio Club: Ainslie Just (Honours), Christopher Gilbert (Honours).

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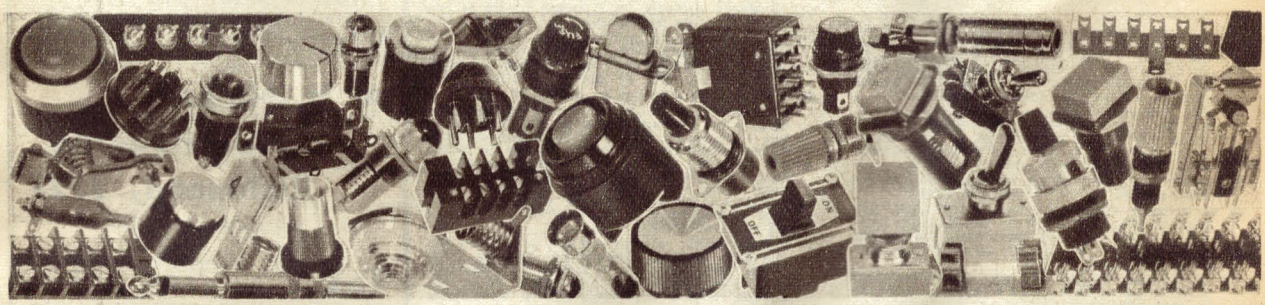


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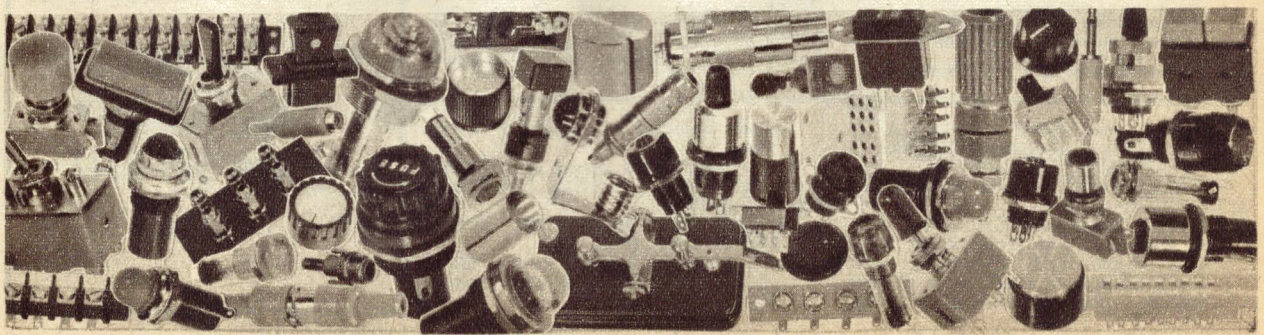


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1970 REMEMBRANCE DAY CONTEST

A perpetual trophy is awarded annually for competition between divisions of Wireless Institute of Australia. On the trophy are inscribed the names of amateurs who made the supreme sacrifice in World War II. The Contest is conducted to perpetuate their memory throughout amateur radio in Australia.

Many who participate in this contest are not contest-minded in the true sense of competition but, rather, look upon the event as an opportunity to renew acquaintances with fellow operators throughout the Commonwealth. Nevertheless to make the event a success it is necessary for logs to be submitted. In the past the percentage of logs received has been low when compared with the total who participate. The Federal Contest Committee of the W.I.A. and Divisional Councils invite all who are able to participate to do so, and submit a log of the contacts made.

Although awards are made to the highest scorers in each division, the contest is essentially between the six divisions of the W.I.A., the divisions being based on the State boundaries of the Commonwealth of Australia.

Stations in VK1 and VK2, VK5 and VK8 may work each other for scoring contacts. Also, the scores of the VK1 stations will be included in the VK2 score. Likewise the VK8 stations in VK5 score, and VK0 stations in VK7 score. VK9 station scores will be distributed as follows: New Guinea, Papua, and New Britain to VK4 score; Norfolk Island to VK2 score; Christmas and Cocos Islands to VK6 score.

RULES

OBJECTS:

Amateur operators in each VK call area will endeavour to contact amateur stations in other VK call areas on any of the Australian amateur frequency bands. Intrastate contacts will be permitted on the VHF and UHF bands for scoring purposes.

CONTEST DATE: 0800 hours GMT Saturday, August 15, 1970, to 0759 hours GMT Sunday, August 16, 1970.

All amateur stations are requested to observe 15 minutes silence before the commencement of the contest on the Saturday afternoon. An appropriate broadcast will be relayed from all divisional stations during this period.

1. There shall be four sections to the Contest:
   (a) Transmitting phone.
   (b) Transmitting CW.
   (c) Transmitting open.
   (d) Receiving open.

2. All Australian amateurs may enter the contest whether their stations are fixed, portable or mobile. Members and non-members of the Wireless Institute of Australia will be eligible for awards.

3. All authorised amateur bands may be used and cross-mode operation is permitted. Cross-band operation is **NOT** permitted.

4. Amateurs may operate on both phone and CW during the contest, i.e., phone to phone, or CW to CW, or phone to CW. However, only one entry may be submitted for sections (a) to (c) in section 1 above.

An open log will be one in which points are claimed for both phone and CW transmission. Refer rule eleven concerning log entries.

5. For scoring, only one contact per station per band is allowed. However, a second scoring contact can be made on the same band using the alternative mode. Arranged schedules for contacts on the other bands are prohibited.

6. Multi-operator stations are not permitted. Although log keepers are permitted, only the licensed operator is allowed to make contact under his own call-sign. Should two or more wish to operate any particular station, each will be considered a contestant and must submit a separate log under his own call sign. Such contestants shall be referred to as "substitute operators," for the purposes of these rules and their operating procedure must be as follows:—

Phone: Substitute operators will call "CQ RD" or "CQ Remembrance Day" followed by the call of the station they are operating, then the word "log" followed by their own call sign, e.g., "CQ Remembrance Day from VK4BBB log VK4BAA."

CW: Substitute operators will call "CQ RD de" followed by the group call sign comprising the call of the station they are operating, an oblique stroke and their own call sign, e.g., "CQ RD de VK4BBB/VK4BAA."

Contestants receiving signals from a substitute operator will qualify for points by recording the call sign of the substitute operator only.

7. Entrants must operate within the terms of their licences.

8. Ciphers — Before points may be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial number of fire or six figures will be made up of the RS (telephony) or RST (CW) reports plus three figures, that will increase in value by one for each successful contact.

If any contestant reaches 999 he will start again with 001.

9. Entries must be set out as shown in the example, using **ONLY ONE SIDE** of the paper and wherever possible standard W.I.A. log sheets should be used. Entries must be clearly marked "Remembrance Day Contest 1970" and must be post-marked not later than September 6, 1970.

Logs should be addressed to Federal Contest Manager, W.I.A., G.P.O. Box N1002, Perth Western Australia, 6001. Late entries will be disqualified.

10. Scoring will be based on the tables shown.

Note: — Read tables from left to right for points for the various call areas.

In addition, all intrastate contacts on 52MHz and above are worth 1 point each per band.

Portable operation: — Log scorers of operators working outside their own call area will be credited to that call area in which operation takes place, e.g., VK5ZP/2. This score counts towards New South Wales total points score.

11. All logs shall be set as in the example shown and, in addition, will carry a front sheet showing the following information:—

NAME .....

ADDRESS .....

.....

SECTION ..... CALL SIGN .....

CLAIMED SCORE .....

No. of CONTACTS .....

Declaration: I hereby certify that I have operated in accordance with the spirit and rules of the contest.

SIGNED .....

DATE ....

All contacts made during the contest must be shown on the log submitted (see rule 4). If an invalid contact is made it must be shown but no score claimed.

Entrants in the Open Sections must show CW and phone contacts in numerical sequence.

12. The Federal Contest Manager has the right to disqualify any entrant who, during the contest, has not observed the regulations or who has consistently departed from the accepted code of operating ethics. The Federal Contest Manager also has the right to disallow any illegible, incomplete or incorrectly set-out logs.

13. The ruling of the Federal Contest Manager of the W.I.A. is final and no disputes will be discussed.

AWARDS:

Certificates will be awarded to the top scoring stations in sections (a) to (c) of rule 1 above in each call area and will include the top scorer in each call area operating exclusively on the 52MHz section of the contest and above. VK1, VK8, VK9 and VK0 will count as separate call areas for awards. There will be no outright winner for Australia. Further certificates may be awarded at the discretion of the Federal Contest Manager.

The Division to which the trophy will be awarded shall be determined in the following way.

To the average of the top six logs shall be added a bonus arrived at by taking the ratio of logs entered to the number of State licensees (including limited licensees) multiplied by the total points from all entries in sections (a), (b) and (c) of Rule 1. Average of top six logs plus:

$$\frac{\text{Logs entered}}{\text{State licensees (inc. limited calls)}} \times \text{Total points from all entrants in sections (a), (b) and (c).}$$

VK1 scores will be included with VK2, VK8 with VK5, and VK0 with VK7. VK9 logs will be added to the division which is geographically the closest.

Acceptable logs for all stations shall show at least five valid contacts.

The trophy shall be forwarded to the winning Division and will be held by that Division for the specified period.

RECEIVING SECTION Section (d):

1. This section is open to all short-wave listeners in Australia, but no active transmitting station may enter.

2. Contest times and logging of stations on each band are as for transmitting.

3. All logs shall be set out as shown in the example. The scoring table is to be used in the same way as that used for transmitting entrants and points must be claimed on the basis of the State in which the receiving station is located. A sample is given to clarify the position.

It is not sufficient to log a station calling "CQ" — the number he passes in the contact must be logged.

It is not permissible to log a station in the same call area as the receiving station on the bands between 1.8MHz-30MHz. But on bands 52MHz and above such stations may be logged, once only per band, for one point.

4. A station heard may be logged once on phone and once on CW, for each band.

5. Club receiving stations may enter for the receiving section of the Contest, but will not be eligible for the single operator's award. However, if sufficient entries are received a special award may be given to the top receiving station in Australia. All operators must sign the declaration.

AWARDS:

Certificates will be awarded to the highest scorers in each call area. Further certificates may be awarded at the discretion of the Federal Contest Manager.

EXAMPLE OF TRANSMITTING LOG

DATE/ TIME GMT	BAND	EMISSION AND POWER	CALL SIGN WORKED	RST No. SENT	RST No. REC'D	POINTS CLAIMED

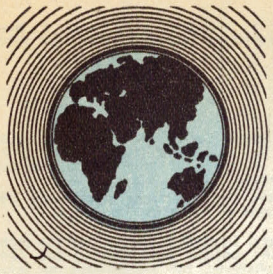
EXAMPLE OF RECEIVING LOG (VICTORIA S.W.L.)

DATE/ TIME G.M.T.	BAND	EMISSION	CALL SIGN HEARD	RST No. SENT	STATION CALL	POINTS CLAIMED
Aug. 1970						
15 0810	7MHz	A3(a)	VK5PS	S8002	VK6RU	4
15 0812	7MHz	A3(a)	VK6RU	S9007	VK7EJ	3
15 1035	52MHz	A3	VK4ZAZ	S6010	VK5ZDR	3
15 1040	52MHz	A3	VK3ALZ	S9025	VK3QV	1

SCORING TABLE

	To VK0	1	2	3	4	5	6	7	8	9
From VK0	—	6	6	6	6	6	6	6	6	6
„ VK1	6	—	1	1	2	3	5	4	6	5
„ VK2	6	3	—	1	2	3	5	4	6	5
„ VK3	6	4	1	—	2	1	4	3	6	5
„ VK4	6	3	1	2	—	3	6	5	4	3
„ VK5	6	5	2	1	3	—	4	3	3	6
„ VK6	6	6	2	1	4	2	—	3	5	6
„ VK7	6	5	1	1	3	2	5	—	5	6
„ VK8	6	5	1	1	2	3	6	4	—	3
„ VK9	6	5	1	2	3	4	5	6	1	—

NOTE: Read table from left to right for points for the various call areas.



LISTENING AROUND THE WORLD

Transeurope Radio in operation

A new commercial short-wave station at Sines, Portugal has been heard in its initial broadcast, relaying programs of the Deutsche Welle beamed to Eastern Europe.

by Arthur Cushen

Transeurope Radio, a new commercial station located at Sines, Portugal (near Lisbon), is now on the air for 12 hours a day with programs relayed for the Deutsche Welle in Cologne. Two transmitters of 250KW are used primarily to beam programs to eastern Europe. A session at 0900-1000GMT, sponsored by the Portuguese Travel Office, is beamed to Britain. A third transmitter of 250KW is due to come into service in September. Its operation has been held up because at present the available electrical power is not sufficient to drive all three transmitters. The Swedish gospel group, IBRA, will sponsor programs on the third transmitter when it comes into operation. The present schedule is:

To Eastern Europe:

GMT	KHz
0335-0515	7150, 9665
0530-0630	7150, 9665
1430-1721	11850, 15405
1830-1945	9665, 11850
1954-2100	7150, 9665
2109-2230	9650, 11905
2245-2345	5995, 7275

To Great Britain:

0900-1000	9650, 11720
1345-1415	9625, 11865

RADIO MANTA ON 6140KHz

One of many interesting signals received at good level during the present period of afternoon reception from South America is a new station, Radio Vision de Manta (HCDE4), in Ecuador. Our reception on 6140KHz has been from around 0430 to 0500GMT, when the station carried popular music along with some commercials. News was presented at 0500, preceded and followed by a cuckoo clock as an interval signal. Reception suffered from light sideband interference from Radio Deutsche Welle in Cologne, using 6145KHz.

According to its announcements, Radio Vision de Manta operates with 5KW of power on both medium and short-wave bands, and on FM bands. Presumably it will also be heard in our late evening with its early morning transmission. The address of this new station is Casilla 4817, Quito. Verification policy is not certain, but the "World Radio Handbook" gives some information about the station, so it does appear to answer reports and letters.

BUCHAREST USES 15285KHz

One of the new frequencies put into service by Radio Bucharest in Romania is 15285KHz; this channel provides good reception in our area for services to South America and later to North America.

We first noted the station at 2400GMT when a service in Spanish is presented to Latin America. Later, at 0430 to 0500GMT when the third daily program in English to North America is released, signals are very good. At this time, the station also announces its other frequencies, 15250, 11940, 11885, 11810, 9570, and 9510KHz. These frequencies give varying reception though 15250 and 9510KHz seem best to this listener. The other signals suffer from interference to varying degrees.

SOUTH AMERICAN RECEPTION

During the present winter months, reception of short-wave stations in South and Central America is at its best for our late afternoon listening, while in the late evening the low frequency bands also provide signals from this part of the world. Listed below are some of the most interesting signals compiled from information from several of our readers including Chris Davis, Featherston, N.Z., and Bob Padula, Melbourne, Victoria.

KHz

3360 TGVN Nahuala, Guatamala opens at 1100GMT.

4765 ZYN37 Feira de Santana Brazil, opens at 0730GMT and closes at 0400GMT.

4795 CP73 Radio Nueva America, Bolivia heard at 1100GMT.

4800 YVMO Radio Lara, Venezuela, heard at sign on at 0955GMT.

4840 YVOI Radio Valera, Venezuela, heard with fair signal at 1030GMT.

4915 HJSG Radio Guatapuri, Colombia, heard from 0430 to sign off at 0500GMT.

4940 YVPA Radio Yaracuy, Venezuela, with fair signal at 1000GMT.

4995 ZYX2 Radio Brazil Central heard closing at 0400 and opening at 0800GMT.

5075 HJGC Radio Sutatenza Colombia closes at 0400, also heard opening at 0900 using 5095 and 6075KHz.

5980 Radio Splendid Buenos Aires, Argentina, opens at 0900GMT.

6006 Radio Reloj, Costa Rica all night transmission and best at 0700GMT.

6060 LRA31 Buenos Aires, Argentina, opens at 0900GMT.

6110 Trans World Radio, Bonaire, heard with Portuguese at 0800 and German at 1000GMT.

6115 OBZ40 Radio Union, Lima, now heard all night and best at 0800GMT.

6160 HJKJ Bogota, Colombia, strong signal around 0700GMT.

6185 ZYR77 Radio Bandeirantes, Brazil, heard with good signal at 0900GMT.

NEW SERVICE FROM POLAND

Radio Warsaw has commenced a new transmission to North America which, once established, should give good reception in our winter. The program, which is in both Polish and English, is now being transmitted on a test basis at 0200 to 0300GMT. These times are given as 10.00 and 11.00 p.m. Eastern Daylight Time in North America, so it is presumed that the program would be broadcast one hour later when the U.S.A. goes back to standard time in October. In the past, transmissions from Warsaw were carried in a service to the Pacific at 0730GMT, but this has been cancelled and transmissions at this time are now beamed only to Europe.

Reception has been best on 15275KHz, but the station indicates that it also uses 11815, 11800, 9550, 9540 and 7125KHZ.

TGVN VERIFIED

An interesting verification from Station TGVN at Nahuala, Guatemala, has been received by Chris Davis of Featherston, N.Z. The letter (in English) came from Dennis Evans, a British volunteer radio engineer, who gave details of this educational station which transmits on 3360KHz. According to Mr Evans the report was the first received from the Pacific area and the station is keen to receive further reports from listeners. The broadcast which was heard was transmitted at 1100GMT.

The station broadcasts daily at 1100-1300GMT with music and educational programs, 2300-0000GMT with children's programs, 0000-0230GMT with educational service, and 0230-0400GMT when the program consists of request music. The station is located at Nahuala, 60 miles west north west of Guatemala City. The letter further stated the need for this educational station, as in the age group of 14 years and older some 94 per cent of the students were illiterate. It can be seen that radio is being used as a major educational means in this part of Guatemala.

SIGNALS FROM CUZCO

A Sunday program from OAX7A in Cuzco, Peru, has been received on 6240KHz. The program consisted of news at 0415GMT, followed by dance music from 0430 until 0515 GMT. The station used "Some Enchanted Evening" as a theme before the news and at sign-off. Signals in New Zealand were good until the 0515GMT sign-off.

This station is assigned to 6128KHz, but for years has been received on 6250KHz. Cuzco is near the Bolivian border on the eastern slopes of the Andes at an altitude of 11,400 feet. It was a former Inca capital and is noted for its archeological sites.

OAX8X USING 4815KHz

One of the most interesting signals we have heard from Peru during this winter reception period is station OAX8X in Iquitos, using 4815KHz. The station uses the name Radio Amazonas and has a power of 1KW. Broadcasts have been of typical Latin American music with frequent slogans and commercials. Broad-

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney 12 hours for Wellington.

casts include a full station announcement at 0455GMT: following this the Peruvian national anthem is played and broadcasts conclude for the day. The address of the station is Radio Amazonas, Casilla 494, Iquitos, Peru.

HCJB'S NEW CHANNELS

HCJB in Quito, Ecuador is reported by several readers to be using new channels for their broadcast of gospel programs. John Corder of Timaru, N.Z., reports that 11915KHz is again in operation and has been heard in English at 0800GMT. Our reception of the Spanish transmission on 9555KHz has been at 0930GMT when the station has a news bulletin. This frequency replaces 11745KHz.

According to Radio Japan DX Session, HCJB now has three programs each day in Japanese which also are carried on new frequencies. The Japanese transmissions are at 1130GMT on 11765 and 9715KHz, at 2200GMT on 17890 and 15405KHz, and at 2330-2400GMT on 15380 and 17890KHz. The first transmission is beamed to Japan, but the other two are for reception in South America.

Further frequencies in use by HCJB are reported by "Australian DXers Calling." HCJB has been heard on 9570KHz with English at 0800 and with Russian at at 0830GMT, this frequency replacing 9645KHz; and on 15135Hz with a program in Portuguese at 1000 and in German at 1030GMT, this frequency replacing 15115KHz.

WNYW NEW YORK.

The latest schedule of Radio New York World Wide, in effect until September 5, is as follows.

To Europe:

GMT	KHz
1700-2215	17845
1700-2200	15415
2215-2330	11805

To Americas:

1700-2215	17845
2145-2345	21525
2230-0015	17760
2345-0230	11855
0000-0230	15355
0130-0230	9615

To Africa:

1700-2145	21525

RADIO ANTILLES

The reception of Radio Antilles was reported last month and we have now received an airmail verification confirming our reception of this medium-wave station. Radio Antilles located at Montserrat in the Leeward Islands, operates on 930KHz on the broadcast band with the power of 200KW.

The verification letter came from Guy Comminges, Managing Director, who was surprised to receive a report on their broadcast over such a distance. According to a coverage map and brochure supplied, the station serves an area in the West Indies during daylight hours. After dark this coverage is extended to cover the whole of the Caribbean, Florida, Mexico and Venezuela. The station broadcasts in English, French and Spanish and has been heard in New Zealand to 0500GMT. The station claims to be the most powerful commercial radio station covering the West Indies and Central America. The address is Radio Antilles, P.O. Box 35, Montserrat, West Indies.

DELHI ON 21555KHz

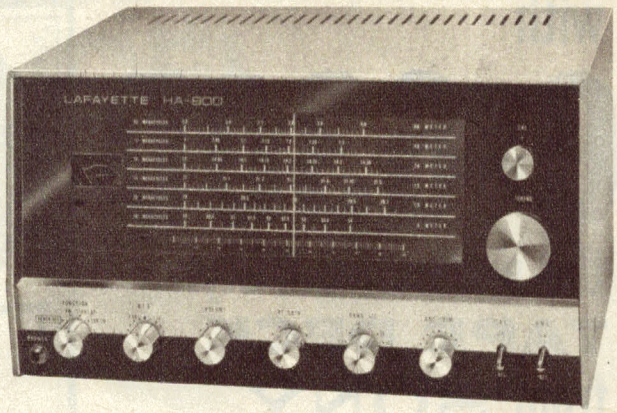
All India Radio of Delhi, in its English transmission beamed to North East Asia, Australia and New Zealand is using the new frequency of 21555KHz from 1000 to 1100GMT. The new channel is received at fair level, but suffers some interference from London, using 21550KHz. The transmission is beamed to Australia and New Zealand also on 11775, 15210, and 17820KHz. Other frequencies used to North East Asia are 15105, 17380, and 21555KHz.

PRIMITIVE LISTENING

How the early listeners operated, and the types of receiver used, formed the subject of an interesting display given recently

LAFAYETTE NEW! HA800

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80 Metres 3.5-4.0 MHz. 40 Metres 7.0-7.3 MHz. 20 Metres 14.0-14.35 MHz, 15 Metres 21.0-21.45 MHz, 10 Metres 28.0-29.7 MHz, 6 Metres 50.0-54.0 MHz

This outstanding new receiver, Model HA-800, designed specifically for the amateur bands features advanced circuitry with double conversion on all bands. Circuit utilizes 3 FETs and 14 Transistors plus 7 diodes for cool, reliable performance on CW, AM and SSB signals. Tuned RF and 1st Mixer stages provide maximum sensitivity with high front end selectivity and an excellent signal-to-noise ratio. IF circuits use two selective mechanical filters. Product detector and variable BFO for CW and SSB. Built-in 100 KHz calibrator (supplied less crystal). Power supply utilizes constant voltage zener stage.

Operates from 12 volts DC (negative ground) or 220-240 volts AC.

- Dual Conversion On All Bands.
- Two 455 KHz Mechanical Filters for Sharp Selectivity.
- FETs in RF, Mixer, and Oscillator Stages.
- Zener Voltage Regulated Power Supply.
- Series Gate Automatic Noise Limiter.
- External Receiver Muting Rear Panel Connection.
- Illuminated Calibrated S-Meter.
- Edge Illuminated Slide Rule Dial.

THE HA-800 RECEIVER IS PACKED WITH FEATURES NEVER BEFORE OFFERED AT ANYWHERE THIS SPECIAL AMATEUR PRICE OF $195.00

Calibrator Crystal 100 KHz optional extra $8.95.
SPECIFICATIONS: Sensitivity: Better than 1 uV on 80, 40, 20 metres, .5 uV on 15, 10 metres and 2.5 uV on 6 metres; **Selectivity:** —6 db at ± 2.5 KHz, —60 db at ± 6 KHz; **Intermediate Frequency:** 1st IF 2.608 MHz, 2nd IF 455 KHz; **BFO Frequency:** 455 KHz ± 2.5 KHz; **Image Rejection:** Better than —40 db; **Audio Output:** Impedance 8 and 500 ohms, Power 1 Watt; **Antenna Input Impedance:** 50 Ohms; **CONTROLS:** Function, BFO Tuning, Volume, RF Gain, Band Selector, Antenna Trimmer, Tuning, Calibration Adjustment, Calibrator On-Off, Automatic Noise Limiter.

SEND REMITTANCE WITH ORDER FOR IMMEDIATE DELIVERY.

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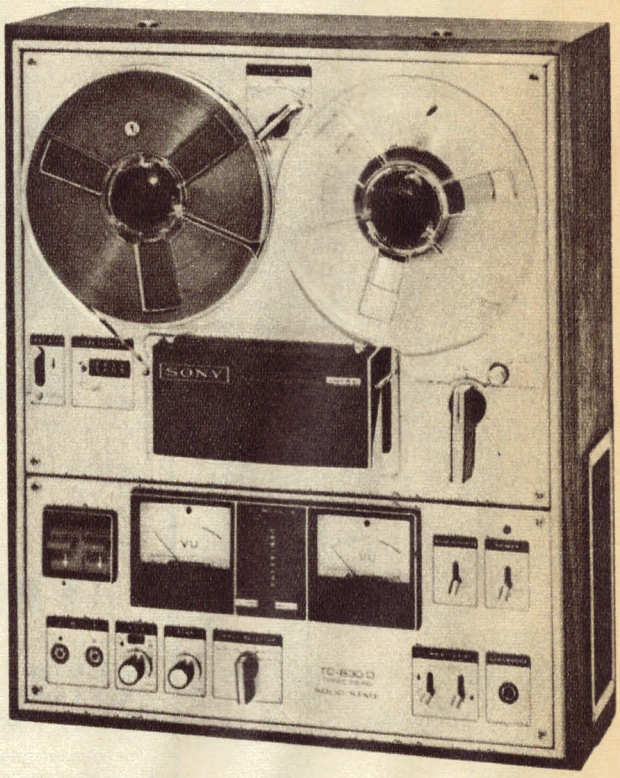
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CONNECT the TC-630D to your present entertainment system or SONY stereo amplifier and you'll be ready to reserve a comfortable seat at your favourite concert. By manipulating the control knobs on the panel you can be the conductor of your own personal orchestra. This professional type 4-track, 2-channel stereo/mono tape deck—with all silicon transistor circuitry—will satisfy the most discriminating audiophile. Retractable pinch roller for one hand tape threading and simple selection from 50 Hz to 60 Hz or vice versa. Attractive styling in a handsome walnut grained wooden cabinet.

Model TC-630D is the Tape Deck version of the TC-630

SPECIFICATIONS

Recording system: 4-track stereo/mono recording and playback. **Tape speeds:** 7½ ips, 3¾ ips, 1⅞ ips. **Reel capacity:** 7" or smaller. **Frequency response:** 20-22,000 Hz at 7½ ips, 20-17,000 Hz at 3¾ ips, 20-10,000 Hz at 1⅞ ips. **Bias frequency:** 160 kHz. **Flutter and wow:** 0.09% at 7½ ips, 0.12% at 3¾ ips, 0.16% at 1⅞ ips. **Signal-to-noise ratio:** 52 dB. **Harmonic distortion:** 1.2% at rated output. **Level indicator:** dual VU meters. **Recording time** (with 1,800' tape): 4-track stereo, 6 hours at 1⅞ ips; 4-track mono, 12 hours at 1⅞ ips. **Fast forward and rewind time** (with 1,200' tape): Approx. 2 min. 30 sec. **Inputs:** microphone, sensitivity—72 dB (0.19 mV), impedance 600 ohms. Aux—1, Aux—2, sensitivity—22 dB (0.06V), impedance 100 k ohms. Aux—3, sensitivity—22dB (0.06V), impedance 560 k ohms. **Outputs:** line output, output level 0 dB (0.775V), impedance 100 k ohms. Headphone output, impedance 8 ohms. **Rec/PB connector:** input impedance 10 k ohms, output impedance 3.3 k ohms. **Dimensions:** 16⅛ (W) x 7⅞ (H) x 18 15/16 (D). **Weight:** 24 lb. 15 oz.

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by the N.Z.B.C. in Invercargill. The most interesting receiver was one which was put into use in 1922. As well as the three-valve receiver, the letter and the instructions which accompanied the set showed just what the early listener had to face. At that time there were only two radio stations in New Zealand.

The accompanying letter said (in part), "The set is going well and will be consigned tomorrow. It picks up Auckland concerts very well and should you have any trouble in tuning to Dunedin we will send up an expert if you wish, but it will cost his railway fare. We think you will get on well without his assistance."

Included in the instructions were details of the erection of an aerial "which should be 70 to 90 feet long, and as high as possible. There should be two insulators, one at each end. For the lead-in, you should keep this away from the side of the roof, and so the top of a bottle on the end of a stick out from the house is quite good for this. You should twist the lead-in around the neck of the bottle or around the bottle itself."

The instructions went on to discuss the earth system and stated that "as it is difficult in the country where there is not a water system, it is advisable to find a damp spot and drive a pipe into the earth."

NEW LOCATION FOR WWVH

According to a report in the World Bulletin, the Pacific station of the U.S. National Bureau of Standards, WWVH, at present located at Puunene, Maui, Hawaii, will shortly be transferred to Barking Sands on the more westerly Hawaiian island of Kauai. The site has been chosen to provide a clear path to the Far East, where WWVH's signal has hitherto been inadequate. The power has been increased to 10KW from the present 2KW on all frequencies, and new antennas will be erected.

WWVH can be heard on 2500, 5000, 10,000, 15,000KHz and other frequencies. WWV Fort Collins, Colorado, operates a similar service on the same frequencies, and the signals from both stations suffer from mutual intereference in our area.

FIJI MAKES MAJOR CHANGES

The Fiji Broadcasting Commission at Suva has informed us through their chief engineer that a new transmitter on medium-wave went into operation on May 1, while two of the other stations are to change frequency.

The new station, located at Labasa, operates on 840KHz with 5KW. It has already been heard by Merv Branks, of Invercargill, N.Z., opening at 1800GMT on Saturday, when the frequency is free from the N.Z.B.C. station on the channel. The new Labasa station is located on the Vanua Levu, and is designed for coverage of northern Fiji and adjacent Rotuma. The station is remotely controlled from Suva, and carries the Fiji Hindi program from 1800 to 1030GMT. On Saturday this is extended to 1100GMT.

The stations scheduled to change frequency are Lautoka, from 1320 to 640KHz, and Rakiraki, on 1470KHz and expected to use 680KHz.

THE S.I.O. CODE

There seems to be a general swing to easier reception reporting by international short-wave stations, with many approving the adoption of the S.I.O. code. The British Broadcasting Corporation, and Canadian Broadcasting Corporation and Radio Nederland all use this type of reference to signals, which has only three sections: S for signal, I for interference and O for overall rating instead of the better known five-section SINPO code.

We dealt with the SINPO code in the November, 1969 issue, when we reprinted part of an article from Contact, the bulletin of the World DX Club, in which Allan Thompson summarised the various points of the code. The name SINPO is derived from these five divisions: S for signal level, I for interference, N for noise, P or propagation conditions and O for overall merit. It is often a difficult task for younger DXers to interpret the SINPO codes. Interpretation of propagation conditions can only be based on long experience and audible detection that signals are being disturbed over the transmission path, is not always possible.

Several of the other international services have a different system of signal accessment; for example, Radio South Africa rates its signals SIFO (Signal, interference, fading and overall rating). Vatican Radio, Austrian Radio, Radio Sweden and many others continue to use the SINPO code.

The evaluation of the SIO code is as follows:

SIGNALS:
5 very strong.
4 strong.
3 fair.
2 weak.
1 very weak.

INTERFERENCE:
5 nil.
4 slight.
3 moderate.
2 severe.
1 extreme.

OVERALL RATING:
5 excellent.
4 good.
3 fair.
2 poor.
1 unusable.

RECENT VERIFICATIONS

Some of the recent verifications received by members of the Australian Radio DX Club show how necessary it is when reporting to the smaller station, to send return postage in the form of International Reply Coupons or mint stamps.

CHILE: Radio Mineria, Santiago, confirms reception in four weeks, with a form letter in English and Spanish, and also sends a pennant. The station is being heard on 9750KHz at around 0930GMT. Radio Presidente Balmaceda, which also operates from Santiago and is heard at 0930GMT on 9590KHz, confirms reception with a blue and white card, received by airmail in three weeks. Most members report reception of the verification card. It seems that return postage in the form of an IRC is necessary.

SAUDI ARABIA: Saudi Arabia Broadcasting Service, which has been heard on 11855KHz in English at 0430GMT, has verified after four months. The card was signed by Werner Storg.

IRAN: A verification card received from Iran for a reception report on Radio Teheran on 11730KHz shows a picture of a radio mast with radiations and a lion with a sabre in its paw; it was signed by E. Golesorki, Director General. The card arrived four months after the report of reception. An IRC was sent with the report.

TANGIER: Radio Television Morocco, which has studios at Tangier and Rabat, confirms reception with a folding card. The report took eight weeks to be verified. One IRC was sent.

NEW CALEDONIA: A verification card has been received from Radio Noumea confirming reception of its new medium-wave frequency of 670KHz. According to the card, the power on this frequency is now 20KW; the two short-wave stations on 3355 and 7170KHz also have been increased in power to 20KW; and the transmitters are now operating from a new site. James Stack, of Gladesville, N.S.W., reports reception of Noumea on 670KHz at 0640GMT.

THAILAND: A verification letter has come to hand confirming our reception of the Thai Television Co. Ltd. on 1146KHz. This broadcast band outlet has the power of 15KW. The verification letter, in English, was sent by registered airmail form Mr Choo NaLampang, Director. The address is Mansion B, Rajdamnern Avenue, Bangkok, Thailand.

CHILE: Radio Mineria has verified Cyril Anderson of Perth, W.A., with a duplicated letter written in Spanish and English. The reception was for a report on 9750KHz, and the station was heard opening at 0930GMT.

PAKISTAN: Radio Pakistan, Karachi, has verified Gerhard Rosam, Berkeley. N.S.W., with a card and letter. This was received four months after reporting reception of the broadcast, which was heard on 15382KHz at 1500GMT.

FLASHES FROM EVERYWHERE

EUROPE

BELGIUM: Brussells has been heard on some new frequencies, and our reception has included a broadcast on 17740KHz at 0530GMT when the Home Service was relayed. The transmission to South America has been heard on 17720KHz from 2300 to 0100GMT. English programs are broadcast at 2305 and 0050GMT. The station has also been observed on a new 13M band frequency of 21460KHz opening at 1000GMT with programs beamed to Africa. Reception has been fair with some light interference on the frequency.

CZECHOSLOVAKIA: Radio Prague has been heard in its broadcast to Africa by Master N.D. Repin, Bellevue Hill, N.S.W. The station verified with a letter and card, and gave details of their transmissions in French to Africa, as follows:

GMT	KHz
1830-1920	9600, 11990, 17840
2030-2130	9600, 11990, 17840 5930, 7345

YUGOSLAVIA: Radio Belgrade now runs a short-wave listeners' and DX program on the first Tuesday of every month at 1830-1900GMT on 6100, 7200 and 9620KHz. The station would appreciate reception reports on this new program. These should be sent to the short-wave section, Radio Belgrade, Belgrade, Yugoslavia.

AFRICA

SEYCHELLES: According to Sweden Calling DXers, F.E.B.A. Seychelles has increased its power from 2KW to 30/40 KW. Its current schedule is:

GMT	KHz
0100-0245	15185
0100-0245	15185
0100-0330 (Sun)	15185
1300-1530	15265

English is broadcast daily from 1400-1430 GMT and on Sunday only from 0300-0330GMT. The address of the station is the Far East Broadcasting Association, Box 234, Victoria, Seychelles.

UGANDA: According to a Press report, two high-power Chinese transmitters are to be installed in Uganda to counter the broadcasts of Radio South Africa. The station is keen to receive reception reports on its present transmissions on 4976KHz, which are heard around 2000GMT. The address of the station is Radio Uganda, Ministry of Information, P.O. Box 2038, Kempala, Uganda.

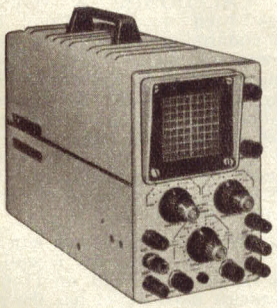
ASIA

SINGAPORE: Forces Broadcasting Service is at present providing good reception on Sunday with a popular music program at 0930GMT on 6040KHz. At 0945GMT the station relays the B.B.C. Sports Review program direct from London.

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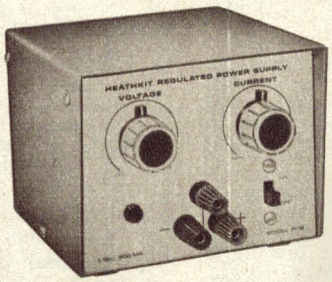
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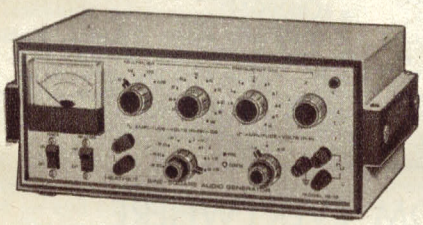


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Price $47

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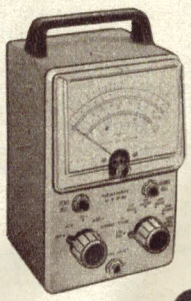
High Accuracy . . . Low cost ● Output available from 1 Hz to 100 kHz using repeatable switch-selection ● Sine and Square Wave output available simultaneously ● Metered sine wave output ● Less than 1% sine wave distortion ● Voltage and dB meter scales ● Switch - selection of internal 600 ohm load or external load ● Less than 50 ns square wave rise time ● Floating outputs than 0.1% sine ● 8-position output attenuator for sine waves ● 3-position output attenuator for square waves ● New Heathkit instrumentation styling and unitised construction for easier operation and servicing ● Simple circuit board construction. Dimensions: 5 1/8" H x 13 1/4" W x 7".



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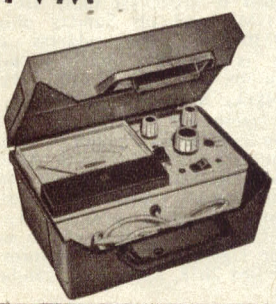


● One probe makes all measurements ● 7 AC, 7 DC, 7 Ohms ranges—scales are easy to read ● Sensitive, high quality 4 1/2" 200 uA meter ● 1% precision resistors ● Extended frequency response plus/minus 1 dB 25 Hz to 1 MHz ● Measures RMS and Peak-to-Peak ● Easy-to-build, electronically stable circuit board construction ● New Heathkit beige and brown instrumentation colours ● 240 VAC operation. Dimensions: 7 3/8" H x 4 11-16" W x 4 1/4" D.



Price $54

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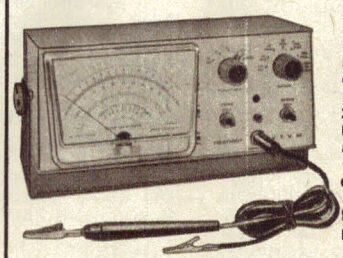


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SOUTH KOREA: According to the Japanese Short-wave Club, the Korean Broadcasting System is now operating in English as follows: 2100-1320, 0500-0530, 0900-0930 and 1100-1130GMT on 9640KHz and, in addition, the 1100GMT transmission is carried on 15430KHz.

SOUTH VIETNAM: The present transmitting schedule of the National Broadcasting System of Vietnam, Saigon, is as follows: in Vietnamese 2200-1600GMT on 7245KHz and 1000-2400GMT on 11950, 9620, 7175 and 6165KHz. All other language programs are carried on 9755KHz including English 0430-0500GMT, French 0500-0530GMT and Thai 1230-1300GMT.

INDONESIA: In a recent report in Sweden Calling DXers, Padang has been heard on the unlisted frequency of 6190KHz at 1100GMT. According to a verification from Palembang on 4855KHz, it is on the air 2300-0130, 0500-0800 and 0900-1600GMT. English is broadcast from 1530-1630 on Saturday. The station welcomes reception reports.

CAMBODIA: A listener in Japan reports the reception of a new Home Service outlet of Radio Cambodia at Phnom Penh on 11945KHz. Best reception is around 0930GMT and the same program has been heard on 4907KHz. Most of the broadcasts are in Cambodian, but some programs in French have been observed.

TURKEY: Ankara Radio is being well received with its broadcast in English at 2200GMT on 15160KHz. Signals have also been noted at 0430GMT when the Home Program is relayed in Turkish. The station has under construction a new 250KW transmitter which is expected to go into operation this year.

JAPAN: Two signals from N.H.K. in Tokyo have been observed by Brian Withers of Christchurch, N.Z. One program on 7230KHz is noticed to 1000GMT when the station closes and DZ19 in Manila can be heard. The other signal from Tokyo on 7285KHz carries English from 0920-0955GMT when news is presented. The station closes at 1000GMT.

OCEANIA

SOLOMON ISLANDS: The broadcasts of the S.I.B.S. have been heard on 7115KHz by Simon Bass, of Strathfield, N.S.W., at around 0900GMT. At this time news was broadcast, and music and commercial programs were heard later. The same program was also received on 3995KHz.

According to Samson Voron, of Coogee, N.S.W., the Solomon Islands is giving good reception at his location on the new frequency of 7115KHz. The station was noted at 0845GMT with a request program.

THE AMERICAS

COLOMBIA: Radio Nacional, at Bogota, has been heard by Ross Gibson, Dunedin, N.Z., on the relatively new channel of 6030KHz. The station has the usual Nacional Radio program and signs off after 0500GMT. At this time the signal suffers interference from Stuttgart on the same frequency. The same program is observed on 4955KHz and has been noted as late as 0530GMT.

EL SALVADOR: According to a letter received by a listener in Canada and reported in Sweden Calling DXers, Radio Nacional El Salvador is soon to add English and French to its transmission schedule. The station will broadcast 0300-0330GMT Monday to Saturday, with news in English, French and Spanish. On Sunday the schedule is 0030-0100GMT. The frequencies of 5980 and 9555KHz are used, the station callsign is YSS, and vertification is generally in the form of a card and pennant.

ORU VERIFIES

The Belgium National Radio at Brussels has recently verified our reception on 17720KHz with the usual card, a copy of the script of their "Mailbag" program in which our report was acknowledged, the latest schedule, a booklet on Belgium and a 45 rpm recording. The recording was of the station's identification in English, French, Dutch, Congolese and other languages, as well as various themes used for programs and the station's identification signal. The schedule is as follows:

GMT	KHz	Language
0530 0735	17780, 17860	French and Dutch
1000-1200	17780, 21590, 17860, 15265	French and Dutch
1230-1300	17780, 21725, 17860	French and Dutch
1430-1530	6010, 6170, 11715, 17780	French and Dutch
1545-1745	11790, 11715, 15250, 7780	Congolese
1800-2200	17780, 17860, 15250, 15335	French and Dutch
2215 2305	15335, 17715	French and Dutch
2305-2315	15335, 17715	English
2330-2400	15335, 17715	French and Dutch (Tue.-Sat.)
2400-0050	15335, 17715	French and Dutch
0050-0100	15335, 17715	English
1330-1700	21460, 17860, 6010, 6170	French and Dutch (Sunday Sports).

The transmitting powers are: ORU 3 100KW; ORU 4 100KW; ORU 5 20KW; ORU 6 50KW.

BROADCAST BAND NEWS

INDIA: A report in the New Zealand DX Times indicates that the All India Radio Vividh Bharati cultural programs is carried by all the B stations and the following stations: Bombay C 1230, Calcutta C 1320, Delhi C 1370, Hyderabad C 1220, Lucknow C 910, Madras C 1550, Srinigar C 1490, Jullundur 1350, also Chadigarh, Jodhupur and Ranpur. Vividh Bharati stations normally sign off earlier than the stations transmitting National or Regional programs, and do not carry the news in English. Jullundur 1350 carries the External Service until 1830GMT. Nagpur on 590KHz has increased power and is now carrying programs for Nepal and Tibet. Calcutta on 1130KHz with the power of 1000KW transmits the General Service in English 1330 to 1500GMT.

THAILAND: The Thai TV Radio has been heard in New Zealand on 1146KHz at 1600GMT. This frequency carries the alternative program, and is mainly in the Thai language with frequent commercial announcements, station identification and local music. The other frequency used by the station is 1500KHz, but this is now blocked by 3AK Melbourne with its 24 hours a day broadcasts.

According to the European DX Council Bulletin, a new transmitter of 50KW is to be built at Surin near Cambodia. Broadcasts will include programs in Cambodian. Another 50KW station is to be installed on the east coast at Shantaburi. The output of the Ubol Rajthani transmitter will be increased from 10KW to 50KW.

AUSTRALIA: According to the Australian Radio DX News, new National stations will be established at Julia Creek, Hughenden and Mossman in Queensland, and at Leigh Creek in South Australia. The station at Julia Creek will be high powered to provide primary coverage for Cloncurry, Julia Creek, Mary Kathleen and Richmond.

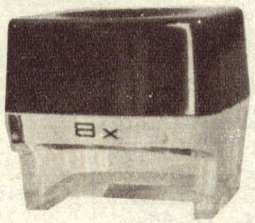
LEEWARD ISLANDS: Radio Antilles was heard in New Zealand to signoff at 0500GMT on 930KHz. This station has the power of 200KW and its reception at our listening post was for a period from 0430 to signoff when the program was in Spanish. At about the same time PJB Bonaire on 800KHz was observed to sign off at 0515GMT.

SAN MARINO: A new commercial station is due to commence operations shortly from this tiny republic, reputed to be Europe's oldest and smallest State. The station will operate on 1184 with commercial programs in Italian. The station has been silent since prewar days, when it was well known as a broadcaster in Europe.

IRAN: According to the "EDXC Bulletin," a station is operating in Iran on 1160KHz with 10KW, operated by the Iranian Oil Company, Abadan. The station has verified reports with a letter from the Head of Public Relations. They require no return postage. ■

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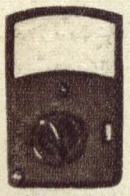
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D.C. Volts 6, 6, 30, 120, 600, 1,200, 3,000, 6,000 A.C. Volts 6, 30, 120, 600, 1,200. D.C. Current .06-6, 60, 600mA. Resistance, 6K, 600K, 6meg., 60meg., D.B. minus 200 to plus 62, 5 Ranges. Specially suitable for transistor use.

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P.T. 34 1000 OPV

D.C. Volts, 0, 10, 50, 250, 500, 1000.
A.C. Volts, 0, 10, 50, 250, 500, 1000.
M.A. 1-100-500 RESISTANCE.
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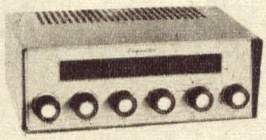
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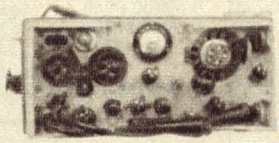
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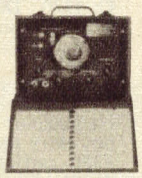
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DC, V 0-1.5-5-15-50-150-500-1,500 V. Rms. A.C.V.0-1.5, 5.5-15-50-150-500-1,500 V. Rms. 0-1.4-4-14-400-1400-1400-4000 V. P.P. Resistance: RX10, 100,1K ,10K, .100K, 1M 10M, Decibel — 100dB minus-plus 65db.
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100 YDS HOOK-UP WIRE

10 Assorted Colours.
$1.00
Post 25c.

LAB STANDARD METERS

7in in Cedar Cabinets. Leather Cases.
0 to 10 amps. 0-20 amps.
0 to 50 amps. 0-250 amps.
$10.50

SOLENOIDS-RELAY

12V DC Coil resistance 120 Ohms. 4-pole change over contacts. 10 Amps.
$1.75
Pack and post, 25c.

12V 2 AMP. TRANSFORMER

240 VAC 50CPS prim.
$3.00
Pack and Post. 50c.

NEW GRAMMO MOTORS

240V. A.C.
3 Speeds, $2.75.
Post: 40c.

DYNAMIC LO-IMP STEREO PADDED HEADPHONES

With cord and stereo plug.
$3.50
Pack and Post., 50c.

No. 19 TRANSCEIVERS

2 to 8 megs. 15 valves. New condition.
$19.75
ALSO BRAND NEW.
$27.00

SCR 522

Transceiver, 4-channel, crystal locked. 100-150 mcs. .. . **$29 75**
Separate 522 Transmitter. Complete with all valves. Modulation Transformer, etc. .. . **$15.00**
Separate 522 Receiver. Complete with all valves and components.
Suitable for Reception of Aircraft Tower Frequency. **$14.00**

TR-1935 TRANSCEIVER

V.H.F. 10 channels Crystal locked. Freq. 100—155 MCS. Inbuilt 28 V DC Supply. AM. 10 watts power output.
$35.00

AN/APX-6 TRANSPONDER TXRX

900-1200mcs.
Complete with cavity tuning, resonator, digital counters, 2C42-2C46 lighthouse tubes. 28V D.C. blower motor.
$17.50

AWA RF SIGNAL GENERATOR

240 V AC. 50 CPS. Calibrated 140—300 MCS Lab standard Modulated
$49.50

AWA-8C RECEIVER

240 V AC—110 V AC—12 V DC operation.
Freq. 1.85—26 MCS in 4 bands. Plug-in coil boxes—in-built speaker. 455 KC Crystal Filter—A VC—BFO.
2 RF Stages. Valve line up. 4—6U7G, 1—6J8G, 2—6J5GT. 1—6G8G. 1—6V6GT. 2—6X5GT. Size, 31in x 18in x 15in.
$95.00

RECEIVER-INDICATOR UNIT

Type R-65/APN-9, 3BP1 C.R.O. tube with Mu-Metal Shield and Socket. 33 valves. 2 x 2—5Y3 — 6Y6 — VR105 — 6SA7 — 6N7 — 2 x 2 SJ7, 3 x 6 SL7, 3 x 6SK7, 7 x 6H6. 13 x 6SN7.
Inbuilt super-het. Receiver designed for reception of pulsed waveform.
4 channels. 1750KC—2020KC.
$19.75

WANTED

Communications Receivers. Test equipment. P.A. Gear. Large or small surplus stock. Best prices. Call, write or phone any time.



GUITAR AMPLIFIERS

14-Watt, 4 Inputs. Base and Treble Boost, 2 Twin-cone Speakers, $63
17-Watt, 4-Channel, Bass and Treble Boost. Two Twin-cone Speakers $76.25

35 WATT

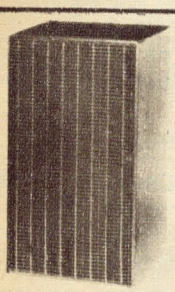
4-Channel, Bass and Treble Boost. 4 Twin-cone Speakers, $109.05
Vibrato with foot control and 2 preset controls for frequency and intensity, $10.50 extra on above models.

REVERBERATION UNITS

Latest design to suit organs, stereo, guitar, any hi-fi equipment.
$5.75
Post 35c.

MUSICOLOUR

Sound control of coloured lights. As described E.A. Oct., 69.
Kit Set $46.05
Wired and Tested $54.00

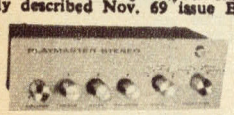


MULLARD MAGNAVOX

Designed bookshelf enclosure with 6WR twin cone and 3TC tweeter $24.75 ea.
Super bookshelf enclosure with 2 x 6 WR .. .. .. $36.75 ea.
Hi-Fi enclosures with magnavox 8WR or Rola C8MX .. 8 watts RMS .. .. $36.75 ea.
With 2 x 8WR or 2 x 8CMX 15 Watts .. .. .. $45.00 ea.
With 10WR — 10 Watts $39.75 ea.
With 12WR — 10 Watts $45.00 ea.
With MSP 12 UAX — 20 Watts .. .. $55.00 ea.
8 or 15 ohms available.
All cabinets are constructed of Pineboard and Veneered with Oiled Teak Formica and are complete with crossover network — Tweeter — Innerbond packing.

PLAYMASTER 127 STEREO CONTROL UNIT

For tape replay, Magnetic, disc, and crystal cartridge input. Radio fully described Nov. 69 issue E.A.



KIT SET $49.50
Wired and Tested $59.50.
Pack and Post 75c.

128 STEREO AMPLIFIER

64 Watts per channel
Kit Set $95.00
Wired and Tested $109.00

PIGGY BACK GUITAR AMPLIFIER

30 Watt $79.75
45 Watt $89.75
60 Watt $119.75
4 Inputs, Bass and Treble Boost Vibrato if required, $10.50 extra.

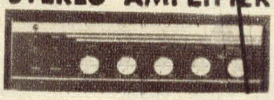
PIGGY BACK GUITAR AMPLIFIER

Complete with Speakers & Cabinet
30 Watt Lead $138.75
30 Watt Bass $146.75
45 Watt Lead $158.75
45 Watt Bass $166.75
50 Watt Lead $218.00
60 Watt Bass $234.00
Vibrato if required extra $10.50

50 WATT SOLID STATE GUITAR AMPLIFIER

E.A. July & August Issue. Kitset, including Cabinet.
$98.00
Wired and Tested.
$114.00
Speaker Enclosures to suit 4 M.S.P. Speakers.
$104.00
2 Pioneer 15in Speakers.
$94.00
2 Rola 50 watt Speakers.
$128.00

ALL SILICON TRANSISTOR SOLID STATE STEREO AMPLIFIER



240V AC powered, 8 watts RMS per channel inputs for magnetic, ceramic, and crystal cartridge, also recorder and radio tuner. Hi-Fi frequency response speaker matching 4-16 ohms. Size 10½in x 6½in x 3½in. Attractive oiled teak cabinet.
$54.00 Pack and Post $1.50.

HI-FIDELITY TWIN CONE SPEAKERS

Aust. made, 8 to 16 ohms.
6in .. $9.00 12in .. $11.75
8in .. $7.50 Postage:
8in .. $9.50 Interstate 80c
10in .. $10.75 N.S.W., 50c.

STEREO RECORD CHANGER

Current models, 4 speeds, automatic or manual operation. Standard model $28.50
Ceramic cartridge, Sapphire Stylus Standard model with 12in turntable $34.00
Deluxe model with 12in turntable, Cueing device. Ceramic cartridge Diamond Stylus $40.00
Deluxe model as above with — adjustable counter balance, 2 spindles, calibrated stylus pressure control added $46.50
Deluxe model as above with 12in Diecast Heavyweight Turntable, 4-pole Shielded motor, Suitable for Magnetic cartridge $56.50

The latter two record-changers can be supplied with magnetic cartridge and diamond stylus at $10 extra.

RECORD-CHANGERS, 4-speed stereo record player, $12.95.

PLATFORMS

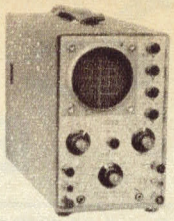
Teak Platforms, suit above changers, $9.00. Fully moulded tinted perspex covers, suit platforms 17¼in x 13½ in x 4in, $9.00.
Pack and Post. 50c.

WIDE BAND OSCILLOSCOPES

VERTICAL AXIS
Deflection Sensitivity (at 1 kc) 0.1 V p-p/cm,
Frequency Characteristics, 1.5 cps —1.5 MC.
Input Impedance, 2 M ohms 25pF.
Calibration Voltage IV p-p/cm.

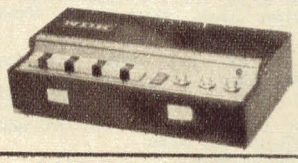
HORIZONTAL AXIS
Deflection Sensitivity 0.9V p.p./cm.
Frequency Characteristics 1.5 cps —800 KC.
Input Impedance 2 M ohms 20 pF.
Sweet Oscillator (5 Range) 10 cps —300 KC.
Synchronisation Devices Internal (Positive and Negative, External).
Power 240v AC 50/60 cps.
Cathode Ray Tube 3KF1F.

3-inch $102.75



5 Meg Bandwidth Push-Pull vertical and Horizontal Amplifiers, 8 positions, high sensitivity, vertical Amplifier Frequency Compensated on all positions Calibrated .02 to 600 volts. Hard time base. 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

5-inch $118.75



AUTOMATIC RHYTHM BOX

12 RHYTHMS.
9 PERCUSSIVE INSTRUMENTS
240v A.C. OPERATION.
$145.00

RHYTHMATIC ELECTRONIC RHYTHM UNIT

Solid-state, battery operated. Excellent accompaniment for guitarists. 6 rhythms, variable tempo control, volume control. Can be powered from external supply.
$67.00
Post., 50c.

PIANO BASS fully transistorised

240 V.A.C. Operation. Suitable to operate with instrument amplifier. Portable. In black vinex carry case.
19in x 14in x 6in.
Keyboard. C1-C3. 2 octaves.
Models, Mellow — Bright — Sustain — Percussion.
Slow and fast decay.
Fine tuning adjustment control which matches piano bass to other instruments.
$74.50

ORGAN KEYBOARDS

49-Note. Complete with Switching System,
$72.00
13-Note, Pedal Claviers. Complete with Switches.
$39.95



AUDIO GENERATOR

De Luxe Model TE—22D.
Freq. range, Sine 20 cps—200 KC. SQ. 20 cps—25 KC. Output Voltage, Sine 7V, SQ, 7V P.-P. Output Impedance 1000 ohms. Acc. 5 per cent, Distortion less than 2 per cent, 4-range attenuation, 1/1, 1/10, 1/100, 1/1K. Printed circuit. 240V A.C.
$42.95



LEADER SIGNAL GENERATOR LSG11

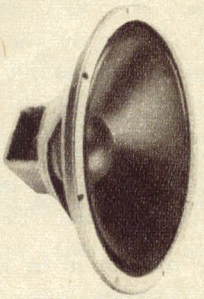
240 V AC operated, 6-band 120 KC to 390 Megs. Provision for crystal.
Post N.S.W., 75c; Interstate $1.25.
$39.50

B.S.R. 4 TRACK

STEREO TAPE DECK.
3 speeds, 7in spools. 3-digit counter Fast forward—fast rewind.
$48.50.
Fitted with third head for monitoring. **$55.50.**
PM119 STEREO TAPE ADAPTER with bias osc. and erase circuitry. 240V AC operation.
$90.00

SIGNAL GENERATOR

De Luxe Model TE20D.
Freq. Range 120 KC—500 Mcs. 7 Bands. Accuracy 2 per cent. Output 8V. Provision for Xtal. Suitable for self-calibration Marker generator. Printed circuit. 240 V.A.C. **$31.50**



15" PIONEER

15in Pioneer Low Frequency Speaker, Imp. 8 ohms.
Power, 30 watts. R.M.S. Designed especially for use with Bass Guitar or Electronic Organ. Also ideal for Stereo Woofer Speaker.
$30.00

T.E. 46 RESISTANCE-CAPACITANCE

Bridge and Analyser.
Capacity 20pf to 2000mfd.
Resistance 2 ohms to 200 megs.
Also tests power factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.
Indications by eye and meter.
$53.75

VOLT A.C.

VARIABLE TRANSFORMER.
0-260V, 10 amp **$49.50**
0-260V, 5 amp **$37.50**
0-260V, 2½ amp **$25.50**

A.C.E. RADIO

AMPLIFICATION COMMUNICATION ELECTRONICS

★★★★★★★★★★★★★★★★★★★★

PHONE 51-3845
51-7008

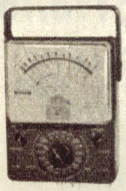
37 VICTORIA AVENUE, MIDDLE COVE
WEEKENDS & AFTER HOURS 40-5391

136 VICTORIA ROAD MARRICKVILLE — 51-3845

KAISE VOLT-OHM-MILLIAMMETER

MODEL SK-100

HIGH SENSITIVITY
100,000 Ohms per Volt DC
10,000 Ohms per Volt AC



SPECIFICATIONS
- DC Volts: 0.6 3, 12, 60, 300, 600, 1200V.
- AC Volts: 6, 30, 120, 300, 1200V.
- DC Current: 12uA, 300uA, 6mA, 60mA, 600mA, 12A.
- AC Current: 12A.
- Resistance: 20K ohms, 200K ohms, 2M ohms, 20M ohms.
- Decibels: Minus 20 to plus 17, 31, 43, 51, 63.
- Accuracy: DC plus minus 3%, AC plus minus 4% (of full scale).
- Overload Protected by Dual Silicondiodes
- Double-jewelled plus minus 2% Meter
- Plus minus 1% Temperature-stabilised Film Resistors.
- Polarity Changeover Switch
- Scale with Mirror

Price $34.75. Post 75c. Interstate $1.00.

MODEL SK-7
4K Ohms per Volt D.C.
2K Ohms per Volt A.C.
SPECIFICATIONS:
D.C. Volts: 10, 50, 250, 1000.
A.C. Volts: 10, 50, 250, 500, 1000.
D.C. Current: 250uA, 10mA, 250mA.
Resistance: 20K (x10) 2 meg (x1000).
Decibels: 2db cps plus 62db.
$9.75.
Post 50c, Interstate 75c.

MODEL SK-70
30K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
D.C. Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
A.C. Volts: 10, 50, 250, 500, 1000.
D.C. Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 7K, 70K, 700K, 7 meg.
Decibels: Minus 10 cps plus 62 db.
OVERLOAD PROTECTION.
$19.95
Post 50c, Interstate 75c.

MODEL SK-140
20K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 2.5, 10, 50, 250, 1000.
A.C. Volts: 10, 50, 250, 500, 1000.
D.C. Current: 50uA, 25mA, 250mA.
Resistance: 40K, 4 Meg.
Decibels: Minus 20 db cps plus 62db.
$11.95
Post 50c, Interstate 75c.

MODEL SK-60
50K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
A.C. Volts: 10, 50, 250, 500, 1000.
D.C. Current: 25uA, 5mA, 50m, 500mA.
Resistance: 10K, 100K, 1 Meg, 10 Meg.
Decibels: Minus 10 cps plus 62 db.
OVERLOAD PROTECTION.
$22.75.
Post 50c, Interstate 75c.

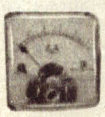
MODEL SK-55
30K OHMS PER VOLT D.C.
14K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.6, 3, 12, 60, 300, 1200.
A.C. Volts: 12, 60, 300, 1200.
D.C. Current: 60uA, 12 mA, 300mA.
Resistance: 10K Ohms, 1 M ohm, 10 M ohms.
Decibels: Minus 10 cps plus 23 db.
OVERLOAD PROTECTION.
$18.75.
Post 50c, Interstate 75c.

MODEL SK-20
20K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.25, 2.5, 10, 50, 250, 1000.
A.C. Volts: 10, 50, 250, 1000.
D.C. Current: 50aU, 25mA, 250mA.
Resistance: 7K, 700K, 7 Meg.
Decibels: Minus 10 cps plus 22 (at A.C./10V) plus 20 cps plus 36 (at A.C./50V), Upper freq. limit 7 Kc.
OVERLOAD PROTECTION.
$13.50

MODEL SK-80
20K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.5, 2.5, 10, 50, 250, 500, 1000V.
A.C. Volts: 10, 50, 250, 500, 1000V.
D.C. Current: 50aU, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5 Meg.
Decibels: Minus 10 cps plus 62 db.
OVERLOAD PROTECTION.
$16.45
Post 50c, Interstate 75c.

MODEL SK-44
30K OHMS PER VOLT D.C.
10K OHMS PER VOLT A.C.
SPECIFICATIONS:
D.C. Volts: 0.6, 3, 12, 60, 300, 600, 1200, 3000.
A.C. Volts: 6, 30, 120, 300, 1200.
D.C. Current: 30uA, 6mA, 60mA, 600mA.
Resistance: 10K ohms, 1 M ohms, 10 m ohms, 100 M.
Decibels: 20 cps plus 17, 31, 43, 57, 63.
OVERLOAD PROTECTION.
SPECIFICATIONS:
Post 50c, Interstate 75c.
$19.25

PANEL METERS



Clear Plastic Flush Mounting
1¾ins, 2ins, 3ins, 4ins.
Full range available.
From 50uA—10A DC, 15 VDC, 500 VDC, 300VAC, VU and S.
Also
Edge Meters.
VU — Stereo Balance.
Send for price list. SAE.

DYNAMIC MICROPHONES



Model		
DM-304	50K-600-	$14.95
DX-129		$12.75
Hi Imp	Dynamic DM 401	$8.75
Hi Imp	Dynamic DM 203	$8.75
Hi Imp	Dynamic DMS-3	$5.50
Crystal	Pencil BM-3	$7.50
Crystal	Lapel	$1.75

AMPLIFIERS
Public Address Range 240V-AC



MINIATURE P.A. AMPLIFIER
15 WATTS OUTPUT

Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing
P.P. EL-84 output .. **$42.50**
30 Watt. As above, EL34 P.P. .. **$57.50**
40 Watt. As above, EL-34 P.P. .. **$85.50**
60 Watt. As above, 6DO6 P.P. .. **$105.50**

Public Address Range.
All models available with either multi-tapped 600 ohm line or 15 ohm Voice Coil.
Solid State 240V A.C

20 Watt .. **$49.50**
50 Watt .. **$69.50**
50 Watt 240 A.C. plus 12v. D.C. .. **$89.00**

All have input for 2 microphones or 2 Magnetic or Crystal P.U. With Mixing.



P.A. SPEAKERS

8 WATT.
8in Units in Waterproof Projection Horns.
15 Ohm Voice Coils.
$15.25
Line Output Transformers to suit.
$1.75 extra.

MICROPHONE STANDS

Floor Model. 6ft adjustable with heavyweight cast-iron base.
$11.75

8" Table Model $3.50
Flexible Goose Necks.
9in .. **$2.75.** 18in .. **$4.35**
12in .. **$3.50.** 24in .. **$5.00**

Low Loss Microphone Cable PVC covered.
Single Core .. .. .. **15c per yd.**
Twin Core .. .. .. **20c per yd.**
Twin Speaker Flex **$4.00**, 100yds.



8 TRANSISTOR CAR RADIOS

R.F. Stage for long range reception. 6 or 12 volt operation. On ordering please state polarity requirements complete with lock down aerial and lead.
Speaker Selection. 5", 6", 8", 7" x 5" or 6" x 9".
De Luxe Push Button Model, **$55.75**
Standard Manual Model.
Complete with 5" x 3" Speaker. **$43.00. Post $1.25; Interstate $2.00**
Car Aerials complete with lead.
Top cowl mounting, 3", 6", **$2.75**
Lock Down, 3" 6" **$4.75**

TAPE CASSETTES
TENSILISED MYLAR

C 60 .. .. **$1.25**
C 90 .. .. **$2.00**
C120 .. .. **$2.75**
Head Cleaners **$1.75**

MECCA-SOUND MATE
SOLID STATE CASSETTE TAPE RECORDER

2 track, mono. 8 transistors.
Battery operated. Auxiliary input for recording, records, TV, radio. Complete with microphone with remote control switch and table stand. Provision for external 7½V DC supply. Battery record level indicator.
$54.00
Pack and post., 75c.

NEW RECORDING TAPE

7in Mylar L.P. 1800ft .. **$3.75**
7in Mylar D.P. 2400ft .. **$5.00**
7in Mylar T.P. 3600ft .. **$6.00**
7in P.V.C. 1200ft **$2.50**
Postage: N.S.W. 15c.
Interstate 25c.

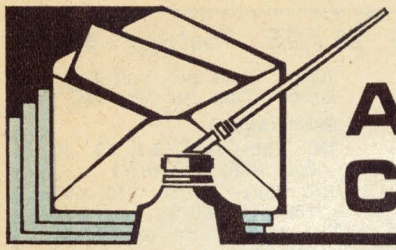
HI-FI STEREO HEADPHONES



20—12000 cps **$6.75**
20—18000 cps **$9.00**
Pack and Post 35c.

NEW SPEAKER SPECIALS
8-16 OHMS

5¼ins **$3.35**
6ins **$4.15**
8ins **$4.85**
4ins x 2ins **$3.45**
5ins x 3ins **$3.45**
6ins x 4ins **$4.25**
7ins x 5ins **$4.85**
9ins x 6ins **$6.25**
3in Pillow Phone 8 ohm **$2.45**
Pack. and post 35c.



ANSWERS TO CORRESPONDENTS

VALVE RADIO: I have been informed that some time ago, over a number of issues, you presented an assignment for the construction of a valve radio in sections. If this is true, I would appreciate your advice as to the cost of obtaining these plans. **(G.H., Rockdale, N.S.W.)**

● From the limited amount of information in your letter, it is difficult to be sure which receiver you have in mind. It could be one of two series, the "Little General 1961" or the "All Wave Series" of 1967. The All Wave series started in August 1967, and month by month added an extra valve and associated circuitry until the series culminated in December 1967 with the 'All Wave Seven." In this series, a complete receiver was presented each month. An extra article, with some modifications was presented in April 1968 to enable the receiver to be used with converters. This was a multi-band receiver. The Little General was a broadcast band receiver, and was described a section at a time. The series had four articles, beginning in March, 1961 (file Nos. 5/ACR4/40-43), the All Wave series had six articles (file Nos. 2/SW/42-47). All, or any of these articles may be obtained through the information service for 20 cents per article.

RECEIVER FOR 41MHz: I am a regular reader of "Electronics Australia." Have you published a circuit for a 41MHz receiver, preferably tunable, but crystal locked would be acceptable. I want to be able to receive the police and traffic officers. **(D.J.G., Halcombe, N.Z.)**

● We suggest that you carefully examine the licensing regulations in your country before embarking on the construction of a receiver which could receive only police and related transmissions. You will probably find that you can use a general receiver (such as the Solid State Fremodyne which we published in May, 1970, File No. 2SW/51) which includes this band, but not a receiver which can receive only the particular frequencies. Also, you will most likely find a clause in the New Zealand regulations very similar to that in the Australian ones governing the secrecy of communications. The relevant clause in our regulations states: "Any person operating an authorised station or having access to messages transmitted or received by an authorised station, shall not, without lawful authority, divulge, or make any use whatsoever of, any portion of the text of any message transmitted or received by any radiocommunication station whether situated in Australia or elsewhere, or disclose in any manner whatsoever the existence of any such message." If you still want to go ahead with a single-frequency receiver, you could perhaps modify our 50MHz receiver published in June, 1970 (File No. 3/TR/1). Alternatively, you could modify the design of our latest 50MHz crystal-locked converter published in March, 1963 (File No. 2/CV/17). Copies of the articles mentioned may be obtained through the Information Service for 20c each. (See panel, alongside.)

BATTERY VALVES: I have obtained the valves from a commercial receiver (portable and mains). The numbers of these valves are 1T4, 1R5, 1S5 and 3V4. I would like to know if I could use these valves in a radiogram; if so could you send me a circuit and list of components. **(R.L., Toorak Gardens, S.A.)**

● The valves you have mentioned are all battery types, R.L., and they are virtually useless for the task you have in mind. Of necessity these valves are a compromise in design between performance and their ability to run from batteries. They are now considered useless for almost anything but elementary amplifiers and, even then, the cost of batteries to power them is enough to make their use uneconomical.

MODEL ROCKETRY: I have taken an active interest in model rocketry over the past few years, and have been disappointed at the loss of two of my best models, which I am unable to track visually. I require a miniature lightweight transmitter, which will emit a "beep," to use in tracking on a small directional receiver. By the way, I have just completed the Electronic Bongos from the April issue and find they work extremely well. Many thanks for another excellent project. **(R.D., Townsville, Qld.)**

● Thank you, R.D. for the kind words about our bongos. As you can see, we are trying to cater for all readers, and this project was one which included those more musically minded. As for your request for a tracking transmitter, we can only say that we have never described one, and we are not sure that they would be legal. Perhaps there is some section of the "model control" band which may be used for this purpose. In any case, we suggest you write to the P.M.G. Radio Branch (there is a branch in your city), and find out from them if such a device is allowed.

TUNABLE IF: The article on a 144MHz converter in your April, 1970 issue refers to the possibility of a future article describing an IF-cum-receiver of modern design, if there is sufficient reader interest. I would be very interested in such a device. Like many "Z-call" amateurs, my station receiver was just good enough to feed with a converter when I acquired my licence about 13 years ago but by today's standards it is sadly lacking. A straightforward design with AM and FM facilities is all that most amateurs would require for VHF/UHF operation, with SSB as an optional extra. The VK3 VHF Group have a fine series of kits for 52MHz, 144MHz and 432MHz converters, and one reads of similar efforts in New Zealand, but no one in Australia, as far as I know, has come out with a solid-state tunable IF project offering the sort of performance required for VHF use today.

I am finishing off an SSB receiver with HF crystal filter which is coming up to expectations for its intended use, but with its narrow bandpass I shall be limited to receiving the few really stable transmissions on 144MHz. I feel sure there will be many more readers interested in a solid-state tunable IF than in your admittedly attractive converter. **(D.C., Brighton Beach, Victoria.)**

● Thank you for your comments and suggestions. We will bear these in mind when considering future projects.

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: For a 20c fee, we will supply data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for project data will be answered more speedily if the projects are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to six months old the cost is the face value, plus 5c surcharge. From seven to 12 months, 10c surcharge; over 12 months, 20c surcharge. Package and postage is 10c extra per issue. Please indicate whether a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

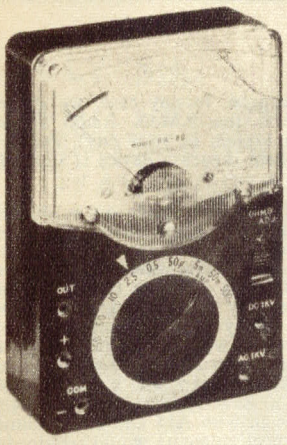
COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W. 2001: 5/69

NEW RH (Radio House) RANGE OF MULTIMETERS

Model RH-80 $18.00 Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current: 50uA, 5mA, 50 mA, 500 mA

Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. —10 + 62 lb

Accuracy. DC±3%, AC ±4% (of full scale)

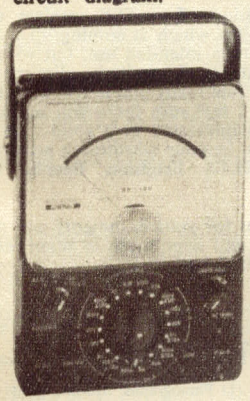
Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

Model RH-100 $39.75 Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

● Overload Protected by Dual Silicondiodes ● Double-jewelled ± 2 per cent Meter ● ±1 per cent Temperature-stabilised Film Resistors ● Polarity Changeover Switch ● Mirror scale, instruction for operation with circuit diagram.



SPECIFICATIONS:

DC Volts: 0.6, 3, 12, 60, 300, 600, 1200V (100,000Ω/V)

AC Volts: 6, 30, 120, 300, 1200V (10,000 Ω/V)

DC Current: 12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.

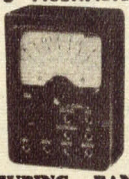
Resistance: 20KΩ, 200KΩ, 2MΩ, 20MΩ

Decibels: —20 to + 17, 31, 43, 51, 63.

Accuracy: DC±3 per cent, AC± 4 per cent (of full scale)

Batteries: Two 1.5V dry cells, size AA, "Eveready" 915

NEW TYPE Y-3 MULTIMETER



MEASURING RANGE: D.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). A.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). D.C. Current: 150 mA. Resistance: 0-100,000 ohms. Complete with 1.5 volt battery and test leads. Size: 3¾" x 2¾" x 1¾".

Checked, Packed and Posted — $9.50. Limited Stocks.

"HANDYMAN" RH 150 $11.50



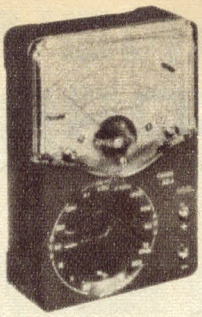
CHECKED PACKED & POSTED FREE

Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS

DC Volts 2½, 10, 50, 250, 1000. AC Volts 10, 50, 250, 500, 1000. DC Current, .1, 25, 250 M/amps. Resistance, 20K and 2 megohms. Decibels, —20db = +62db .7K/c. Capacitance, .0001, .01, .0025, .25 mfd.

Model RH-20 $13.95. Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

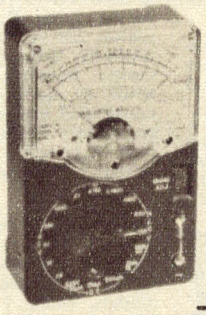
DC Current. 50 uA, 25mA, 250mA

Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. —10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

Batteries: Two 1.5V dry cells.

Model RH-55 $20.00 Postage 50c



30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

SPECIFICATIONS:

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V.

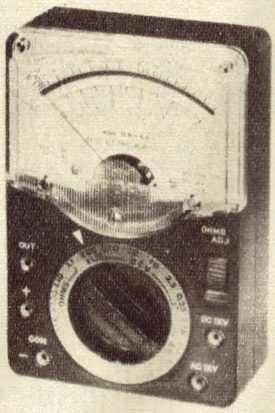
*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: -10 db +23 db.

Model RH-60 $25.00 Postage 50c



50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

Decibels. —10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells.

Models RH-80, -55, -60 are:—

● Overload-protected by dual silicon diodes ● Mirror scale ● Double-jewelled ±2% meter ● ±1% temperature-stabilised film resistors.



LATEST MODEL MICRO RADIO

7 transistors, uses 1 standard Penlite battery size 2¼in x 2¼in. The only miniature radio using standard batteries (refill battery 10c). Complete with instruction leaflets.

Pack and post $39.75.

FLASHLIGHT BALL POINT PEN S-88

Lights up automatically when pen cover is in position for writing. **$2.00 posted.**

Bright illumination. Modern shape with silver finish. You can write when it is dark. Spare parts available. Two batteries 30c. Pen refill 15c. Globes 15c.



RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171

ANSWERS – continued

RADIO CONTROL: Referring to the radio control receiver of February, 1970, could you tell me the approximate value of the parts, and where you could obtain the components. Would this receiver be suitable for single channel radio control for model aircraft? I would appreciate any extra information on this or any other aspect of radio control. **(J.S. Midland. W.A.)**

● It is not our policy to quote the cost of the parts used in our projects, J.S., as there are so many variables involved. The price may be obtained from any of the companies who specialise in our projects, and there are quite a number who advertise in the magazine. The parts may be obtained on mail order from most of these firms. The receiver is eminently suitable for single channel control of model aircraft. In fact, this is one of the purposes for its design. The only other article we can offer you on radio control is one published in December 1965 and January 1966. (File Nos. 3/MC/3 and 3/MC/4). Either of these articles is available from this office under the conditions outlined in the Information Service panel.

"Q" CODE: Could you please give a list of the Q code and its meanings, for example QRM, etc. **(B.W., East Preston, Vic.)**

● We are preparing a complete list of data applicable to amateur radio, including the Q code, for publication as soon as possible.

TRICK DISC: On page 101 of the February, 1970, issue you mention a 10-inch 78 rpm disc with three tracks on each side. I have such a disc, still in its green cover, and, when required, play it on a "Symphonia" acoustic gramophone, which was originally purchased by my father. I would draw your attention to the fact that "Telegen" is not "THE" journal of the Engineering Division of the A.P.O. but "A" journal of the Division. The other one is "On The Line," the latter directed at line staff. Items such as the one on electric powered vehicles are of special interest to me. Best wishes for the continued success of your journal. **(K.S., Kelvin Grove, Qld.)**

● Thank you for your letter and for the comments on various subjects, which we have not been able to reproduce in detail. Some of these items which, a few years ago, were likely to be thrown out as out-dated junk, are finding new value as curios.

Murphy phurphy?

PLAGIARIST: Murphy is an out and out plagiarist. The law falsely credited to Murphy was originally propounded by Gamble in his famous "Law Of Perversity." The law applies to all aspects of life and Murphy has appropriated that part of it which applies to electronics. A simple but typical corollary of Gamble's Law is "All post-offices are on the other side of the road." **(Michael Gamble, Toorak, Vic.)**

We do not normally publish names in this column but we assume that you are speaking on behalf of your ancestor, who was allegedly responsible for the Law:

Re wacky situations,
You say we pulled a phurphy
So now we're quite uncertain . . .
Was Gamble first . . . or Murphy?

HELP FOR AMATEURS: In your "Answers to Correspondents" section, I have noticed several readers have asked for information about becoming radio amateurs. The following information may help them. I obtained a Morse key from Ham Radio Suppliers, of Melbourne. This company also supplies log books for radio amateurs. The following textbooks have been suggested by the P.M.G.'s Department for those who wish to sit for the Amateur Operators' Certificate of Proficiency: Radio Amateurs Handbook (A.R.R.L.); Radio Handbook (Editors and Engineers Ltd.); The Amateur Radio Handbook (R.S.G.B.); Handbook for Operators of Radio Stations in the Amateur Service (P.M.G.'s Department, Australia). The first three are available from either Angus and Robertson Ltd. or Dymock's Book Arcade Ltd. (both of Sydney). The last book can be obtained from the Superintendent, Radio Branch, P.M.G.'s Department, Box 6004, G.P.O., Sydney, 2001. The Radio Branch will also supply further information about the Amateur Operators' Certificate of Proficiency and previous examination papers free of charge. A Certificate cannot be issued to a person who has not attained the age of 14 years. I hope that the information is of some use to somebody. **(M.P., Leura, N.S.W.)**

● Thank you very much for the information, M.P., which we feel sure will help someone on the road to becoming an amateur. Although some of the information has no doubt appeared before in various letters and articles you have put it all together to save others the trouble of assembling it.

PROJECTS: I would like to compliment you on a fine magazine. Have you published details of the following projects: transistorised VTVMs and multimeters; a ten to twenty-watt transistorised amplifier, battery operated; and crossover networks for loudspeakers, **(N.R.I., Natimuk, Vic.)**

● Thanks for the compliment, N.R. We have published all of the projects mentioned in your letter. We have described a large number of VTVMs and mutimeters, the last transistorised version being in December, 1968. (File No. 7/M/32.) A 30-watt transistorised amplifier was described in May 1968. (File No. 1/PA/26). It is fully solid state, and runs from a 12-volt car battery, or a mains power supply described the following month. We described the operation of a crossover network in an article in October, 1955. Photostat copies of this article are available at twenty cents per page; there are six pages involved. Also, some of our loudspeaker systems using simple crossover networks describe their operation. We must stress, however, that crossover networks must be designed to suit the class of loudspeakers involved, taking into consideration in particular their impedance and their intended operating frequency range.

TRIP SPOILED: I recently satisfied a long standing ambition by being able to visit Australia. Unfortunately, I happened to travel on the same plane as a rowdy pop group who apparently came from Queensland. They behaved in thoroughly objectionable manner and more than that played a tape recorder loudly throughout the journey to the discomfort of other passengers. **(J.C., Sandringham, Vic.)**

● We can imagine your feelings, having been subjected to the noise of transistor radios on trains. Fortunately, this seems to be happening less than it used to, except on public holidays. We are surprised that the crew let them get away with it on an international flight. Rather than protest to us, what about a letter to the airline concerned?

UNITED TRADE SALES

PTY. LTD.

TRANSISTOR V.H.F. CONVERTER Tunable 108-136 Mhz Aircraft Band 1F-600Kc to 1,000Kc. No connecting wires needed, 9V Battery, self-contained, just place alongside broadcast radio. Price only **$14.40 plus 45c** postage.

RESISTORS 100 for $2 in Poly Packed Bags. Mixed Values only. P. and P. 25c.

Computer Boards, contains Diodes and Resistors. **75c** ea. P. and P. 25c.

PIANO 5-Key Switches **$1** ea. P. and P., 25c.

MULTIMETERS, 200H, 20K ohms per volt, **$11.25,** inc. tax. CT 500 20K ohms per volt, **$15** inc. tax. CT 330 20,00 ohms per volt, **$17.25** P. & P. 45c.

C1000 Pocket Multimeter $6.50. P. and P. 25c.

Crown Level Meters and 2-Track Tape Heads, **$1.50** ea. P. and P. 25c ea.

CAPACITORS
80 for $2 in Poly Packed Bags. Mixed values only.

TAPE HEADS
Cassette Recorder Type Replay Heads. 2-track Mono Current Manuf.
New $1.50 ea.
PLUS 10c pack. and post.

MU-METAL SHIELDS
To suit 5BP1 and other 5in CRTs mfd. by Magnetic Shields Ltd. **Brand-new, $5 ea. plus 30c pack. and post.**

3,000 TYPE RELAYS.
Large range. **Only 50c each.**

TRANSISTORS
2SD65, 2T76, **25c** ea. or in 100 lots **20c** ea. P. and P. 10c.

OC400, **20c,** SB346, **25c;** OC468, **70c.**

VALVES

6J8	$1.75	6J6	30c
6K8	$1.00	ECC33	50c
6BF6	$1.00	6J7	50c
6SJ7	60c	TT15	$1.00
6SL7	$1.00	807 (ATS25)	50c
6U7	60c	QVO4/7	$1.00
6G8	$1.50	5B254M	$1.00
815	50c	13E1	$1.50

Tinsley 50HZ Tuning Forks, as new, $40.00. P. and P. $1.50.

All prices subject to alteration without notice. All items PLUS POSTAGE.

WANTED TO BUY
RECEIVERS, TRANSMITTERS · TEST EQUIPMENT.

280 LONSDALE STREET, Melbourne. Phone 663-3815.
(Opposite Myers)

SOUND PROJECTORS

Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

from $90.00

CIRCULAR SLIDE RULE

3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.

$1.25 each
Post 10 cents.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$23.00
(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

Please note we are now able to include ½ mile of telephone cable FREE with each set of Phones.

BATTERY CHARGERS

240 volt A.C. Input.
Each battery Charger will charge either 6 or 12 volt batteries.
2 amp. without meter, **$13.75**
2 amp. with meter, **$15.75**
Post N.S.W. 70c; Interstate 95c.

MINIATURE ELECTRIC MOTORS

1½ to 3 volts D.C Ideal for model boats, cars, planes, etc. Strong torque. Only
65 cents each or 10 for $4.00.
(Post 7c).

TRANSCEIVER

(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54 megacycles F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100 K/cs: step 10 channel per meg/cycle with power supply. Leads, mike and headphones **$45**, 60c cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER

(2-way radio) 62 set ideal small ships, Hams, etc. 1.6 to 10 megs. Crystal locked or V.F.O. controlled 5 watt output. Complete with antenna, headphones and mike **$60.** 60c cartage to rail. Freight payable at nearest attended Railway Station.

HEAD PHONES

Low impedance moving coil fitted with rubber muffler to reduce external noise, fitted with press to talk, dynamic hand microphones. Ideal for use with all types of transceivers. $3.50 pair. Same with black felt muffler, $4.50 pair.
Post N.S.W 25c; Interstate 30c.

COLLINS TRANSCEIVERS

Auto-tuned 100-150 megacycles, 10 channels .. ..

$65.00

6 TRANSISTOR radios, new, in leather case, only $12.50 each, post N.S.W. 60c. Interstate 85c.

AVO MULTI METER

Type CT 38
$75.00

A.W.A. AUSTRALPHONE

Transceivers 12 V
New Complete Station.
1.6 to 10 megs on transmit.
0.54 to 16 megs on receive.
$150.00

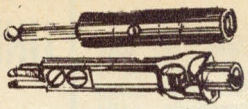
LAVOIE HETERODYNE FREQUENCY METERS

10-100 Megs. LAS. **$250.00.**

100-500 M/cs. **$350.00.**

ADLER FREQUENCY METER

100Kc-20 M/cs. **$175.00.**



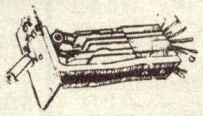
P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
Post 7c.

NIFE CELLS

1.2 Volt fully charged, 4in x 3in x 11in 4 AH.
$1.00 each
Post, N.S.W., 25c; Interstate 35c.

WALKIE TALKIE TWO-WAY RADIOS

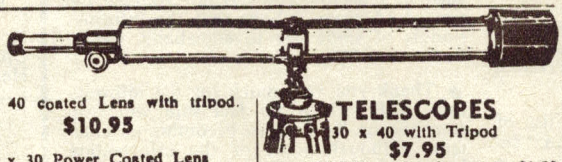
P.M.G Approved Citizen Band. 9 Transistor, **$79.00 per set of 2.** Post, N.S.W. 50c; Interstate, 60c.



P.M.G. TYPE KEY SWITCHES.
45c each. Post, 15c.

BC 221

Frequency Metres
$55.00



45 x 40 coated Lens with tripod.
$10.95

30 x 30 Power Coated Lens
Brand new.
$3.75

60 magnification with a 60mm coated objective lens.
With tripod.
$23.00

As illustrated.
Postage, 95c; Interstate $1.20.

HIGH STABILITY RESISTORS

I.R.C. brand new, usually 80c ea. 50 assorted values for only
$3.75
Post 15c.

STEREO headphones, brand new, $7.50, post N.S.W. 60c. Interstate 85c.

TYPE S POWER SUPPLY

(240 Vac supply for AT 5-ARB) suit most types of Disposal transmitters and receivers outputs 250 volt, 10ma 550 volt 200ma, 300 volt 100ma, **$30.00**

TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ¼ mile) **$7** per coil.
Post, N.S.W. 70c; interstate $1.20.

SCOOP PURCHASE

Gramo Motors. New. Made in U.S.A. 4-speed 240 volt A.C. 50 cyc. Only **$2.75** each.
Post, N.S.W. 30c; interstate, 40c.

CO-AXIAL SWITCH

70 ohms 4 positions.
can be motor driven completely waterproof 70 ohms type connectors. Housed in metal case 9in x 8in x 8in $5.00 each. Post N.S.W 70c. Interstate $1.20.

ELECTRONIC COUNTER

(Austronic) 0-100 K/cs. 240V operated. **$150.00**

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639B Western Electric, top grade, original cost **$250,** ideal Broadcast Studio, music recording, Church and play recording, etc.
Fraction of original cost.
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200 Mill. amp., 24 volt, 1/8in push movement.
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Types TR1934 100-125 meg/cys. and TR1935 125-150 meg/cycles. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.
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ANSWERS—continued

INTERCOM: Would it be possible for you to publish a simple transistorised intercom? Also what does "O.V." stand for on power supplies for radios? **(C.M., Holland Park W., Qld.)**

● A number of transistorised intercoms have been described in past issues, C.M. The January, 1960, and August 1962, issues both described units which may meet your requirements. The articles concerned are available through our Information Service under File Nos. 1/IA/8 and 1/IA/9 re spectively. The letters "O.V." are not common but we presume they stand for "output volts" and refer to the voltage available from the particular power supply.

COLOUR TELEVISION: On This Day Tonight some time ago I saw a young man explaining how he had adjusted his monochrome set to receive colours. Will "Electronics Australia" be telling readers how to do this? **(A.T., Kingsford, N.S.W.)**

● Without debating exactly what was said on This Day Tonight, your impression of the situation is quite wrong. What the young man actually had was a full-scale colour television receiver designed for British standards, to which he had added still further circuitry. We referred to the matter in "Forum" in the May issue. There is no really attractive or practical way of modifying a monochrome set to reproduce programs in full colour. Those who want colour will have to buy a colour set.

6W AMPLIFIER: I find your magazine very interesting and I would like to congratulate you for being able to keep it very informative. I am looking for a transistor mono amplifier with about 6 watts output. Could you print a circuit soon or advise of one that has already been published? **(A.M., Kensington Garden, S.A.)**

● Thank you for your comments about the magazine, A.M. While we have not published a transistor amplifier having the power output specified, a 3-watt design appeared in the September 1969 issue and is available under File No. 1/MA/48.

TRANSCEIVERS: I have read your "Communications Receiver" project (Jan., Feb., and March, 1970) and am proceeding to assemble it. Could you tell me if you have printed a similar project on a "Communications Transceiver." If so, how can I obtain a copy of this? Maybe one of your readers may have such a circuit. **(K.S. Pascoe Vale. Vic.)**

● We have never published such an article, K.S., partly because of the problems of developing, describing and duplicating such a complex piece of equipment. From the reader's point of view, failure to get it going properly would be a very expensive failure indeed.

COMPLIMENT: I enjoy reading your magazine each month; keep up the good work. Despite recent criticism of the magazine, particularly regarding the Serviceman, I enjoy it and sure there are hundreds like me. **(P.W. Pt. Lincoln, S.A.)**

● Thank you for the compliment and for your faith in the magazine. We, likewise, are sure many people read and enjoy "The Serviceman," if our mail is to be taken as a guide.

RECEIVERS: Does "Electronics Australia" have plans to publish a more elaborate regenerative receiver than the All-Wave Two in the April issue or a less refined superhet than the 240 Communications Receiver? When making tape recordings of broadcast music programs is it just a matter of connecting a small preamp via a capacitor to the tape recorder input from the transistor tuner volume control? What value of capacitor should be used? In the 27MHz Radio Control receiver (February, 1970) is the SFD-455B filter used the same as the SF455D and are they interchangeable? **(R.D., Chippendale, N.S.W.)**

● Most of the regenerative receivers published have followed more or less the same pattern with variations in the audio stages. Currently under development is a simplified version of the 240 communications receiver which should meet your requirements both in cost and simplicity. It is not usually necessary to use a preamp when recording from a radio receiver as the signal level is usually quite high enough. A small electrolytic capacitor connected from the top end of the volume control to the pickup or line input of the recorder is normally sufficient. The value of capacitance is not critical and any value from 2 or 3uF up is satisfactory. The "earthy" side of the tape recorder input would have to connect to the tuner "earth." The maurata filter SFD-455B is the new designation for the SF455D and they are otherwise identical.

RADIO: Unofficial history

Your story, a few months back, about the makeshift nature of the early country "talkies" struck a chord of remembrance from this reader.

My grandfather owned the "flicks" in a small country town and, like many other such people, faced the prospect of having to close down when the locals would no longer patronise a silent show.

Just when the end seemed inevitable, a local man who had been working temporarily in Sydney as a projectionist, told my grandfather that he could get him a complete talkie system from a suburban theatre which was being rebuilt. He had seen and heard the gear in action and it was a bargain . . . etc.

I can only speculate that his enthusiasm might have been prompted by more than just local interest.

Anyway, the equipment was secured and the show closed for a couple of weeks to allow time for the "new" equipment to be installed in the projection box, still more holes to be cut in the front wall, the optics lined up and so on. Quite certain that everything would be in order, a program was arranged, posters went up and Saturday was announced as the big night when talkies would come to the town.

Unfortunately, while the optics could be checked with a few odd pieces of silent film, there was no way of checking the sound. But the city projectionist was full of confidence: everything would be just fine!

Unfortunately, as often happened in those country areas, the big metal box of film was overcarried and only frantic phoning by the local stationmaster managed to get it back into the town mere minutes before the show was due to start.

But it might as well not have arrived. The pictures flashed on the screen all right but the loudspeakers remained stubbornly silent.

My grandfather was thoroughly put out, as you might imagine, but he had a trick up his sleeve. From the silent stage he apologised for the breakdown, told the people to pick up their tickets and come back next week. He'd get in touch with his grandson who worked in a radio factory and he would fix the trouble in a few minutes!

Having to work for a living, I couldn't do anything to help until the following Saturday but I duly turned up with tools, a meter and a box full of spare parts, to service an amplifier that I knew nothing about.

And what an amplifier It was contained in something that resembled an over-sized black meatsafe — a collection of transformers, valves, sockets, vacant terminals and other stuff that looked old, even in those far-off days. Not only did the amplifier look hopeless to start with but, as far as I could judge, a whole section was missing that must have been some sort of a control unit on the projection wall.

I could only shake my head and state my conviction that the patrons wouldn't be listening to that amplifier, on that night or any other night. A lot of would-be patrons were going to be disappointed — again

Well then, could I build a new amplifier and, if so, how long would it take?

With the foolishness of youth, I said "three weeks." Privately, I reckoned that I'd need the first week to find out something about talkie amplifiers, another week to buy the parts and assemble them and the third week to wire and test it — without access to a talkie projector!

Twice during the next fortnight I had to assure my grandfather by telegram that I was working on the amplifier and that I expected to have it ready as promised. And I did.

But what I didn't know until I arrived on the third Saturday was that he had advertised a show for that night. The possible problems of marrying an orphan amplifier to orphan projectors, arranging changeover, and all that kind of thing, hadn't even been considered.

If ever there was a case of "panic stations," that was it. With local handymen mounting loudspeakers, running wires and helping in any way they could, I was checking sound heads (and learning about them at the same time) cleaning away surplus grease and oil, establishing amplifier connections, and so on.

I got signal from the P.E. cells — hissing, humming, then plopping when I stroked a screwdriver through the light beam. We loaded up a film and got our first talkie sound at 6.45 p.m. — and it sounded promising.

There was just time for a quick rinse, toilet, tea and toast before it was time to greet the patrons arriving for the third time with music from records, including the inevitable "Blaze Away."

Then the lights went out (you don't have dimmers in a country hall) and the first full reel of film that the rebuilt system ever reproduced was the first reel of the program!

Fortunately, the system kept on working, though the patrons had to try to follow the sound through a strange hissing noise.

Background from the sound track?

No, just continuous sighs of relief from a grandfather and his grandson!

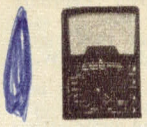
(Readers are invited to submit contributions to "RADIO: Unofficial History" and a publication fee will be paid for those used. Stories must be humorous and they must be true. Letters must be signed and the locale of the story indicated as a mark of good faith. The Editor reserves the right to re-phrase contributions as necessary to preserve uniformity of style.

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MELBOURNE, VIC. 3000
TELEPHONES: 677329, 674286

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1H5	.75
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1K7	.50
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5 for	$2.00
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1S5	$1.70
1T4	$1.00
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2D21	$1.20
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3V4	$1.70
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5R4GY	$2.00
5T4	$1.75
5U4GB	$1.30
5V4(GZ32)	$1.50
5Y3GT	$1.20
5Z3	$1.50
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6AB7	$1.00
6AC7 ea.	.50
or 5 for	$2.00
6AD8	$1.35
6AE8 (X79)	$3.50
6AG5	.20
or 12 for	$2.00
6AG7	$1.25
6AJ5	.75
6AK5(EF95)	$2.55
6AL3	$1.55
6AL5	.75
6AM5	.75
or 3 for	$2.00
6AM6	.75
or 3 for	$2.00
6AN7/A	1.55
6AQ5	$1.30
6AR7GT	$1.80
6AU4GT/A	$1.50
6AU6	$1.30
6AV6	$1.20
6AX4	$1.50
6B6	$2.00
6B8	$3.00
6BA6	$1.40
6BE6	$1.40
6BH5	$1.35
6BK8 (EF86)	$2.00
6BL8	$1.50
6BM8	$1.60
6BQ5 (EL84)	$1.50
6BQ6GTB/	
6CU6	$2.50
6BQ7A	$1.50
6BY7	$1.35
6BX6	$1.35
6BY7	$1.95
6C4	.50
or 5 for	$2.00
6C8	$1.00
6CA4	$1.10
6CA7/EL34	$3.00
6CB6	$1.40
6CD6G/A	$4.50
6CG7	$1.50
6CH6	$2.40
6CK5	$2.00
6CK6	$1.40
6CM5	$2.20
6CQ6	$2.20
6CQ8	$1.40
6CS6	$1.30
6CW4 (NUVISTA)	$2.75
6DC6	$2.40
6DC8	$1.90
6DQ6A	$2.20
6DQ6B	$2.65
6DS8	$1.80
6DT6	$1.40
6DX8	$1.65
6EA8	$1.55
6ES6	$1.80
6ES8	$1.80
6F6G	$1.25
6G8G	$2.50
6GV8	$1.70
6GW8	$1.70
6H6GT	.20
or 12 for	$2.00
6HG5	$1.50
6HS8	$1.50
6J5GT	$1.00
6J6	.75
or 3 for	$2.00
6J7G	.50
or 5 for	$2.00
6J8G	$3.00
6K6	$1.00
6K7	.50
6K8GT	$1.25
6K8 Metal	$2.00
6KV8	$1.75
6L6G	$2.90
6L7	.50
6M5	$1.35
6N3	$1.20
6N7	.30
or 10 for	$2.00
6N8	$1.40
6Q7G	$2.50
6R3	$1.55
6S2	$1.85
6SA7GT	$2.20
6SC7	.75
6SF5	.75
6SF7	.75
6SH7	.50
or 5 for	$2.00
6SJ7	.75
or 3 for	$2.00
6SL7GT	$1.25
6SN7GT	$1.00
6SQ7GT	$2.10
6SS7	.75
6U4GT	$2.00
6U7G	.75
or 3 for	$2.00
6U8/A	$1.55
6V4	$1.05
6V4	$1.05
6V6GT	$1.75
6X2	$1.95
6X4	$1.00
6X5GT	$1.50
6Y9	$1.90
7A8	.35 or
8 for	$2
7C5	.50
7E6	.50 or
5 for	$2
7H7	.75
7W7	.50 or
5 for	$2
9A8	$1.90
9U8	$1.75
12A6	.50 or
5 for	$2
12AH7	.50
12AT7	.50 or
5 for	$2
12AU6	$1.50
12AU7	$1.45
12AV6	.75
12AX7/ECL83	$1.60
12BE6	.75
12BY7/A	$1.75
12C8	.50
12J5	.50
12SA7GT	$1.00
12SC7	.50
12SH7	.50
12SK7	.50
12SN7GT	$1.00
12SR7	.50 or
5 for	$2
16A8	$2.00
35L6	$1.00
19	.50
30	.50
42	$2.50
47	.50
57	.50
58	.50
78	$1.00
80	$1.50
100TH	$3.00
717A	
807	$1.25
808	$1.00
832A	$7.00
866A	$1.00
954	50c or
5 for	$2
955	.50
956	.50
958A	50c or
5 for	$2
1625	50c or
5 for	$2
1629	.50
5636	.75
9006	25c or
10 for	$2
BA50	10c or
12 for	$1
ECC35	$2.00
ECH35	$2.80
EF86/6BK8	$2.00
EL34 (6CA7)	$3.00
EM84	$1.50
EY91	.50
KT61	$3.90
KT66	$4.75
KT88	$5.30
RL18	75c or
3 for	$2
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VR150 (volt Reg.)	$1.25
2D21	$1.20
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2X2/879	.75
6CW4 NUVISTA	$2.75
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150C4/OA2 Reg.	$1.65
832A	$7.00
866/A Reg.	$1.00
807	$1.20
884	$2.85
885	$2.85
2051	.50
S763	$2.55
6146A	$5.95
6146B	$6.25
OA2/150C4	$1.65
OB2/108C1	$2.50
QE03/10	$2.55
QQE03/12	$2.65
QQE03/20	$17.00
QQE06/40	$12.95
QV04/7	$1.50 or
3 for	$3.75

ALSO OTHER TYPES AVAILABLE, P.O.A.



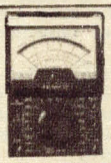
MODEL OL-64D MULTIMETER. 20,000/OPV, DC Volts: 0-0.25/1/10/50/250/500/1000V at 20K/OPV, 5000 volts at 10K/OPV, AC Volts: 0-10/50/250/1000V at 8K/OPV, DC/A: 50uA/1mA/50mA/500mA/10 amps. RESISTANCE: 0-4K/400K/4M/40Megohm, DB Scale: —20 to plus 36db. Capacitance: 250pF to .02uF. Induct. 0-5000H, size: 5¾ x 4 1/8 x 1¾ in.

PRICE: $19.50 post 30c.



MODEL 200H MULTIMETER. 20,000 opv, DC Volts: 0-5/25/50/250/500/2500V (20,000 opv) AC Volts: 0-15/50/100/500/1000V (10,000 opv) DC/Amps: 50uA/2.5mA/250mA, Resistance: 0-60K/6M ohm (scale centre 300 ohm—30K ohm. Capacitance: 10uuf to .001uF/.001uF — .1uF, D3 scale 20 db to plus 22 db. Size 4½ x 3¼ x 1 1-8.

PRICE: $11.25 post 30c.



NEW MODEL US-100, Overload protection, Shockproof Movement, polarity switch DC volts: 0.25/1/25/10/50/250/1000V (20K/OPV AC Volts: 0-2.5, 10/50/250/1000V (5K/OPV), DC/Amps: 1mA/25mA/500mA and 10A. AC/Amps 10A. RESISTANCE: 0-50M/ohms (centre scale 50) R X 1/10/100/1K/10K, db scale —20 to plus 10 plus 22/plus 35/plus 50db.

PRICE: $28.75 post 40c.
Mirror Scale



MODEL C-1000 POCKET MULTIMETER. 1000 ohms/per Volt, AC Volts: 0-10/50/250/1000 (1000 opv) DC Volts: 0-10/50/250/1000 (1000 opv), DC Current: 0-100mA, Resistance: 0-150K ohms (3K centre), 2 colour scale, Range Selector Switch, Dimens.: 3½ x 2¼ x 1in.

PRICE: $6.50 post free



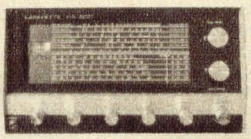
MODEL CT500 MULTIMETER, 20,000/Opv, DC Volts: 0-2.5/10/50/250/500 5000V (20K/OPV) AC Volts:0-10/50/250/500/1000V (10K/OPV) DC/Amps: 5uA/5mA/50mA/500mA, RESISTANCE: 0-12K/120K/1.2Meg/12Megohms, (scale centre: 60/600/6K/60K, DB scale: —20db to plus 62db (5 ranges). Size: 5½ x 3 5/8 x 1¾ in.

PRICE: $14.95 post 30c.



MODEL CT330 MULTIMETER. 20,000/OPV, DC Volts. 0-6/6/30/120/600/1.2K/3K/6K Volts, AC Volts: 0/6/30/120/600/1.2K Volts (10K/OPV), DC/Amps: (0-0.06/6mA/60mA/600mA. RESISTANCE: 0-6K/600K/6M/60M/600Megohm. (30/3K/30K/300Kohms) centre scale: Capacitance: 50 uf to .01 uf .001 to 0.2 uf. Decibels: —20 to plus 63db size approx: 5½ x 3 5/8 x 1¾.

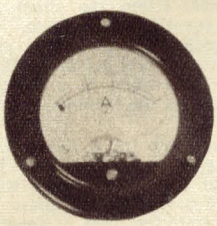
PRICE: $16.75 post 30c.



NEW LAFAYETTE SOLID STATE HA600 RECEIVER

5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE. 150 Kc/s—400 Kc/s and 550 Kc/c—30 Mc/s. F.E.T. front end ● 2 mechanical filters ● Huge dial ● Product detector ● Crystal calibrator ● Variable BFO ● Noise limiter ● S Meter ● 24in Bandspread ● 230V A.C./12V DC, neg. earth operation ● RF gain control. Size 15in x 9¾in. 8¼in. Wt. 18lb. S.A.E. for full details.

PRICE $199.50



"KEW" KYORITSU MO 65 METERS, NEW

Size: 3¼ inch, mounting hole 2½ inch. 1½ inch deep.

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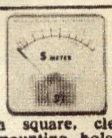
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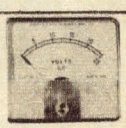
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50 uA	$7.00	50-0-50 uA	$8.75
100 uA	$6.75	15 volts d.c.	$8.75
500 uA	$6.50	25 volts d.c.	$8.75
1, 5, 10, 25, 50 100, 250 and 500 mA	$8.75	30 volts a.c.	$8.75
		"VU" Meter	$8.25

LT91 RECTIFIER
20 Volt 2 Amp
Price: $1.50 post 10c.

ANSWERS – continued

SIMPLEST RECEIVER: Back in the days when E.A. was RH, a reader remarked that some radios had a lot less components than others, yet seemed to perform just as well. He asked how far the reduction of components could go. The Editor came up with the ultimate in circuits: "The invisible 3." The "circuit" showed an aerial and earth connection, terminals for phones and blank space in between. I had this circuit in a frame for years, to the amusement of my colleagues. **(V.S., Croydon, Vic.)**

● We can't remember the item, V.S., but, if you say we printed it, then we printed it. A circuit like that shouldn't be too hard for anyone to reproduce, if they have the same taste in wall art!

AMPLIFIERS: I am a fourth-year High school student, doing an Electro-Technology course. I was wondering if I might be able to purchase some "Electronics Australia" magazines with circuit diagrams and values of transistorised amplifiers. **(M.G., Cloverdale, W.A.)**

● We have published a large number of amplifiers, many of which are solid state. Without knowing your exact requirements we cannot really help. Perhaps you may be interested in simple transistorised amplifiers published in March, 1970 (File No. XA/10), or a more elaborate amplifier, a 30 watt PA amp. published in May, 1968 (File no. PA/26). Any of these articles can be obtained from the information service for the fee of twenty cents.

KITS OF PARTS: I would like to know whether the "All Wave Two" receiver described in "Electronics Australia" for April, 1970, will be available as a kit or not and if so where it can be obtained. **(B.J., Riverwood, N.S.W.)**

● We are not quite sure what you mean by a project "becoming available as a kit." If you are suggesting that we are likely to make such a kit available then we can only repeat what we say every month in the "Information Service" panel on these pages: "Electronics Australia" does not deal in electronic components; prices, specifications, or other assistance should be sought from the appropriate advertiser or agent. If, on the other hand, you are asking us whether our advertisers intend to make a kit available we are at a loss to understand why you have directed the question at us. The logical people to ask would be the advertisers. Finally, the preparation of a kit normally involves little more than taking the parts list as published and treating it as an order. Thus most readers simply request their dealer to supply all the parts listed for the project in mind. In other words, it is not necessary to wait for the announcement of a kit, by an advertiser, before placing an order.

PENFRIENDS: I am 13 years old and think your magazine is just terrific. Could you please publish my name and address as I would like some "electronic" penfriends. Do you have a circuit for a crystal set with a self-contained aerial? What does "DX" stand for? Also, I have two tape recorders. I would like to know how I could obtain an echoing effect on voices or music. **(George Raicevich, 42 Novara Cres., Como. 2226).**

● As you can see, George, we have published your full name and address. We hope that this has the desired results. We have never published a crystal set of this type but we doubt whether it would be much of a proposition. DX is a common abbreviation for "distant," and refers to long-distance transmission of radio or TV. The echo effect heard on many "pop" records is usually achieved in a professional studio, and would be difficult for the amateur to achieve unless the tape recorder had the facility built in.

BROADCAST INTERFERENCE: Recently, a friend and I were making a tape of unusual sounds. This resulted in a somewhat "haywire" setup in my room, including some long leads from the record player to the tape recorder. In attempting to record on tape from the record player, I got some music but not from the record player. It turned out to be all six local broadcast stations. My knowledge of electronics is limited but I can only assume that some sort of diode action must be taking place. What is the reason for this phenomenon and is it common? **(T.M., Gooseberry Hill, W.A.)**

● First of all it is asking for trouble in such a setup to have such long leads. These leads do in fact, perform as an aerial and quite a strong signal can appear on them from nearby powerful transmitters. The phenomenon is common in these circumstances, even with valve operated equipment.
With solid state equipment, the problem is accentuated, mainly because solid state devices normally can only handle small signals under linear conditions. The word "linear" is the key to the problem. If an RF signal appears at the input of one of these devices, of such strength that it is more than can be handled in a linear fashion then the operation becomes non-linear and rectification, or detection, takes place. This results in the modulation on the signal(s) being fed through the amplifier as audio and heard in the speaker. The remedy is fairly obvious, in that these signals must be stopped from getting to the input of the amplifier. This can be combated by keeping input leads as short as possible, shielding if necessary and even providing a low-pass filter to get rid of the unwanted RF signals, before they can cause trouble.

SUGGESTION: I have constructed an economy stereo system using GE types PA237 or PA247 audio IC's in conjunction with your Playmaster 120 control unit. I can thoroughly recommend this combination feeding into a large baffled speaker system. **(C.H., Brigalow, Qld.)**

● Thank you for the suggestion, C.H. We congratulate you on the success of your experiment. Other readers may care to try this, on the grounds of C.H.'s success.

AMATEUR TELEVISION: Would it be possible to publish a converter to feed amateur band television into a normal TV receiver? I feel that this could give the amateurs engaged in this activity a feeling of encouragement to know that their transmissions could be viewed by the general public. **(R.W., Sebastopol, Vic.)**

● The use of a converter to feed amateur TV transmission into a conventional set is quite feasible, and one of our staff members has a personal interest in this subject. However, it is doubtful whether such a device would appeal to the general public. Amateur transmissions are quite spasmodic and relatively few at the present time. The chances of picking up such signals without prior knowledge of the experiments is extremely small. Also, the image transmitted is usually confined to test patterns and similar material which would have little interest for the general public.

DEAD LETTER: We are holding a letter from a reader in Singapore which carries no address and a signature of doubtful legibility. As nearly as we can make out the name is "Lohori." The writer requires reprints of the Deltahet receiver and the SSB Transmitter. It contained a money order issued by the Queen Street Post Office, Singapore. Will the writer supply his full name and address in order that we can complete the transaction. ■

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The pots, are all current types and include switch pots, and dual concentric, tandem, tab pots. etc. LIST PRICE $12.00 per dozen. OUR PRICE $2.50 per dozen. Post and package 60c extra.

FREE With each lot of resistors, condensers or pots. we will supply one new valve. Type 6U7G, 1T4.

Regret special values in resistors, pots and condensers cannot be supplied.

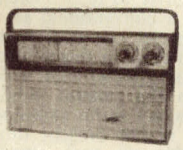


LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KC to 390 Megs. Provision for crystal. **$39.50**
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NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT $24.00



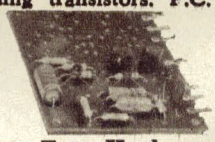
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Using 3 transistors per channel as featured in Electronics Aust. Complete kit of parts including transistors. P.C. board and resistors and condensers. Circuit and full details supplied.



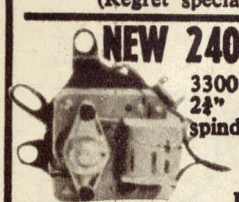
Stereo Kit $8.50.
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State if required for Pick-up or Tape Head.

NEW HIGH STABILITY CARBON RESISTORS 1 p.c. and 2 p.c. TOLERANCE

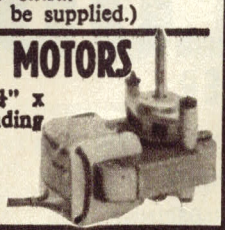
These imported resistors are in ½ and ¼ watt with values from 50ohm. to 1 meg. 1% and 2%. In packets of 50 mixed values.
LIST PRICE 20c each.
OUR PRICE $2.00 per packet of 50.
Post and packing, 20c extra.
(Regret special values cannot be supplied.)

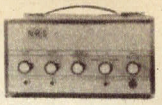
NEW 240V ELECTRIC MOTORS



3300 R.P.M. Size 3¼" x 2¼" x 3¼", including spindle.

$2.75
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NEW 25 WATT P. A. AMPLIFIERS

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Freight extra

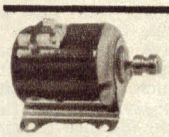
These amplifiers are suitable for installation in clubs, schools, restaurants, factories, etc. Wherever the amplification of speech or music is required.

SPECIFICATIONS

- Output impedance Line output (100, 166, 250, 500 ohms) Nominal power 25 watts.
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- Tone control.
- Frequency response 30 to 18,000 CPS.
- Output impedance Line output (100, 166, 250, 500 ohms) or can be supplied with V.C. output (2, 3, 7, 8, 15 ohms).
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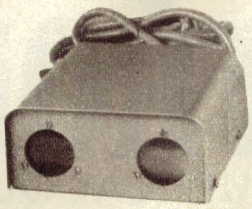


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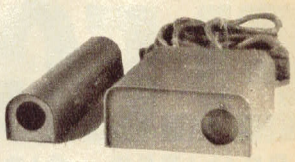
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ELECTRICAL HAZARDS

(Continued from page 13)

The following list outlines some of the precautions that should be observed:

1. Use 3-wire power cords exclusively.
2. Supply all electrical equipment within 15 feet of patient from single bank of wall outlets that have earth terminals tied together by 12 gauge or larger wire.
3. Supply bank of wall outlets from power-line isolation transformer with earth-fault monitor.
4. Abandon all other electrical outlets in vicinity of patient.
5. Connect conductive surfaces of all non-electrical devices within 15 feet of patient to common-earth terminal with separate 12 gauge or larger wire for each device. Connect common terminal to wall outlet earth.
6. Use monitoring equipment with earth isolated inputs.
7. Check all power cords for signs of damage. Check for ground continuity from plug to equipment case.
8. With all equipment turned on, measure potential between common earth terminal and all conductive surfaces within 15 feet of patient. No surface should be more than 5mV from earth.
9. Establish program for periodic inspection of patient environment, including checks on earth continuity, isolation of monitor inputs, and potential on conductive surfaces. ■

About the Author



William F. Craven

Bill Craven has contributed to the design of several diagnostic and patient monitoring instruments at the Medical Electronics Division of Hewlett-Packard, where he is now in charge of the Intensive Care Monitoring Instrument development program. Bill, who obtained his B.Sc. and M.Sc. in electrical engineering from the University of California, has served on several industry committees concerned with patient safety and the standardisation of medical instruments.

CLASSICAL CASSETTES REVIEWED

(Continued from page 121)

nerve stretching, steady tempo throughout but offers little release at the end where the change to a major modulation should be electrifying. But as a buy the "Pictures" make it one of the most worthwhile cassettes I have so far heard.

★ ★ ★

SIBELIUS — Symphony No. 6 in D Minor. Symphony No. 7 in C Major. Berlin Philharmonic Orchestra conducted by Herbert von Karajan.

The playing in both these symphonies is impeccable and Karajan's readings might well please those who don't subscribe to the special type of interpretation of Sibelius' music favoured by Finnish and British conductors. By that I mean that Karajan tends sometimes to soften typical Sibelian edges and give the music a more mellifluous presence. Thus while he quite rightly avoids a schmaltzy quality in the strings in doing so he drains out some of the colour, leaving an unusual —and uncharacteristic—pallor. Those who still have, or remember, the old Collins set might be surprised at some of his tempos especially in the first movement of the Sixth Symphony which, at Karajan's pace, tends to become trivialised. But it still retains many vastly impressive pages. At any rate Karajan's accounts of both works could perhaps be best described as a thought too civilised, a little too much in the Central European tradition. They lack the feeling of a Baltic atmosphere with its climatic rigors. For instance, I missed particularly the strong primary colours that should dominate the Scherzo (Sixth.) The Seventh opens magnificently and continues in this vein, though this, too, develops an alien sweetness as it progresses. However, here are the only two performances I know on cassettes and for that reason I can recommend them.

★ ★ ★

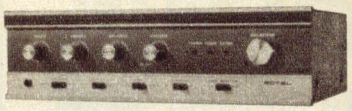
STRAUSS (RICHARD) — Also Sprach Zarathustra (Symphonic Poem). Berlin Philharmonic Orchestra conducted by Karl Bohm. DGG922 027.

All those who have seen the science fiction film masterpiece "2001" will recognise the opening bars' solemn brass passage. Strauss once boasted that he could describe anything in terms of music, even a glass of lager. However I don't think his Also Sprach Zarathustra tells us very much about Nietzsche's philosophy on which the composition is based. The music has only some superficial resemblance to what might be described as the headlines of the book. But this apart, it is fine Strauss with lusty themes sometimes moving through the whole compass of the orchestra. And, of course, it's all gorgeously scored. If the waltz sounds a bit trivial after Nietzsche's "deep eternity" of joy, it nevertheless offers pleasing sound.

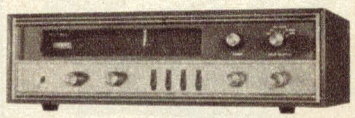
Karl Bohm is one of today's finest exponents of Strauss' music though perhaps better known in the opera house than in the concert hall. And in the Berlin Philharmonic he has a grand orchestra which responds sensitively to his every exacting demand. The sound is good average. ■

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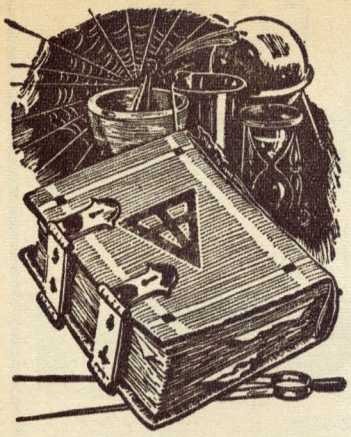
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NAME.....

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ADDRESS.....

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U.K. Metrication Timetable

(Continued from page 18)

flat steel products, wire mesh and electric cables will be available in 1970 to metric specifications. The production of plastics materials will be in metric terms by the end of 1971, while trade in chemicals in metric units will begin in that year and the change-over will be completed by the beginning of 1973. During 1970 the paper, board and printing industries will complete the change-over to metric.

Broadly speaking, therefore, the materials industries will by the end of 1972 substantially be producing and marketing materials in metric terms.

The engineering industries, including shipbuilding, are now going through the initial period of change, and many new designs, particularly equipment for the Armed Services, have been in metric terms from the beginning of 1970. Generally, Government procurement policy is to give preference to metric supplies. In 1971 the pace will quicken. The shipbuilding industry will be substantially metric by the end of 1972, while in the engineering industry major changes will be evident by about the same time. There is, however, no simple pattern embracing changes in these diverse industries, and the nature of the change and its timing will vary widely from one sector to another.

The construction industry will continue its progress toward metrication and all new designs from now on should be in metric dimensions. Bricks, paving flags, fibre boards, concrete pipes and metal windows are now becoming available from stock. The change to metric measures for softwood, hardwood, plywood and sheet materials should take place about the middle of 1970, and by the end of the year cement and ready mixed concrete will be sold in metric quantities and flat glass to metric dimensions will be generally available.

During 1970-71 there will not be much that the public will notice. Some do-it-yourself materials will be on sale in metric quantities, notably paints and timber. The bedding industry will go metric in the beginning of 1971, and some synthetic and woollen fibres will then be available in metric quantities. Footwear sizing is to be in metric units in autumn of 1972, and generally it is at that time that we would expect the general public to become increasingly aware of the change in the shops. Of particular significance will be the change in the units of sale of beer, milk and petrol. Another noticeable stage will be when changes in the Weights and Measures Act become effective. It will not, however, be possible to organise the change-over in the retail trade on one single M-day, and the change-over will be progressive.

The total change on which the country has already embarked is vast in extent, but its apparent complexity is simplified when the detailed elements are identified. We have not encountered as yet any major obstacles, although we are well aware of certain specific difficulties. With proper planning we believe they can be resolved.

We think that there has been a tendency to exaggerate the difficulties and to underestimate the skills of management, and the intelligence and adaptability of the ordinary citizen when the changes required are realistically presented to them. The educational system and the industrial training organisations both as regards new training and retraining of the work force can make a major contribution to easing the problems of the transition. ■

Economical SW Receiver

(Continued from page 85)

With the dial pointer again set to 4MHz, corresponding also to 12MHz on the scale, set the band switch to 16-12MHz. Feed in a signal from the signal generator, set precisely to 12MHz and adjust the appropriate trimmer across L4 for maximum response, also peaking the tuning of L3. If a generator is not available, use can again be made of VNG on 12MHz as before.

Set the band-switch to 1.5-0.5 MHz and tune in a broadcast station of known frequency. Adjust the appropriate trimmer across L4 to bring this station to the correct position on the dial.

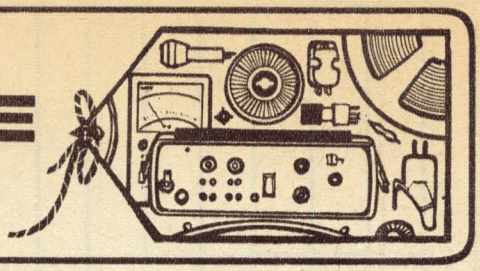
This completes the adjustment and alignment, and your new receiver should now be ready for full operation. Although it is of modest size and design, it is capable of quite a surprising performance. The selectivity is adequate for all normal listening and the overall frequency stability is rather better than we had originally hoped. Although the stability is not as good as an equivalent crystal locked front end, we have found that at all times, any given signal will stay within the pass band of the IF strip. This applies to the worst case, in the ranges 8-12MHz and 24-20MHz, where the local oscillator is on 16MHz.

As the design is very simple, it is reasonable to expect that there would be a number of spurious responses. This is so in practice but they usually fall in such a position as not to cause much if any, inconvenience. Also, because of the simplicity of the front end design, it is vital that the "RF Tune" control be set to the wanted frequency and not otherwise, which can result in an unwanted signal overriding the wanted one. However, a little practice is all that is required to get used to this situation.

And there you have it. We hope that this little receiver meets your needs and comes up to your expectations. In the near future, we hope to extend and modify the design so that the reception of CW and SSB signals will be possible, this involving the addition of a BFO. We also intend to elaborate on the AGC system and possibly add an RF stage. ■

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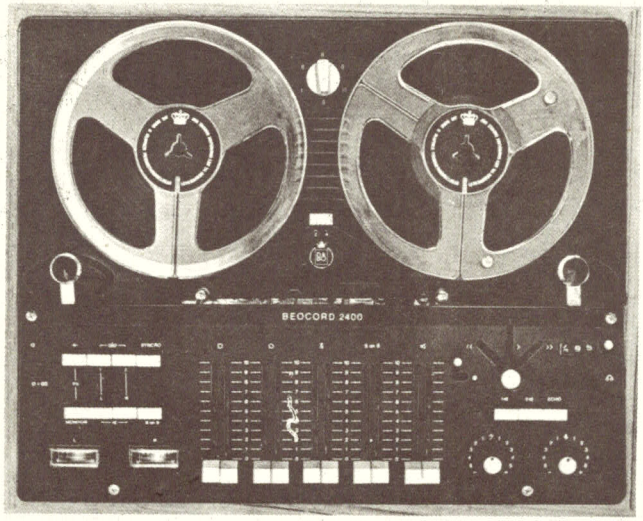
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Tape Transport

FAST TAPE MOTION: 170 sec.

TAPE COUNTER: 3-digit readout with push-button reset.

WOW AND FLUTTER:
Measured according to DIN 45.507.

Tape Speed	RMS Value	Peak Value
19 cm/sec.	< 0.07 %	< ± 0.1 %
9.5 cm/sec.	< 0.11 %	< ± 0.15 %
4.75 cm/sec.	< 0.18 %	< ± 0.25 %

TAPE SPEED VARIATION: Less than 1 %.

TAPE STOP: Foil-contact stop and photo-electrically controlled end-of-tape stop.

SLACK ABSORBER: Prevents jerks when tape is stopped and started. Tape twisting when using thin tapes (such as 3-play tapes) can be avoided by omitting to use the slack absorbers.

Amplifier

POWER OUTPUT: 2×10 watts RMS

POWER BANDWIDTH: 20–40,000 Hz.

FREQUENCY RESPONSE:
4.75 cm/sec.: 40–7500 Hz ± 2 dB.
9.5 cm/sec.: 20–13.000 Hz ± 2 dB.
19 cm/sec.: 20–18.000 Hz ± 2 dB.

EQUALIZATION: DIN 45.513 1969 = NAB 1965, RIAA 1965.

DISTORTION: Less than 3 % via tape, at zero VU-meter reading.
Better than 60 dB (measured according to DIN 45.500. BL-4-2.6).
Better than 65 dB (measured according to DIN 45.500. BL-4-2.5).

CHANNEL SEPARATION: Mono: Better than 60 dB at 1000 Hz and better than 50 dB at 10,000 Hz.
Stereo: Better than 55 dB.

ERASURE: 100 kHz oscillator provides erasure in excess of 70 dB. Entire tape is erased on stereo.
All measurements involving tape operation were performed with BASF LP 35 LH tapes with nominal data.

TONE CONTROLS:
Bass control range: +15 dB –20 dB at 40 Hz.
Treble control range: ± 10 dB at 10,000 Hz.

TRICK FACILITIES: Sound on sound, synchro-playback, echo.

PUBLIC ADDRESS FACILITY:
Amplifier can be operated without the motor running.

Semiconductors

TRANSISTORS: 48.

DIODES: 3. 1 rectifier – 1 thyristor.

External Connections

INPUTS:
Microphone: 50/200 ohms – 35 μV/1000 Hz.
Radio: 47 k ohms – 1.6 mV/1000 Hz.
Gramophone:
Low impedance: 47 k ohms – 2 mV/1000 Hz.
High impedance: 2.2 megohms – 75 mV/1000 Hz.

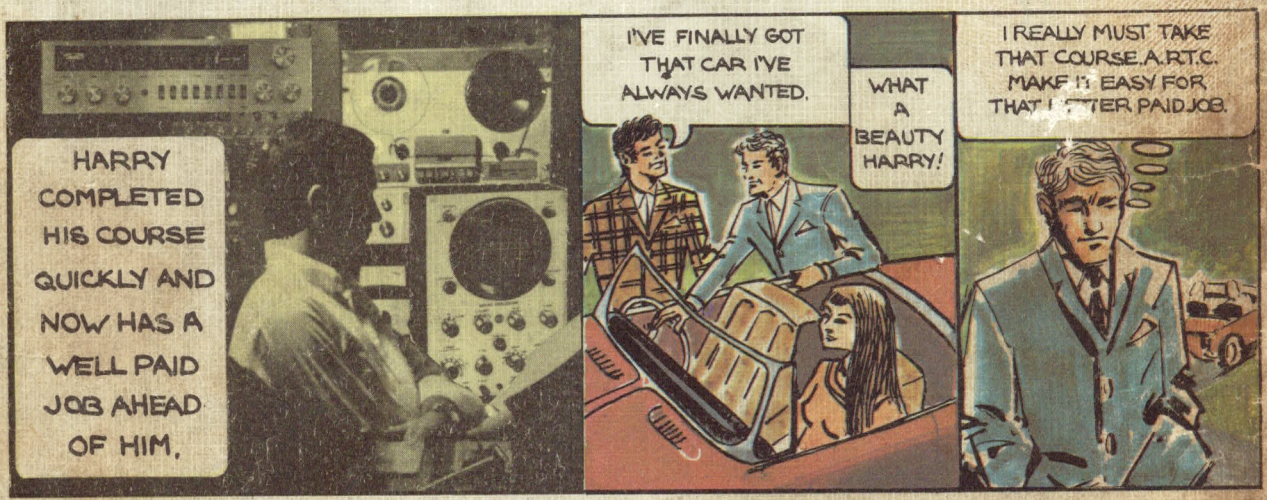
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Radio: 4.7 k ohms – 0.6 V max.

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