NOVEMBER 1971

ELECTRONICS Australia

50c* Fiji 60c Malaysia $2·40

MAKING COLOUR TAPES FOR STAFF TRAINING — Story Inside



BUILD OUR HOT SEAT FOR PARTY FUN

LEAK CHECKER FOR CAPACITORS

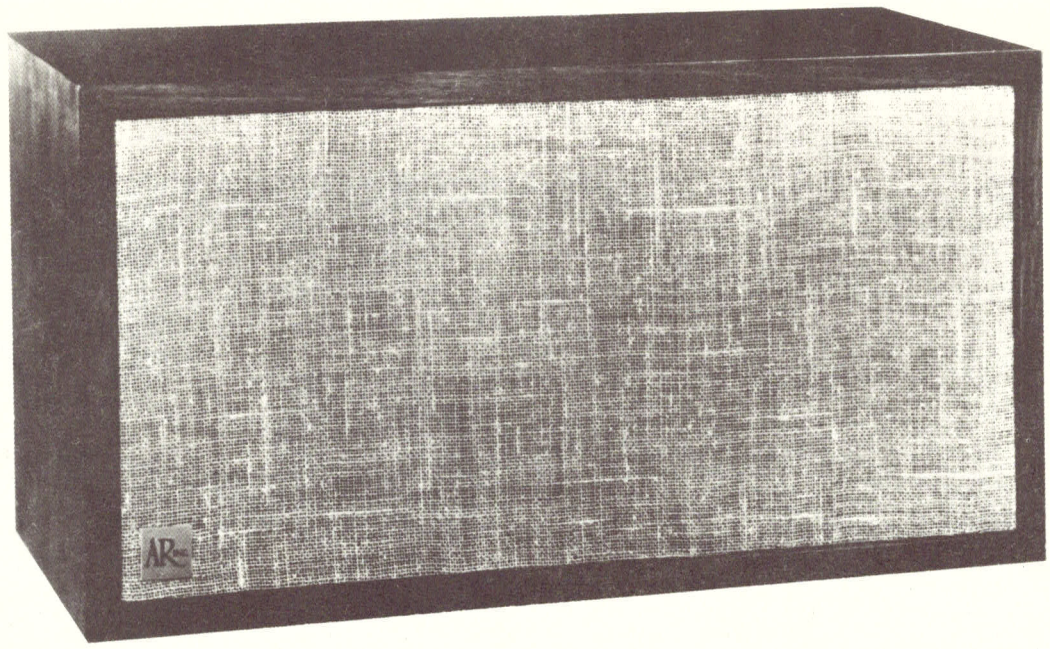
C-D Ignition for 6V Cars

Special Features For Beginners

WE REVIEW THE NEW CASSETTES

Registered for posting as a periodical — Category B.

The Critics' Choice



U.S.A.
"Hi Fi Stereo Review"
"This (frequency response) would be remarkable for any speaker, and in our experience is unique for any speaker in the price class of the AR-4x. We know of no competitively priced speaker that can compare with it."
"High Fidelity"
"To say that the AR-4 (forerunner of the AR-4x) is the best of this class would be to presume too much in the way of individual listener preference; it would perhaps be more to the point to say that we have heard nothing better, so far at least in this price class."
U.K.
"The Gramophone"
"The frequency response curves . . . were better than those published by the manufacturers . . . there is an audible output from 30 Hz upwards, the AR-4x reaches its full output of 50 Hz and sounds remarkably smooth through to the limit of audibility."
"Hi Fi News"
"Extreme bass down to 30 Hz, at adequate levels to enjoy organ pedal tone in domestic surroundings, was obtained with quite small harmonic production. High frequency performance was good on all scores – smoothness, lack of colouration and distribution . . . I like the AR-4x, and it's a good loudspeaker."
FRANCE
"La Revue des Disques"
"There has been nothing like it, and the least I can write is that this speaker is astonishing . . . a model speaker in its class."
HOLLAND
"Stereo Review"
"For speakers this size, the bass is incredible – no resonances, but beautiful, smooth, low bass notes – we would say the 4x is ahead of all other speakers this size – the 4x presents excellent value for money – ideal in an average sized room."
AUSTRALIA
"Australian Hi Fi"
"The subjective impression was of extremely clean, clear reproduction with a particularly low level of distortion, especially on transients. The frequency response is extremely good, being effectively ±6 DB from 55 Hz – 20 KHz and for such a small speaker enclosure this is unusually good. The quality of their reproduction when received in terms of price is still particularly hard to beat."

The workmanship and performance in normal use of AR products are guaranteed from the date of purchase: 5 years for speaker systems, 3 years for turntables, 2 years for electronics. These guarantees cover parts, repair labour and freight costs to and from the factory or nearest authorised service station. New packaging if needed is also free.

The AR catalogue and complete technical data on any AR product are available free upon request.

AR-4x recommended retail price $132.

AR

Acoustic Research Inc.
Massachusetts, U.S.A.

All AR audio equipment is on demonstration at the AR *Music Room* in the Sydney showrooms of the Australian Distributors.

Australian Distributors

W. C. Wedderspoon Pty. Ltd.

Showroom: 193 Clarence Street, Sydney. 29-6681

AR sound equipment may be purchased from the following Australian Dealers:

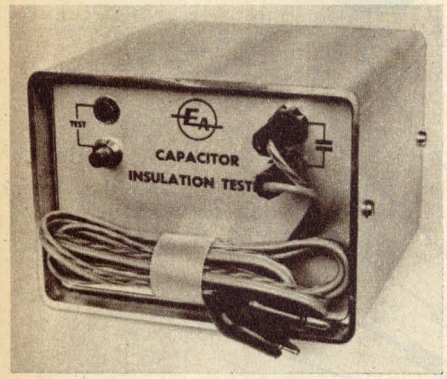
N.S.W.: Magnetic Sound, Sydney. Photo Hi-Fi, Sydney. Sydney Hi-Fi, Sydney. Paxton Photographics, Sydney. Milversons Hi-Fi, Chatswood. DynaStereo, St. Peters. Newcastle Hi-Fi, Hamilton. **VIC.:** Douglas Trading, Melbourne. **S.A.:** Sound Spectrum, Adelaide. **A.C.T.:** Home crafts, Canberra. **W.A.:** Alberts Hi-Fi, Perth. Leslie Leonard, Perth. **QLD.:** Brisbane Agencies, Fortitude Valley.

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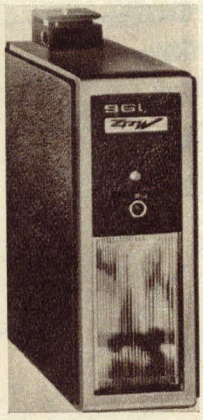
ELECTRONICS Australia

Incorporating "RADIO, TELEVISION and HOBBIES" and "MODERN WORLD"

ABC certified circulation in excess of 48,000 **VOLUME 33, NO 8**



CAPACITOR TESTER: A simple transistorised unit which performs a 500V leakage test on capacitors is described on page 38.



FLASHGUN USES OPTICAL FEEDBACK: This Metz flashgun type 196 features automatic control. An article starting on page 20 describes the principle of operation of this and other flashguns in the Metz range.

OLD PIPE ORGANS: A new era of popularity for the Wurlitzer and other pipe organs is being fostered by electronics. Read the story of the Wurlitzer starting on page 60.

On the cover

The final editing of video tape in the production of a TriStar training tape. Technical director Lou Boonshaft, foreground, blends visual images electronically to produce the master tape with proper visual impact along with opening music, narration, titles and other items. (See page 22.)

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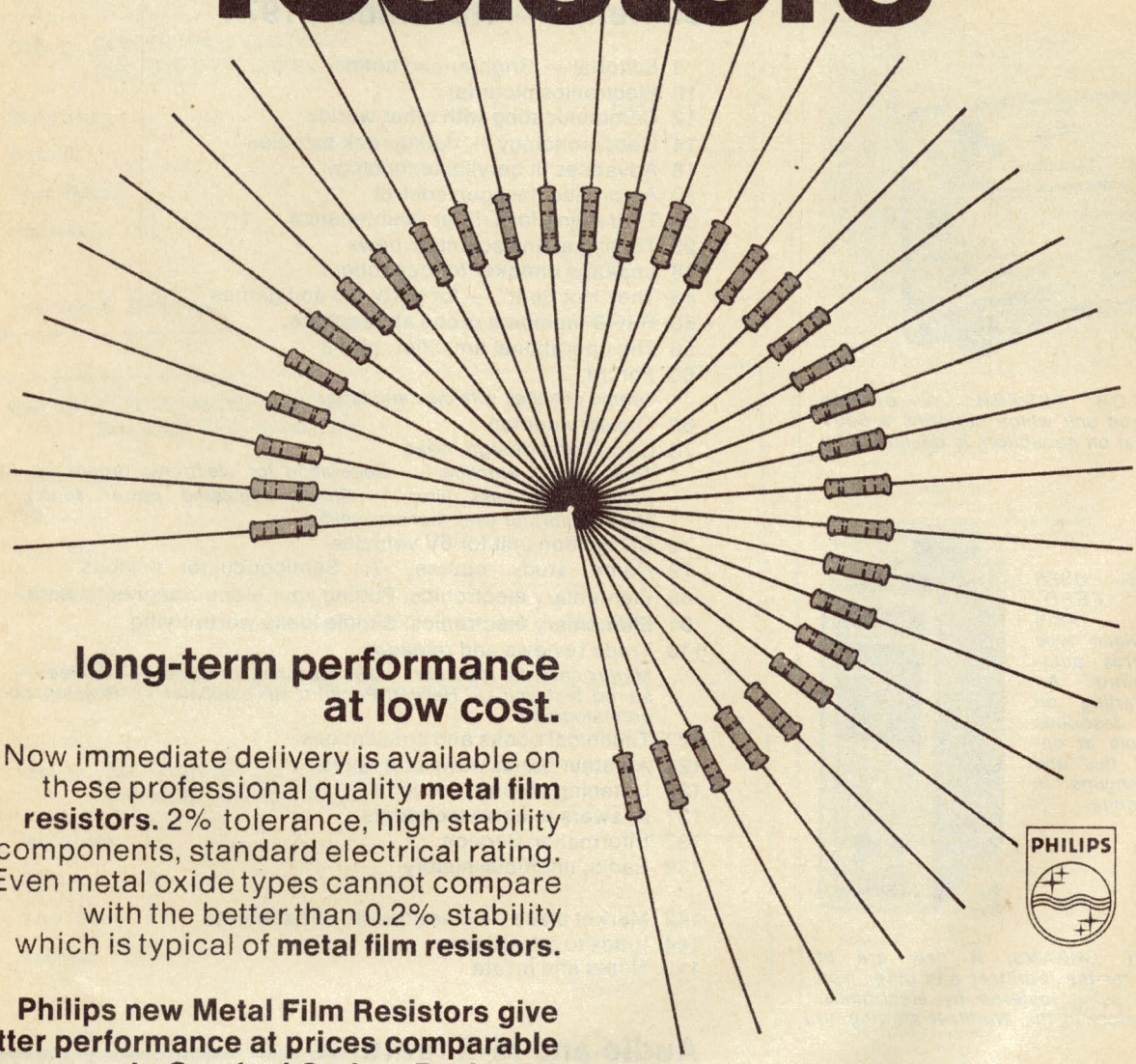
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New metal film resistors



long-term performance at low cost.

Now immediate delivery is available on these professional quality **metal film resistors.** 2% tolerance, high stability components, standard electrical rating. Even metal oxide types cannot compare with the better than 0.2% stability which is typical of **metal film resistors.**

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EDITORIAL VIEWPOINT

Brighter and better . . . .

The observant reader will surely have noticed that, over the last year or so, we have been giving "Electronics Australia" something of a facelift. Without making a fuss about it we have been implementing a program of change designed to increase both the value and the appeal of the magazine, without in any way prejudicing its long-established reputation for technical reliability. Reader response and support suggests that the program is achieving these aims.

In the October 1970 issue we started the "Electronics Pictorial" feature, to enable us to publish a greater proportion of the many interesting news pictures which come our way. Then in April this year we re-styled the front cover to give it a brighter aspect; at the same time we increased the width of the magazine so that our pages became closer to the classical "golden rectangle". We also began to vary the pickout colours, in the belief that the variety would contribute to greater visual interest.

In August we changed the name of our popular "A Reader Built It" feature to "Circuit & Design Ideas", and expanded its format to give it even greater appeal than before.

From the beginning of the year we have also been transferring over to a modern computerised phototypesetting system, which is helping considerably in our efforts to improve the appearance and readability of our pages — packed tightly as they are with information.

When financial pressures forced the closure of our sister magazine "Modern World", we took the opportunity of incorporating its elementary electronics section into "EA". Coupled with this, we have distributed to our younger readers over 3000 free transistors.

Along with these changes we have been re-balancing our content material, with the idea of broadening our technical scope and increasing the appeal of the magazine for readers with specific interests. One can't hope to please all of the readers all of the time, but we're certainly working at pleasing more of you more frequently!

As a further step in this program, we are introducing with the current issue an extension of our Reader Information Services. It is now an easy matter for readers to obtain further information about any product advertised in the magazine, simply by filling in the appropriate details on one of the coupons provided on the last page, and slipping it in the post to our office. We in turn will make sure that the coupons reach the appropriate firm.

This is by no means the end of our program to increase the value and appeal of the magazine. In fact we are now quite deliberately adopting a policy of continuous re-evaluation, to enable us to adapt the magazine more rapidly to the accelerating changes taking place both in the electronics industry and our society at large. In this context any helpful suggestions from readers will be given careful consideration.

At a time when many people within the industry are finding the going a little tough, we are particularly conscious of the part the magazine can play in emphasising the achievements of which the electronics industry can be justifiably proud.

Jamieson Rowe

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INSTROL TURNTABLE VALUE!!

J.H. TURNTABLE (complete)



This outstanding turntable value consists of:—

(A) J.H. TURNTABLE — Belt drive, synchronous motor, unmeasurably small rumble, wow and flutter of better than 0.04%, negligible hum radiation, with 12" diameter of platter.

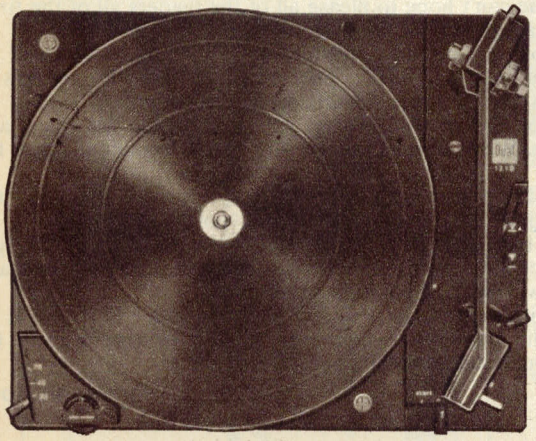
(B) LUSTRE ST510D ARM — A high precision universal arm, stylus pressure is adjusted by calibrated counterweight. Oil damped cueing lift is fitted.

(C) A.D.C. 220X — Magnetic cartridge. Tracking force 1½ to 3 grams, extremely linear and smooth frequency response.

(D) INSTROL 45 STAND — This aesthetically designed player stand is available in either oiled teak or walnut.

ALL THE ABOVE FOR ONLY $86.00 (Hinged perspex cover, $11.30 extra)

DUAL TURNTABLE (complete)



This outstanding turntable value consists of:—

(A) DUAL 1210 (4 pole) — Automatic turntable. One-piece cast aluminium tone arm, which combines extremely low dynamic mass with great torsional rigidity. Continuously variable stylus force 0 to 5.5 grams. Hydraulic Cue control. Pitch control, adjustable over one semi-tone. Three speeds.

(B) MG6 CARTRIDGE — Magnetic cartridge, manufactured by Audio Technica, with frequency response of ± 2.5dB from 20-20,000 c.p.s.

(C) INSTROL 35 STAND — This attractive player stand is available in either oil teak or walnut.

LIMITED STOCKS ONLY

ALL THE ABOVE FOR ONLY $74.00 (Hinged perspex cover, $11.30 extra)

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Please send me your complete Hi-Fi Catalogue and Price List. I enclose herewith postage stamps or money order to the value of 50c.

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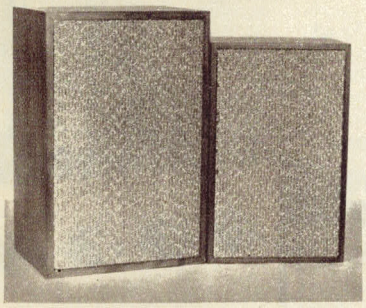
..... **P.C.** ...

E111

INSTROL SPEAKER SYSTEMS

All the systems below are available in kit form. The cabinet kits come in either unpolished Queensland Maple veneer or unpolished teak veneer. All kits are complete, and include speakers, crossover networks (where applicable), cabinet kits, grille cloth and innerbond.

NEW MAGNAVOX 8-30 SYSTEM



Featured in "E.A." Jan. 1971. It handles 30 watts RMS, features a new high performance 8" speaker, two 3" tweeters, and is available in cabinet 20⅞" x 12⅞" x 8⅞" (1 cu. ft.) or 23⅞" x 15½" x 10⅞" (1.6 cu. ft.). Available in teak or maple veneer.

COMPLETE SYSTEM

Kit of Parts .. .. $46.00 (1 cu ft), $58.00 (1.6 cu ft)
Built and Tested . $60.00 (1 cu ft), $76.00 (1.6 cu ft)

SEPARATE COMPONENTS

Enclosure kit (1 cu ft) .. $19.00 (maple), $19.50 (teak)
Enclosure kit (1.6 cu ft) .. $31.50 (maple), $33.00 (teak)
Built Enclosure (1 cu ft) . $32.00 (walnut), $33.50 (teak)
Built Enclosure (1.6 cu ft) $48.50 (walnut), $51.00 (teak)

ECONOMY BASS REFLEX SYSTEM

"E.A." design, Nov. 1970, consists of a Rola C8MX speaker in cabinet 20" x 11" x 9". Ideal for low wattage.

COMPLETE SYSTEM

Kit of Parts (teak or maple) $26.00
Built and Tested (teak or walnut) $39.00

SEPARATE COMPONENTS

C8MX speaker only $9.05
Enclosure kit .. .. $16.50 (maple), $17.00 (teak)
Built Enclosure .. .. .. $29.00 (maple), $30.50 (teak)

WHARFEDALE SPEAKER SYSTEM KITS

The Wharfedale Super Linton, Melton and Dovedale III are now available as build-yourself kits, featuring INSTROL quality cabinet kits in choice of maple or teak veneer.
The Super Linton kit employs an 8" and 3" speaker, frequency response 40-17,000Hz, cabinet 21" x 11½" x 9½". 15 watts RMS
The Melton kit employs a 12" bass and a tweeter, cabinet 22¾" x 13" x 10". 25 watts RMS.
The Dovedale III kit employs a 12" bass, 5" mid-range and 1" tweeter. Cabinet 28" x 15½" x 10". 35 watts RMS.

COMPLETE SYSTEM

Super Linton kit (Unit 3) $49.00
Melton kit (Unit 4) $93.00
Dovedale III kit (Unit 5) $133.00

SEPARATE COMPONENTS

Unit 3 encl. kit .. .. .. $17.00 (maple), $19.00 (teak)
Unit 4 encl. kit .. .. .. $25.50 (maple), $27.00 (teak)
Unit 5 encl. kit .. .. .. $34.00 (maple), $35.50 (teak)

MULLARD MINI SPEAKER SYSTEM

Employs a Magnavox 6WR and a 3TC tweeter, has no crossover network; is ideal for low wattage. Cabinet is 14½" x 8⅛" x 8¼".

COMPLETE SYSTEM

Kit of Parts $27.50
Built and Tested $35.00

SEPARATE COMPONENTS

Enclosure kit .. .. .. $10.50 (maple), $11.00 (teak)
Built Enclosure .. .. .. $16.50 (walnut), $17.00 (teak)

PLAYMASTER ONE POINT THREE SYSTEM

Featured in Electronics Australia, July, 1969, this system employs a Rola C8MX speaker with 3DX tweeter. Power handling capacity of 10 watts RMS. Cabinet 22" x 13" x 10¾".

COMPLETE SYSTEM

Kit of Parts $39.00
Built and Tested $52.00

SEPARATE COMPONENTS

Enclosure Kit .. .. .. $21.50 (maple), $22.50 (teak)
Built Enclosure .. .. .. $34.00 (walnut), $35.50 (teak)

INSTROL
HI-FI & ELECTRONICS CENTRE
91A YORK ST., (between King & Market Sts.), SYDNEY, N.S.W. 2000. Phone 29 4258

Please send me the following speaker systems and/or turntable systems and/or perspex covers. These will be sent by road transport or passenger rail, freight payable on receipt of goods

.... at $ ....
.... at $ ....
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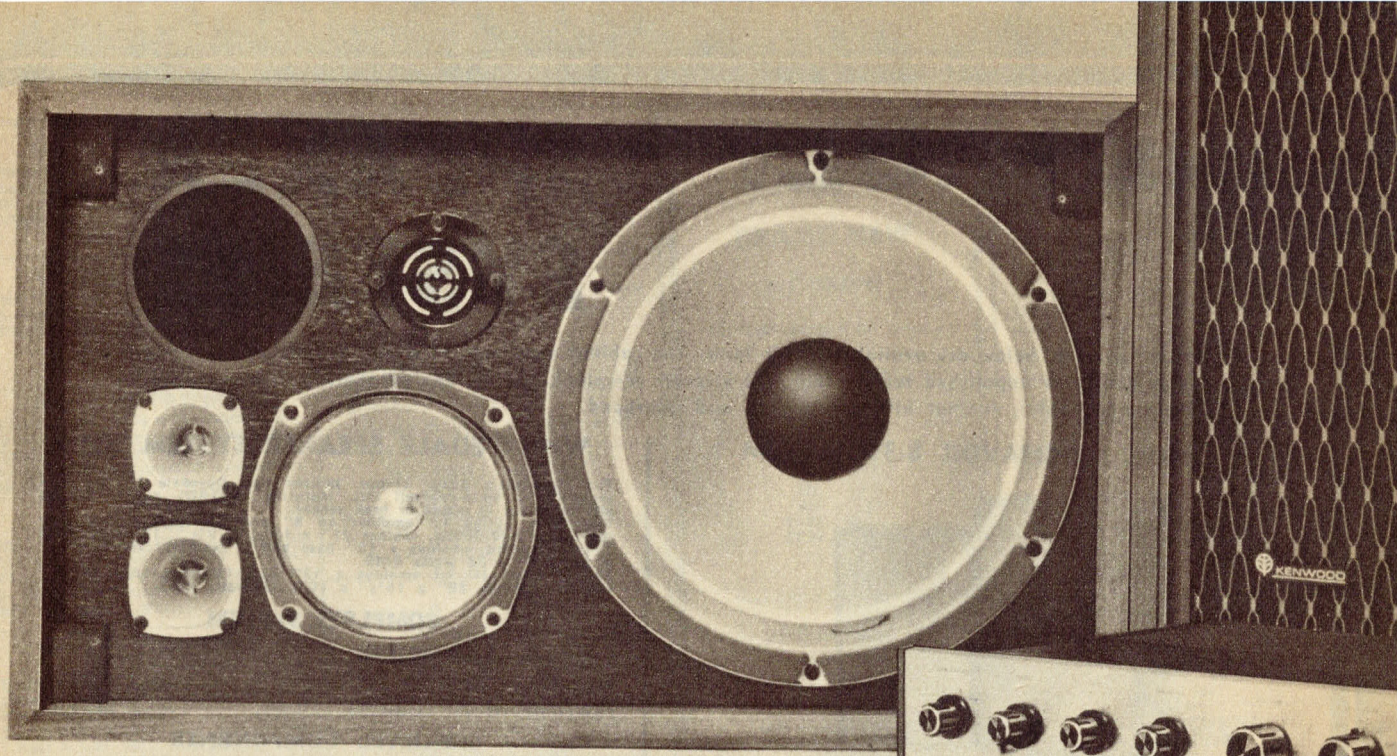
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DAMPED PIPE DUCT 4-WAY 5-SPEAKER SYSTEM **KL-5080**

80-WATT (IHF 4Ω)
SOLID STATE STEREO AMPLIFIER KA-4002

KENWOOD's Compact Yet Powerful Hi-Fi Stereo Component System Will Initiate You Into The Irresistible Pleasure of Creating YOUR Sound

KENWOOD's record playing system is a promise of many hours of listening pleasure. The KA-4002 is a solid state stereo amplifier, which boasts 80 watts and the least distortion, featuring accurate tone control. At a click of the switch, the tone can be varied precisely by 10dB at 100Hz and 10,000Hz. The KP-3021 is a stereo turntable which features a 24-pole synchronous motor and perfectly automatic operation. The KL-5080 is a 70-watt damped pipe duct 4-way, 5-speaker system which features a specially-built 3-step tone selector for panoramic tone variation. Don't hesitate. You can't enter a new world of true sound music too early. Get KENWOOD's true sound of music.

SPECIFICATIONS OF KA-4002

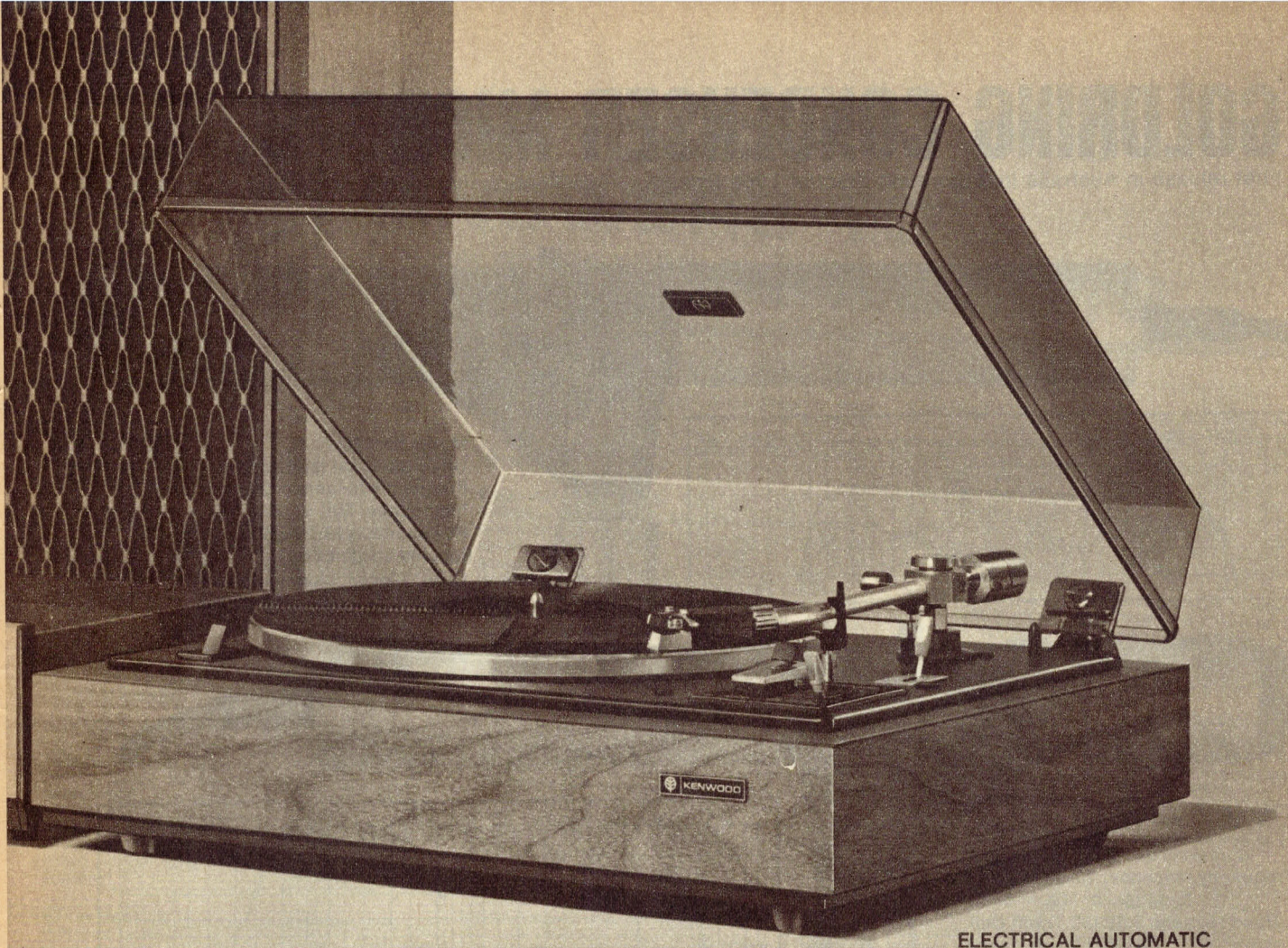
Dynamic Power (IHF)	80 watts (both ch. at 4 ohms)
Continuous Power Output	33/33 watts (each ch. at 4 ohms)
Intermodulation Distortion	0.5% (at rated)
Frequency Response	15-50,000Hz ±1.5dB (main input)
Power Bandwidth (IHF)	18-30,000Hz
Dimensions	13"(W), 4-5/8"(H), 9-7/16"(D).

SPECIFICATIONS OF KP-3021

Drive	Belt Drive System
Wow-Flutter	Less than 0.08%
Special Mechanism	Auto-in Auto-cut Auto-return Auto-repete Disc-size selector Manual-in system
Dimensions	18-1/8"(W), 7"(H), 16-1/8"(D).

SPECIFICATIONS OF KL-5080

Mounted Speakers	12" free-edge type woofer×1 6-1/2" cone type mid-range×1 Horn type tweeter×2 1-1/4" metal cone type super tweeter×1
Maximum Input	70 watts (Full Range)
Frequency Response	30Hz to 22,000Hz
Dimensions	15"(W), 25-1/2"(H), 11-5/6"(D).



ELECTRICAL AUTOMATIC
STEREO TURNTABLE **KP-3021**

the sound approach to quality

KENWOOD

TRIO ELECTRONICS, INC.

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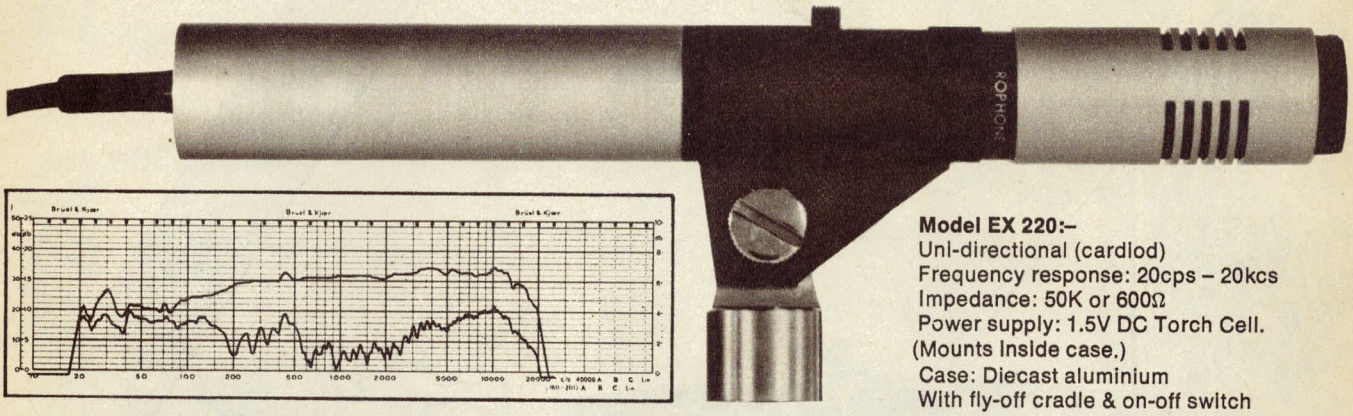
Send me information on KENWOOD Hi-Fi system & name of nearest KENWOOD retailer.

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GOLDRING CONDENSER MICROPHONES

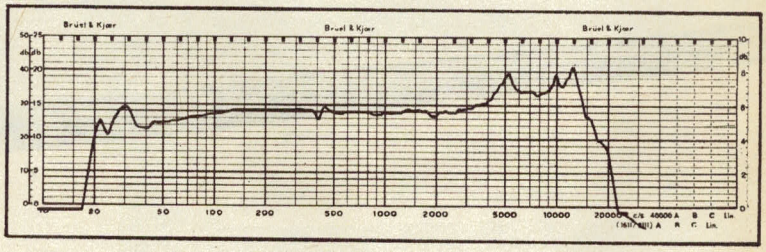
First release in Australia incorporating Electret Type System — excellent quality for both recording and stage use.



Model EX 220:–
Uni-directional (cardiod)
Frequency response: 20cps – 20kcs
Impedance: 50K or 600Ω
Power supply: 1.5V DC Torch Cell.
(Mounts Inside case.)
Case: Diecast aluminium
With fly-off cradle & on-off switch



Model EX 193:
Omni-directional
Frequency response: 20cps – 20kcs
Impedance: 50K or 600Ω
Power supply: 1.5V DC Torch Cell.
(Mounts inside case.)
Case: Diecast aluminium
With fly-off cradle & on-off switch





Stereo Headphones

◄ Goldring Ms450-V:

Professional type with separate volume controls enabling sounds to be adjusted to the optimum level. All outside noise is eliminated by thick soft earpads. Adjustable padded head band. Frequency range: 20cps – 20kcs. Matching impedance 4-16 ohms, maximum input 0.5W. Cord length 15 feet. Weight 16.7 ozs.

Goldring MS45-V: ►

Professional type. Due to the employment of volume controls incoming sound waves can be adjusted as required. All outside noise is eliminated by thick soft earpads. Adjustable padded head band. Frequency range 20cps – 18kcs. Matching impedance 4-16 ohms, maximum input 0.5W. Cord length 15 feet. Weight 16.7 ozs.



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Nothing-anywhere compares with this!

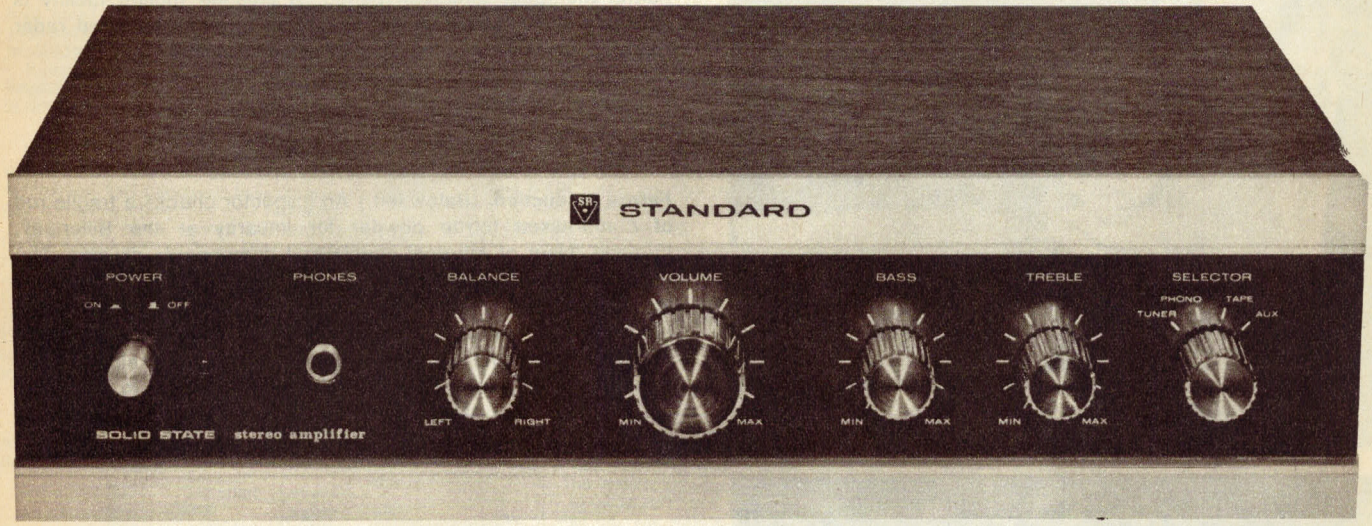
THE

STANDARD 158E

25 watts solid state stereo amplifier.
For Magnetic or Ceramic Cartridge.

IMAGINE ALL THESE FEATURES FOR ONLY

$95



A magnificent stereo performer . . . 158E is a compact, solid state 18 transistor stereo amplifier with music power of 25 watts (IHF) and low distortion ratio. Designed compactly, the set lends itself to ideal arrangement with other units and provides superb stereo sound.

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- ✓ Balance control.
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- ✓ Stereo 'phone jack for personal listening.
- ✓ Selector switch.
- ✓ Pilot indicator lamp.
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Continuous power RMS...7.5/7.5 watts at 8 Ohms THD 1%
Harmonic Distortion . . . less than 0.3%
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Signal to noise ratio . . . AUX 70dB, MAG 60dB
Damping factor . . . 20 at 8 Ohms.
Bass control . . . ± 10dB at 100 Hz.
Treble control . . . ± 10dB at 10KHz.
Inputs . . . MAG 3 mV, CER 200 mV. AUX 100 mV, Tape P.B. 500 mV, Tuner 100 mV.
Auxiliary Circuit . . . REC/PB Din socket Power Voltage . . . 120/240 v (switchable) 50/60 Hz.

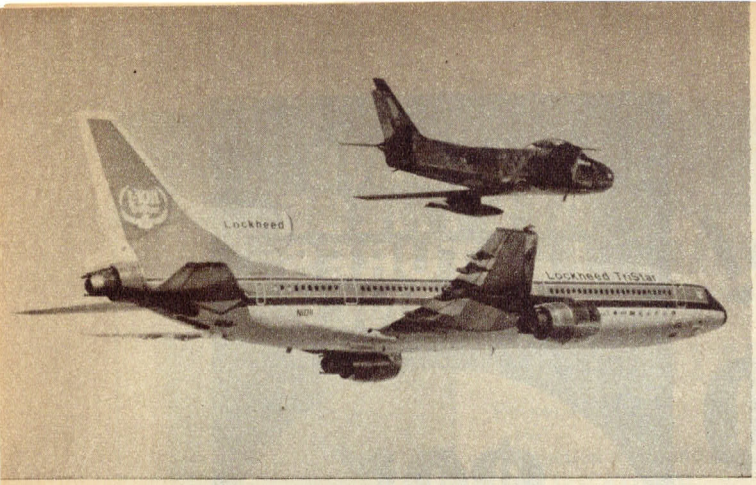
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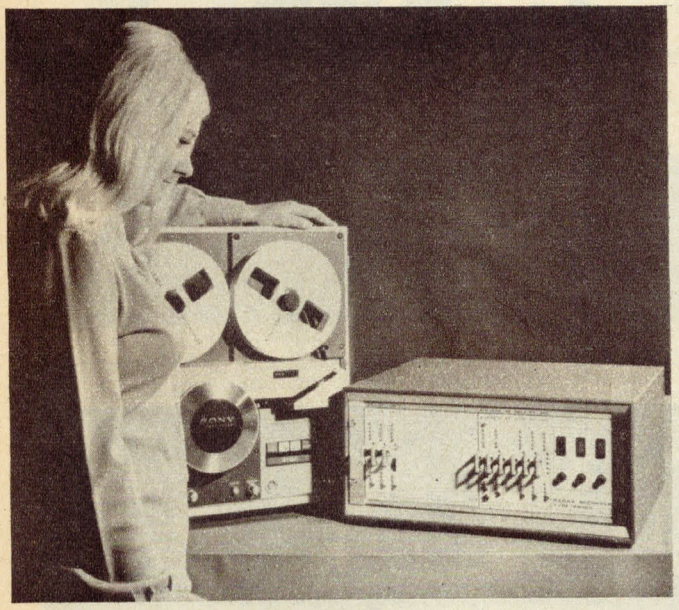
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TriStar tests. (Top left.) A Lockheed L-1011 TriStar jetliner dwarfs a Chase plane during a test flight near the company's plant at Palmdale, California. In flight trials the Rolls-Royce powered TriStar has already reached its peak altitude of 42,000ft, well above its cruising altitude in airline service. It also has flown at a top speed of 660mph (equal to Mach 0.95), 100mph faster than it will cruise in airline service. Other highlights of the flight program include a take-off at a maximum weight of 404,570lb and a maximum flight time of six hours 41 minutes.

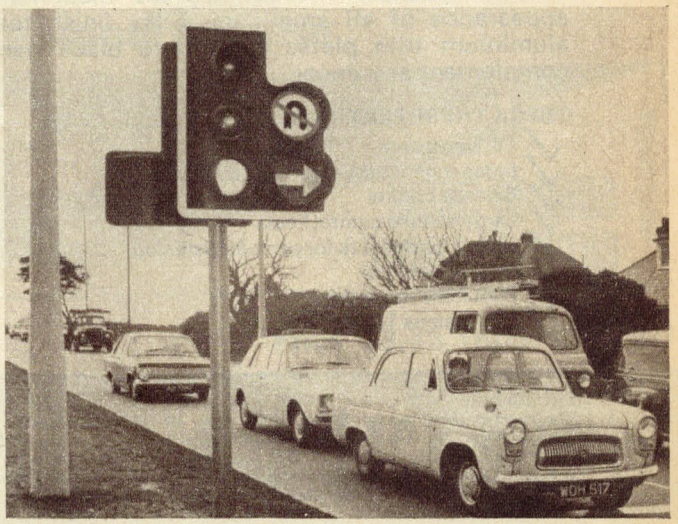


Radar recorder. (Centre.) EMI Electronics, of the UK, has introduced a new version of its RR100 radar recorder based on a range of off-the-shelf modules to cater for wide system requirements including incident analysis, operator training, simulation, etc. The equipment records continuously primary or secondary radar signals irrespective of pulse repetition frequencies and also enables digital information to be recorded during the radar interscan period. A stopped motion facility is available which allows a still picture of any one selected radar return to be displayed on an oscilloscope for examination.

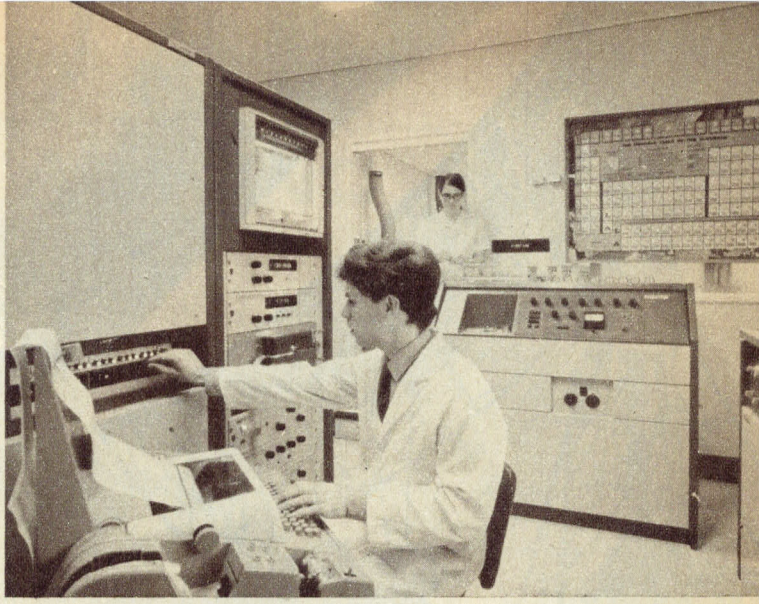


Ferrite production. (Below left.) An inspector checks a fragile rod of compressed ferrite powder for linearity at the Billericay, England, plant of Marconi specialised components division. The rod is about 8in long and 1/3in diameter, and has a hole only 1mm in diameter running through the centre. Earlier, the rod was compressed hydraulically in a modified 6in naval gun. It will next be heated to a high temperature when it will shrink by about 20 per cent. After that process, the rod will be hard enough to cut glass, yet the hole must still be straight and the diameter accurate to within 0.0015in.

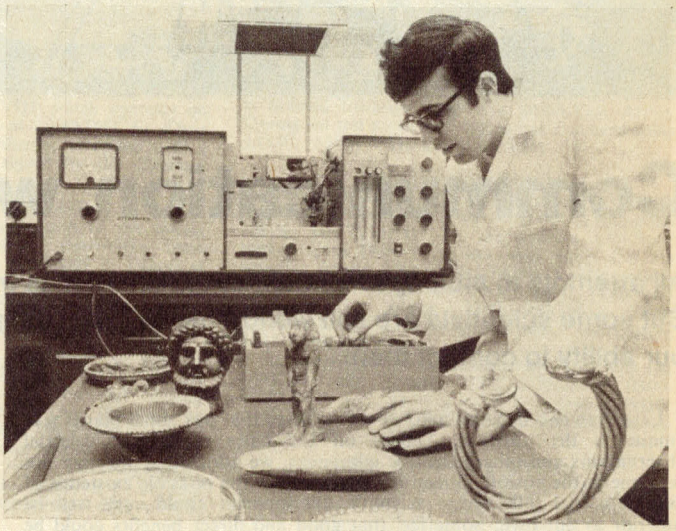
High intensity signals. (Below right.) New high intensity traffic signals, installed at Poole in southern England, are almost 10 times brighter than conventional signals. Built by the traffic division of the Plessey Electronics group, the light output has been increased by using lenses (made of acrylic plastic), and low voltage tungsten halogen bulbs with parabolic reflectors.



ELECTRONICS PICTORIAL



Mineral analysis. (Top right.) A fully integrated computer-controlled x-ray spectrometer was installed last year at the central laboratory of the Colonial Sugar Refining Co at Pyrmont, NSW, primarily for the analysis of mineral deposits. It has already proved a boon to the company for both qualitative and quantitative analytical work. The basic system consists of an x-ray fluorescence spectrometer, an 8K 16-bit computer and software, an associated power generator and electronic interface units. All the equipment was supplied by Philips Industries Ltd.

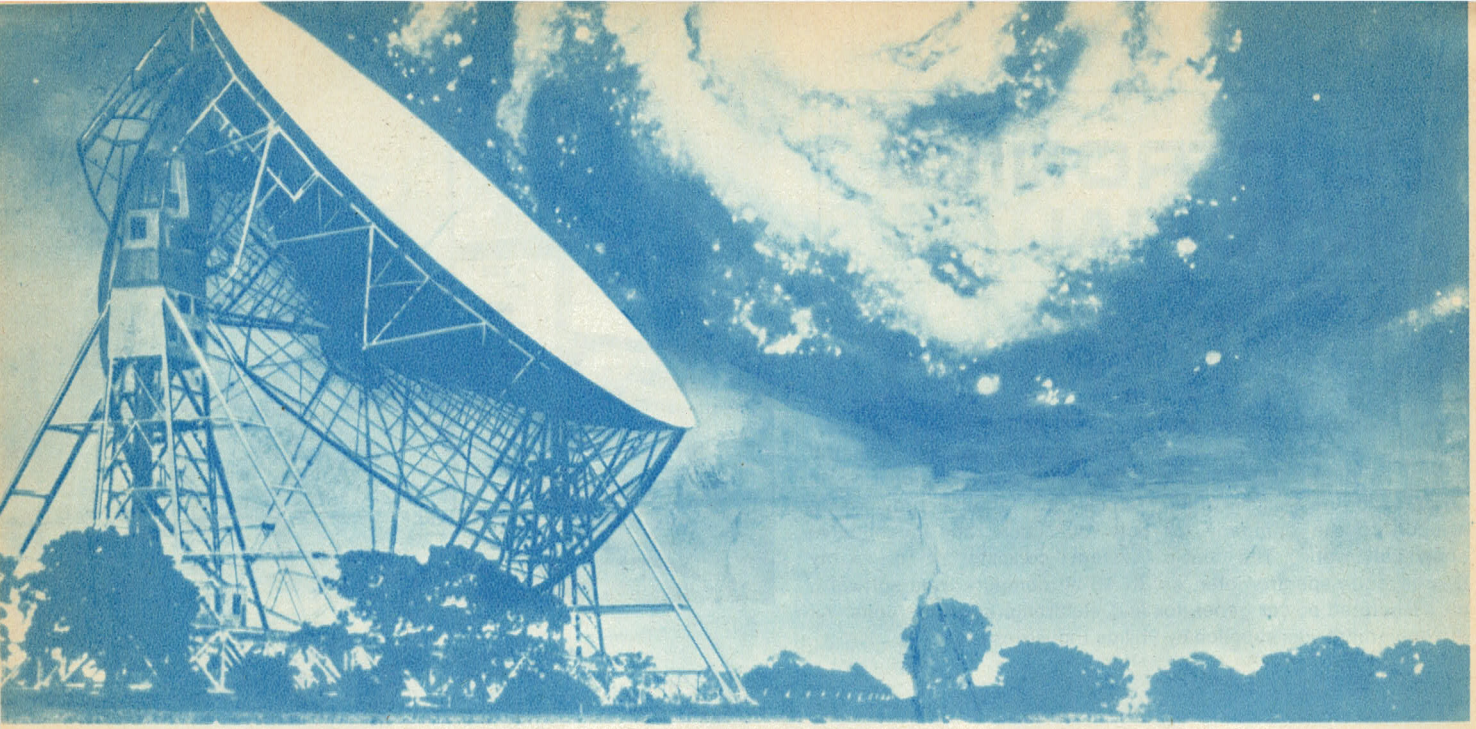


Checking antiques. (Centre.) Dr Michael Hughes, of the British Museum research laboratory, uses a Rank Autospec atomic absorption spectrophotometer to check the authenticity of antique objects. Spectroscopic analysis of a tiny sample of the object can show within minutes whether it has been artifically aged. The Autospec determines the different concentrations of trace elements in the sample. At the museum, the instrument has also been used for analysing flint axe-heads from Britain's Neolithic prehistory. (Rank Precision Industries Ltd, Analytical Division, Hilgar & Watts, 31-33 Camden Road, London NW1, England.)

Police facimile. A new facimile system, which sends from a fixed station to any number of radio-equipped mobile vehicles simultaneously, enables mobile police patrols in Bristol, England, to receive visual information from their base stations while on the road and in conditions when speech communications may be unsatisfactory. Identikit pictures or typewritten information is fed into the base unit (below right) to be transmitted in the form of FM pulses. The printer in the mobile unit turns on automatically when a signal is received, and prints out the information on electro-sensitive paper (below).







Communication with other worlds -

All attempts to pick up intelligent communications from the stars have failed so far. But some scientists are still wondering about intelligent beings on other worlds and our ability to contact them.

Less than two decades ago, we still insisted that our small planet was unique in the universe. Today, on the basis of careful celestial observations and other scientific inferences, we admit that we may not be alone in the cosmic immensity and concede the possible existence of extraterrestrial folk whose scientific development could very well be superior to our own. Some feel that good and direct benefits could be obtained by getting in touch with them.

These speculations have rekindled an interest in interstellar communications technology. Principal attention is directed toward electronic aids because of the limitations of optical devices.

However, we have massive problems here and approaches are not uniform. Some scientists, for example, like to look for any non-Gaussian characteristic in signals received by radio telescopes. Others think that the natural calibration frequency of the universe, the 21cm hydrogen line which radiates at 1.420GHz, should be looked at more intensely. Still other investigators have suggested different approaches altogether.

Thoughts on interstellar communications have a long and continuous history. It was the modern world's first philosopher, the Greek scholar Thales of Miletus (636-546 BC), who proposed that the stars may be other worlds. But it was his student, Anaximander, who apparently was the first to hint that the number of worlds is infinite, some in the process of birth, some dying.

Later, in our own time, thoughts turned to means of communicating with non-terrestrials. The German mathematician Karl F. Gauss proposed that wide lanes of forest be planted in Siberia, forming a huge right-angled triangle. An Austrian astronomer, J. J. von Littrow, suggested that geometric canals be dug in the Sahara and be lit with kerosene at night. Charles Gros, a Frenchman, conceived the idea of a vast mirror to reflect sunlight toward Mars.

More realistic approaches were suggested following the discovery of radio waves. One of the early pioneers in this field, Nikola Tesla, claimed to have received signals of interstellar origin shortly after setting up his electrostatic laboratory in Colorado Springs, Colorado and equipping it with a 200ft transmission tower.

Edison reported a somewhat similar experience. However, a massive attack, in the form of ridicule and scepticism, was made against both Edison and Tesla which reduced them to silence.

At the same time, some radio observations were made which seemed to imply (as interpreted today) that the Earth is visited by transponding communications satellites of extra-terrestrial origin. These so-called "radio mysteries" were first noted in 1927 and expressed themselves as signal delays. The principal investigators attributed the phenomenon to odd behaviour of the Aurora Borealis and filed it as a scientific curiosity. We will present the facts, since they form a strong argument for various hypotheses.

During the summer of 1927, the Norwegian radio engineer Jorgen Hals of Bygdo, Oslo was listening to telegraphy transmissions from the Dutch short-wave transmitting station, PCJJ at Eindhoven. At the time he heard the telegraph signals he also heard strange echoes. One was the usual echo which goes around the world with an interval of about 1/7 second, as well as a weaker echo emerging about three seconds after the principal echo had disappeared.

This matter was brought to the attention of Professor Carl Stormer who, in turn, observed the phenomenon himself and then contacted Dr van der Pol at the Philips laboratories in Eindhoven.

On October 11, 1928, van der Pol and his assistant arranged to have the transmitter staff send a series of three short dots in rapid succession, sent every 30 seconds between 8 pm and 9 pm local time and comprising a total of 120 signals.

Thirteen echoes were observed, the delay times between the echoes and signals being 8, 11, 15, 8, 13, 3, 8, 8, 8, 12, 15, 13, 8, and 8 seconds. The transmissions were conducted at a wavelength of 31.4 metres; the echoes being weak, slightly blurred but plainly audible and, most important, of the same frequency.

This odd phenomenon came and went, rather than existing continuously. The echoes were again observed in 1934 during a series of tests organised by the World Radio Relay League and inaugurated by Sir Edward Appleton. This time the observers were British radio amateurs who worked the frequencies of 9.5 and 6.7MHz. Similar echoes have also been reported by Drs Galle, Talon, and Ferrie.

To make a long scientific detective story short, it was in the early 1950s when the fact of these echoes was re-examined and that the theory of extra-terrestrial-type interference was advanced. Here, as illustrated in figure 1, reviewers assumed the intermittent existence of an interstellar communications probe whose job it was to (a) monitor solar systems for intelligent life, and (b) retransmit radio-frequency emanations from such life (us!) to a distant "home world". Again, the monitoring probe seemed to come and go. In 1947, 1948, and 1949, Drs Budden and Yates attempted to observe long-delayed echoes at Cambridge, England but without success.

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Critics of the interstellar transponder hypothesis became less vocal when another observation was made. This time it involved a television signal that had been delayed for over three years.

At 3.30 pm on September 4, 1953, C. W. Bradley of London, England, picked up on his TV set the American call letters KLEE-TV. Later that month, and various times thereafter, the same letters were observed on TV screens at Atlantic Electronics Ltd of Lancaster, England. There is, of course, nothing unique about freakish long-distance TV reception. The strange fact is that this signal had been sent from Houston, Texas three years earlier and had never been transmitted again up to the time it was received in England. In July, 1950 KLEE-TV became KPRC-TV and no other TV station on this planet has broadcast the call letters KLEE-TV since. (*Of course, there is the possibility that some illegal or amateur broadcaster could have transmitted these call letters. — Editor.*)

Some insisted that the signal was stored, together with scanning information and correct video signals, in a "plasma cloud" which, somehow and for reasons unknown, released this data in a broadcasting mode for all to see; or perhaps it was due to the interstellar transponder postulated above.

In 1959, the prospect of interstellar communications via radio was supported by Drs Cocconi and Morrison, both then at Cornell University. However, because of absorption and scattering of waves by interstellar gas clouds and nebula, plus similar attenuations by atmospheres of planets of interest, the effective range of radio-wavelengths one could use was very limited.

If, for example, wavelengths longer than 300 metres (1MHz) were used, they would be absorbed by the interstellar medium. Further, since

is it possible?

by L. George Lawrence

it must be assumed that given planets have ionospheres of one type or another, only wavelengths of less than 10 or 15 metres are likely to pass through and reach the planets' surfaces. After considering the effects of cosmic radio noise, things were narrowed down to wavelengths between 3 and 30cm, finally to 21cm (1.420GHz).

The reason was that Nature itself provides a fixed, "standard" calibrating frequency in the spectrum of interest to communicators: the precession frequency of hydrogen atoms. Since hydrogen is the most abundant thing in the universe, we can assume that 1.420GHz is the fundamental frequency of Nature and known to technical interstellar societies.

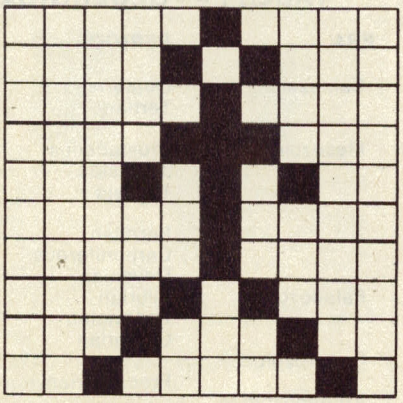
Unfortunately, the 21cm channel is a noisy one. In order to recognise data contained in such a carrier as an artificial signal, the thing to assume is that it might have a narrow-band character and would vary with time. A signal sequence might be in the form of dots and dashes, giving a binary counter-input pattern such as that shown in figure 2. The ones given at (A) have been expressed as dark spaces in the readout matrix (B), while the zeros are entered as light spaces.

While little more than a two-dimensional pattern, a readout of this

Figure 2. Interstellar signals could take the binary form shown here for the conveyance of intelligent information.

0000010000
0000101000
0000010000
0000111000
0001010100
0000010000
0000010000
0000101000
0001000100
0010000010

(A) BINARY INPUT



(B) READOUT MATRIX

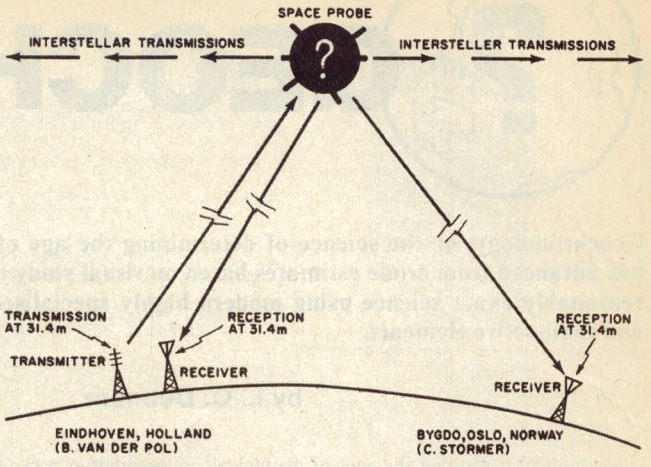


Figure 1. Mysterious radio echos were heard as early as 1928. Some researchers suggested that a space probe may have been responsible.

basic type would contain an enormous amount of information. First, *they* use a decimal system for their purpose. Next, they are bipeds — just like ourselves. And that, in turn, would allow us to reason that there might be similar traits in behaviour, thinking, and expressiveness. Further, being intelligent beings, they would not overwhelm us with complex dimensions in their communications simply because we couldn't understand them. Again, the 21cm hydrogen line appears to be a logical choice for data transport because of its universality.

Subscribing to the 21cm channel theory, Dr Drake's famous "Project Ozma" used the 85ft radio telescope at the USA's National Radio Observatory during the months of May, June, and July, 1960 for actual listening attempts.

The instrument employed two horns and a semiconductor-diode parametric amplifier as the first amplifying stage. During the entire search for intelligent signals, a bandwidth of 100Hz was used. One of the two antenna horns received radiation from a small area near a star of interest (where one might expect to find a transmitting planet). Entering the other horn was radiation from a neighbouring region of the sky. Using electronic antenna switching and synchronous detection at the receiver, a good degree of sensitivity was obtained — but, unfortunately, no results.

Today, many astronomers still share the conviction that deep-space searches for intelligent life should be concentrated on stars which are less than 15 or so light-years away from our solar system.

Interstellar spaceflight is technically feasible, even though it is an enormously expensive and difficult undertaking. Perhaps this has been developed to absolute perfection by extraterrestrial societies whose worlds were old when the Earth was young. Thus, if we assume scientific developments a million or billion years ahead of our own, an altogether different approach to interstellar communications and physical commerce emerges.

Some local field investigations tie in with such and similar considerations. The objective is a geophysical definition of dated American Indian legends which imply the presence of celestial beings within or near tribal systems that have long ceased to exist. Unavoidably, stories of this kind smack of UFOistic hocus-pocus and can be considered valid only after their contents have been verified by impartial scientific methods.

The Yuman-speaking Mohaves, Cocopas, Halchidhomas, Yumas, and Maricopas, together with the Chemehuevis of the Utaztecan language family, all lived, at one time or another, along the lower Colorado River and shared certain legends of space and time. The Chemehuevis, in particular, originally came from the eastern Mohave Desert in California and it was in this approximate region that the legend of "the mountain of the bearded god" was born.

According to the story, a "humming star" came from the sky, landed in the desert near a dry lake and — as Indians watched with great fear from a respectful distance — dug in and triggered massive lava flows from what are now known as the Pisgah and Amboy craters. A short time later, strange men were seen after whom the *mountain of the bearded god* was named. This is an outrunner of the Cady Mountains and, if looked at from the spot the Indians once stood, shows a distinct forehead, a nose, and a small mouth with a massive beard.

The question is: Was a real interstellar experience witnessed by an unsophisticated people or is it mythology and nothing but?



GEOCHRONOLOGY

Geochronology, or the science of determining the age of geological specimens, has advanced from crude estimates based on visual study of rocks and fossils to a reasonably exact science using modern highly specialised electronic equipment and radioactive elements.

by L. C. Debnam

Methods of determing the ages of geological specimens, and ascertaining the dates at which events in the Earth's history occurred, have been sought by men for centuries. Many theories have been expounded, but reliable estimates of such matters have not been achieved until this century, when methods involving radioactive determinations were devised.

Like most sciences, geological age determination was pioneered by the Greeks. Xenophanes of Colophon (570-480BC) recognised that relative ages of rocks could be determined by a study of fossils. His general idea was that the Earth existed for some time before organic life appeared, thus the older rocks would not contain fossils while rocks formed after the appearance of life could (but not necessarily would) contain fossils.

The Greek historian Herodotos (484-424BC) realised that the thick sediments deposited by the Nile river showed in the form of seasonal (annual) layers, and a count of these layers could be used to determine the age of the river.

Scientists were not alone in attempts to determine geological times. The Rabbinical chronology (the writings of the ancient Hebrew religion) quotes the date of creation of the earth as corresponding to 3700BC; and in the mid-seventeenth century, the Anglican Archbishop Usher proclaimed that the earth was created in 4004BC. A few years later a vice-chancellor of Cambridge University refined this estimate by declaring that Adam's creation took place in that year at 9am on Friday, September 17!

Other estimates, arrived at by the philosophical approaches of various Indian religious sects, and based on a study of "cosmic cycles", put the age of the earth at 4,320,000 years. Modern estimates put the age of the earth at 4,500,000,000 years.

The first true attempt at geochronology since the times of the Greeks was made by the German, J. G. Lehmann, in 1767. He extended the ideas of Xenophanes and classified rocks into three classes.

The first of these he believed to be part of the original surface of the Earth, and as such did not contain evidence of organic life. These were called the Primitive Class of Rocks. The Secondary Class of Rocks were the fossiliferous rocks formed by secondary processes, such as erosion and recompression from the Primitive Class. These contained few fossils. The third, or Tertiary Class, contained the "modern" (geologically speaking) sediments with evidence of abundant organic life.

In 1808 Georges Curier and Alexandre Brongniart of France studied minerals and organic remains and recognised that some fossils were of plants which still exist on earth, while others were of extinct plants. These were named respectively modern and ancient fossils, and the two types were used to further subdivide the rock classes.

In 1841 Sir Charles Lyell classified European fossiliferous rocks into Periods and Groups in a form similar to the modern form; and James Dwight Dana, in 1880, divided the major sequences of geologic time into Periods and Eras. These classifications as used today are shown in Table 1

Henry Williams (1893) used variations of Herodotos' method to determine the age of the post-Cambrian deposits. The values used for the rates at which the most abundant sedimentary rocks accumulated were, in years required for one metre thickness to deposit—

sandstone	4,500 years
shale	9,000 years
limestone	75,000 years

Results obtained by this method agree quite closely with values based on modern radioactive dating methods.

John Joly (1899) and E. W. Lane (1929) attempted to date the age of the Earth by the sodium content of ocean water. The method involved dividing the total sodium content of the oceans by the amount of sodium entering them by river transport. This method is not very accurate. Errors arise due to salt being entrapped in sedimentary rocks and changes in sodium in the ocean caused by volcanic action.

Lord Kelvin (William Thomson, 1824-1907) determined the age of the Earth, and Sun, to be 100 million years. He based his calculations on the time required for the Earth to cool sufficiently to support organic life, and the flattening of the poles during this cooling period.

This estimate was advanced on the assumption that there is no source of heat within the Earth. (At that time none was known.) When heat production by radioactivity was discovered in the 1890's, the estimate had no further validity.

The discovery of radioactivity marked the beginning of a new era in geochronology. Radioactivity is the word used to designate the spontaneous breakdown of an atomic nucleus to change its characteristics. This change occurs usually when the original atom, also called the "parent" atom, emits an alpha particle (helium nucleus) or beta particle (electron) from its nucleus to form a "daughter" atom. (This was discussed more fully in "Nuclear Reactions", "Electronics Australia", August 1970.)

An example of this type of reaction is the disintegration of carbon-14 (radio-carbon), which changes by emission of a beta particle into nitrogen-14.

The conversion of radioactive elements into other elements, either radioactive or stable, has been found to occur at a rate which is independent of the physical or chemical influences of the surroundings and this is its main advantage in determining the ages of geological specimens.

The "life time" of a single radioactive atom is indefinite; it may be as short as a microsecond or longer than a thousand million years. But although the life of a single atom cannot be predicted, an average result can be obtained for many millions of atoms. This average life is referred to as the "half-life" of a specimen, the reason for this name being best illustrated by an example.

If at 12.00 mid-day we have exactly 64KG of francium-223, at 12.21 we would have only 32KG left, the other half having converted, or decayed into, radium-223. Twenty-one minutes later, at 12.42 only 16KG of the original would remain, and 21 minutes later again, at 1.03 there would be only 8KG remaining, along with 56KG of daughter products. The quantity of francium-223 is halved every 21 minutes, hence this is said to have a half-life of 21 minutes.

The first daughter product, radium-223, is also radioactive with a half-life of 12 days.

Each radio-active element has a characteristic half-life. For rhenium-187 it is 4×10^{12} years; whereas polonium-213 has a half-life of 10^{-8} second.

To be of use in geochronology a radioactive element should generally have a half-life of some millions of years, but elements with relatively short half-lives such as carbon-14 (half-life 5,730 years) and Hydrogen-3 (half-life 12.5 years) have also been used for dating.

Radio-isotopes used for dating must also have some characteristics which enable both the parent and daughter elements to be detected. A list of such naturally occurring radioactive elements and their half-lives is shown in table II

One of the earliest clues to applications of radioactive dating was made by Boltwood in 1907, who studied the relationships between uranium and lead in rocks and found that the ratio between the two varied with the geological

TABLE 1 — GEOLOGICAL TIME SCALE

ERA	PERIOD	AGE (millions of years)
Cainozoic	Quaternary	1
	Tertiary	63
Mesozoic	Crustaceous	135
	Jurassic	181
	Triassic	230
Palaeozoic	Permian	280
	Carboniferous	345
	Devonian	405
	Silurian	325
	Ordovician	500
	Cambrian	600
Proterozoic	Precambrian	1500
Archaeozoic		4500+

ages determined by classical methods.

The physicists, Ernst Rutherford and Frederick Soddy showed in 1914 that uranium-238, after a number of intermediate transitions, transmuted into lead-206 with a half-life of 4.5 $\times 10^9$ years.

Geologists have been able to make use of this knowledge to determine the age of rocks. The method consists of firstly ascertaining the relative amounts of uranium-238 and lead-206 present in the sample, then calculating the age of the sample by using the known half-life of the uranium.

However, this method can only work if the measurement technique permits positive differentiation between lead-206 (the daughter product of uranium-238) and other forms of lead which may be present, such as lead-204, lead-207, lead-208, etc.

It must also be assumed that:

(1) lead-206 was not produced by any other radioactive process.
(2) no lead-206 was present in the original material.
(3) there was no addition or subtraction of uranium or lead-206 by any external agents.

Assumption (1) is satisfied by our present knowledge of radio-activity, whereby it appears that lead-206 occurs only as a result of the decay of uranium-238.

Assumptions (2) and (3) may not always be completely valid and, at best, would need supporting evidence to justify them.

The uranium-238/lead-206 method has been widely used in determining the age of rock samples. However, as not all rock samples contain uranium, similar processes are used with other parent and daughter products. Some of these are listed in Table II.

Often, more than one dating method is applied to the same sample, to improve accuracy. For example, G. R. Tilton (in 1957) quoted results obtained on a zircon sample from Ceylon, where the ages obtained by uranium-238/lead-206, uranium-235/lead-207, and thorium-232/lead-208 were respectively 540 $\pm$ 12, 544 $\pm$ 16 and 538 $\pm$ 25 million years.

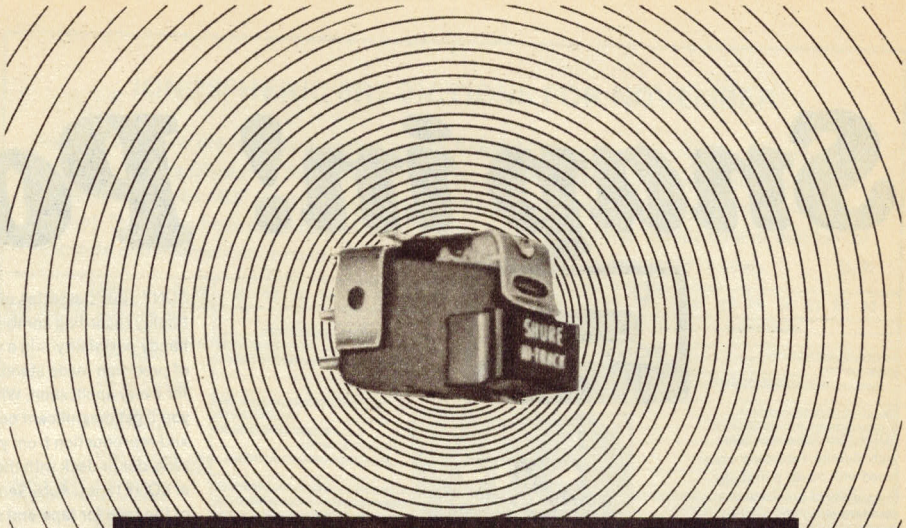
Separation of the parent from the daughter product in these determinations can be by physical or chemical means. However, chemical separation of daughter isotopes is not possible, as all isotopes of a particular substance undergo the same chemical reactions. Isotopic separation must therefore be achieved by physical methods. For early researchers, this was a difficult and time consuming process, but isotope separation became greatly simplified in the 1920s, when Francis Aston devised the mass spectrograph.

The mass spectrograph is basically a cathode ray tube with the electron source (cathode) replaced by an ion source where the substance to be tested is vapourised and ionised. The ions are collimated (directed in a beam) and electrically accelerated toward the target end of the tube which contains a detector such as a fluorescent screen or photographic plate. The paths of the ions are deflected from straight lines by an analysing magnet, the amount of deflection achieved being dependent on the mass of the ion, the lighter particles being deflected more than the heavier particles.

As the mass differences are small, the amount of deflection required to obtain reasonable separation is large. To achieve this degree of separation, the ion beams are deflected through an angle of nearly 180 degrees.

There are three heavy isotopes of lead which are commonly taken into account in mass spectroscopy analyses of rock samples. These are lead-206, lead-207 and lead-208. As can be seen from Table II, these are daughter products of uranium and thorium parents.

Once the quantitative determinations of the lead isotopes have been achieved, the next step is to determine the uranium and thorium content



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Decaying atoms emit very penetrating gamma radiation

of the sample. This can be by chemical separation methods, or by a process known as gamma ray spectroscopy.

In any given time period a definite number of parent radioactive atoms decay, the number being dependent on the total mass of the parent material present and its half-life. As each atom decays it emits very penetrating gamma radiation, and by powdering the rock sample and placing it inside a container which surrounds a scintillation crystal a count of the total number of disintegrations over a fixed time interval may be obtained.

For a sample containing a large amount of parent material a count time of only a few minutes may suffice to determine the amount of material present, but if there is only a small amount the count may require days.

To identify the particular material, the energy of the gamma radiation is also measured, as each radioactive material emits gamma radiation at a different energy.

The precision of this method depends upon the composition of the sample and the equipment used, but in general a precision of better than ± 10% can be achieved.

Another method, known as radioactivation analysis, is to bombard the sample with neutrons to create a series of fission products, and then detect the secondary neutrons emitted over a period of about ten minutes. This method, accurate to within about ±3%, can be used to detect quantities as small as 10^{-8} gram, but is expensive, mainly due to the methods of obtaining the initial bombarding neutrons — for which a thermonuclear reactor is generally required.

The methods of dating just described are only valid if the sample under test may be assumed to be unaffected by any external agency during its lifetime, as outlined earlier as objection (3). The circumstances in which a sample has been obtained must be taken into account; for example such "dating" would be useless if the sample were sand taken from a river bed, as in this case there would have been mixing of crushed rocks of many different kinds, and of different ages. However, if the sample were a piece of quartz with no flaws, or if any flaws present which could introduce other products were carefully cut away, the results obtained could be assumed to be reasonably accurate.

It was mentioned earlier that carbon-14 has a half-life of 5,730 years. Even if all of the carbon on earth at the time of formation, 4,500 million years ago, were carbon-14 there would be very little left today as the earth has progressed through a million carbon-14 half-lives.

The advantage of carbon-14 dating lies in the fact that carbon-14 is being continuously produced by bombardment of nitrogen or oxygen with cosmic rays in the upper atmosphere, at an altitude of about 1600 metres. The ratio of the quantities of carbon-14 and carbon-12 (normal carbon) remains reasonably constant at about 10 micrograms : 1 ton (1 : 1000,000,000,000). All living things take in carbon, either as carbon dioxide or carbohydrate foods. This carbon consists of both stable carbon and radiocarbon in the same ratio for all living organisms. When an organism dies it no longer takes in carbon, and as the radiocarbon disintegrates the ratio of C-14 to C-12 in the dead organism decreases with time. By determination of the C-14/C-12 ratio in a fossil or piece of organic matter, it is possible to calculate how long ago the organism died.

Because of its convenient half-life, radio carbon has been extensively used in the fields of archeology and anthropology for sample dating. Its use in these fields has had a secondary value — a check on the accuracy of the method. Many museums hold samples of known ages, and many of these were used to check the accuracy of the radio carbon dating method during the years 1946-1955. Some results,

It is interesting to note that during this "checking period" Dr Willard Libby of the University of Chicago was given part of the lid of a sarcophagus supposedly 2200 years old, but the radiocarbon dating indicated that it was less than a century old. Further checking revealed that the coffin lid was a fake.

A similar test unearthed a scientific hoax which had remained undetected for 45 years. This concerned the Piltdown skull, said to have been discovered at Piltdown, in Sussex, England, in 1912, and represented as being from a prehistoric species of man living 300,000 years ago. Radiocarbon dating showed that the skull was a mere 620 ± 100 years old, and the jaw was 500 ± 100 years old. Up till the time of this revelation, the skull had been accepted as a genuine prehistoric relic.

Radiocarbon dating has been successful in determining ages to about 50,000 years, and it is considered possible to extend this to 70,000 years; but if an organism has been dead longer than, this the amount of carbon-14 is hard to determine.

The most common method of determining the ratio of C-14/C-12 is to burn the sample and collect the carbon dioxide given off. This is then frozen in liquid nitrogen (−172°C) and passed on to a shielded counter. The amount of C-14 present is determined from its disintegration rate over a few hours or days, and the total amount of carbon present is determined by chemical analysis.

As with uranium-lead dating of rocks, care must be taken with samples for radiocarbon dating to ensure that they are not "contaminated" with older or newer material.

The assumption is also made that the C-14/C-12 ratio in the atmosphere has not changed significantly since the sample died, but this has been checked reasonably accurately by comparison dating with objects of known ages.

One other short half-life radioactive element formed in the atmosphere by cosmic bombardment is also occasionally used for dating purposes. This is hydrogen-3 (tritium, half-life 12.5 years). Tritium occurs as one part in 10^{17} of normal hudrogen in the atmosphere and combines with oxygen to form water. By determining the ratios of the two types of hydrogen present in water it is possible to tell how long ago the water was removed from the atmosphere (as rain) and gauge the rate of movement in underground streams or storage systems such as artesian basins.

Another radioactive element found in the atmosphere is radon-222. This is formed from the radioactive decay of radium-226 in the ground and diffuses into the atmosphere, where its residence time is governed by its half-life of 3.8 days. It eventually decays to lead-210 and then lead-206.

By determining the ratios of lead-210 (radioactive) to lead-206 (stable) in sediments it is possible to derive the date at which the sediment is laid down. For example the rate of ice accumulation at the south pole (by precipitation from the atmosphere) has been determined to be 6 ± 1 cm per century.

Radioactive dating is not confined to the Earth. Until 1969 (Apollo 11 project) the only source of extra-terrestial material available was meteorites. Although the ages of the bodies from which the meteorites came cannot be determined, the ages of formation can be obtained within about 500 million years.

Ages of meteorite samples have been determined by rubidium-strontium methods, osmium-rhenium, lead and potassium-argon methods. Although most meteorites appear to be about 4500 million years old some have been dated as 6000 million years old.

In its journey through space a meteorite is continuously bombarded with cosmic radiation. This can form new elements (spallation products) near the surface. When the meteorite lands on Earth it is protected from the cosmic radiation and by comparisons between the surface and centre it is possible to determine how long ago the meteorite landed.

TABLE II

Naturally occurring radioactive elements

Parent	Daughter	half-life (years)
Potassium-40	Argon-40 and Calcium-40	1.33×10^{9}
Rubidium-87	Strontium-87	5×10^{10}
Indium-115	Tin-115	6×10^{14}
Lanthanum-138	Barium-138 and Cerium-135	7×10^{10}
Samarium-147	Neodymium-143	1.25×10^{16}
Lutetium-176	Terbium-176 and Hafnium-176	2.4×10^{10}
Rhenium-187	Osmium-187	5×10^{10}
Thorium-232	Lead-208	1.4×10^{10}
Uranium-235	Lead-207	7.1×10^{8}
Uranium-238	Lead-206	4.5×10^{9}

TABLE III

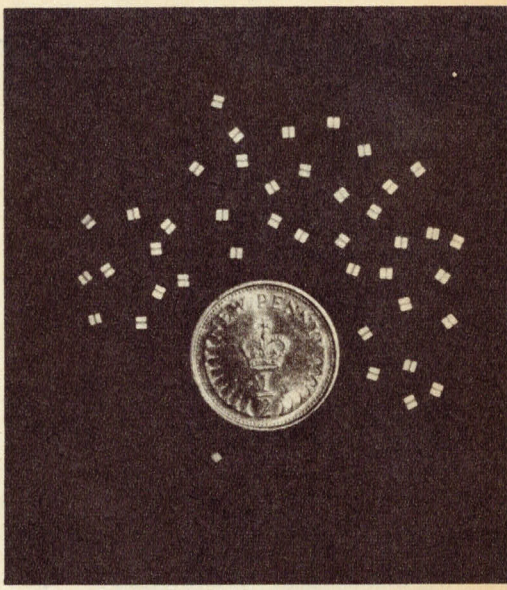
Comparison of ages (in years) of museum samples by historical records and radiocarbon dating.

Sample	Historical records	^{14}C dating
Inca Sample	444 ± 25	450 ± 150
Roman ship	1190 ± 3	2030 ± 200
Ptolemy	2149 ± 150	2300 ± 450
Etruscan Tomb	2600 ± 100	2730 ± 240
Tayinot	2624 ± 50	2600 ± 150
Sesostris	3700 ± 400	3792 ± 50
Nippur	4125 ± 200	4802 ± 210
Zoser	4650 ± 75	4979 ± 350
Hemalca	4900 ± 200	4833 ± 200

Quoted by E. I. Hamilton, Oxford University.

ADVANCES IN BERYLLIA TECHNOLOGY

A new process for metal deposition on to a beryllium oxide surface developed in the UK by Consolidated Beryllium Ltd should have important applications in semiconductor manufacture.



Finished beryllia parts, with gold layer, compared with a coin 11/16in diameter. These will be used in integrated circuit construction.

Beryllium oxide (beryllia) is the only material known which combines high electrical-insulation properties (resistivity 10^4 ohm-cm) with a thermal conductivity surpassing that of many metals, including aluminium. Although its application has hitherto been rather restricted, especially in Europe, demand for beryllia from the electronics industry is now increasing considerably due to its adoption in the manufacture of a range of semiconductor devices, including high-frequency transistors, power transistors, integrated circuits and solid-state rectifiers. It is also used in travelling-wave tubes, klystrons and lasers.

In recent years, the rapid rise in the operating frequencies of communications systems, coupled with an increasing trend towards miniaturisation of equipment, have brought problems of heat dissipation.

The main function of beryllia is to remove the heat generated by power loss away from the active elements to an external heatsink or dissipator. Consolidated Beryllium Ltd, which produces beryllia parts shaped to the requirements of component manufacturers, is currently developing a metallising process to overcome the problem of thermal barriers at interfaces. This process, involving deposition of a metal layer (usually gold) by ion-impact sputtering, is now replacing conventional techniques of metal plating using silver or molybdenum/manganese, which give somewhat inconsistent results.

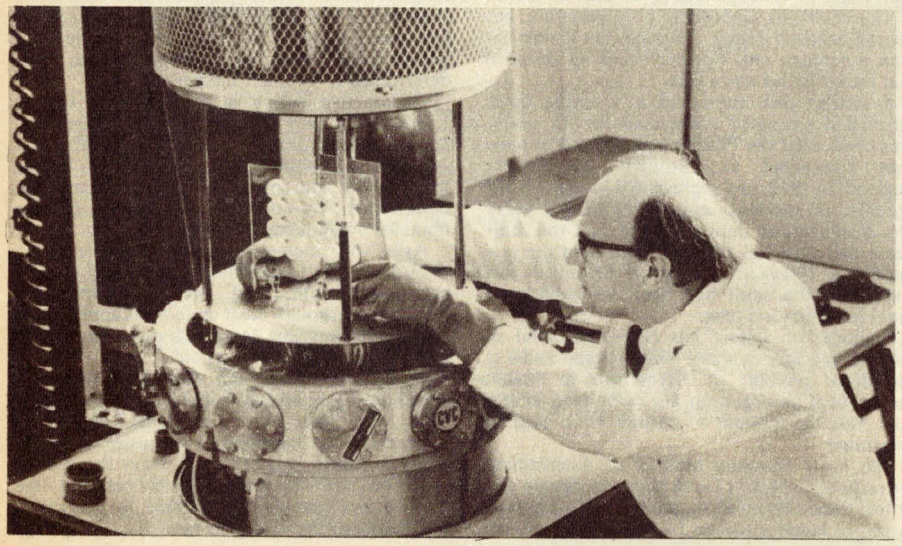
In the sputtering process, the items to be coated are placed on a polarised plate. One or more targets, usually of gold, are arranged in the sputtering chamber (see photograph). These targets are bombarded with high-energy positive ions, and this causes molecules of the target material to be stripped off. These molecules are attracted towards the polarised plate, and many of them settle on the items to be coated.

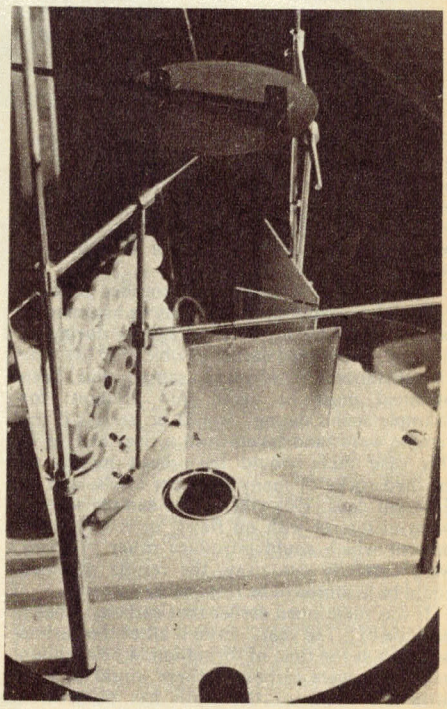
The new method reduces variability and optimises the heat path of the finished items. Parts as small as 0.04in sq have been successfully produced. The company claims to be the only beryllium-oxide fabricator in the world with its own sputtering facility.

The sputtering technique is one of several results of a research program carried out at Consolidated Beryllium Ltd's Milford Haven factory, and sponsored by the British Ministry of Defence (Navy). Other developments include the introduction of a high-purity "body" (material) of guaranteed consistency and of new fabricating techniques such as band-casting, isostatic pressing and injection-moulding. All these enable the factory to meet the demands of the electronics industry for an increasing variety of parts made from beryllia.

Economies of scale have enabled the company to reduce unit prices and to supply standard items from stock. These include: Transistor heatsinks in all the more usual outlines, such as TO3, TO5; washers to suit metric and BA threads for insulating diodes and thyristors; substrates for integrated circuits.

LEFT: A batch of beryllia substrates being placed in a sputtering chamber for deposition of gold plating. RIGHT: The rectangular pieces are gold targets, carefully arranged to give an even coating on the surface of the parts.



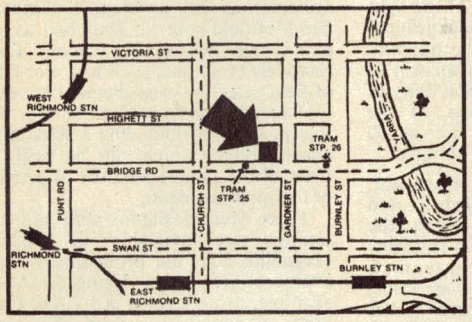


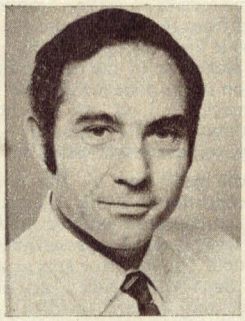
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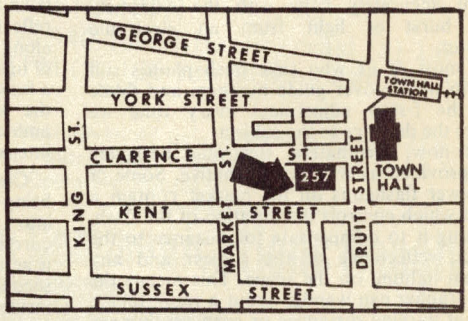
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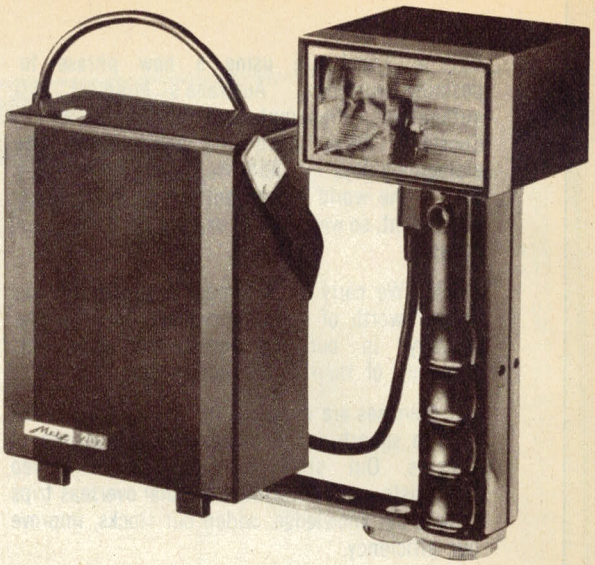
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New flashguns use optical feedback



Problem: how do you stop an electronic flash tube in mid-flash? New flashgun circuits do it by stealing the energy from the flash tube at just the right moment for a perfect flash exposure. They also provide adjustment for depth-of-field.

by DICK LEVINE

Electronic exposure control of cameras is now fairly common, but even the best of these coupled electro-mechanical light meter systems cannot accurately cope with the extremely short burst of light from an electronic flashgun.

So most of us who take flash photos still have to puzzle over guide numbers and fiddle with the f-stop adjustment every time we change the distance to the subject.

But now, fortunately, electronic designers have provided us with an alternative. Some of the newer flashguns on the market contain a circuit which controls the duration of the flash, adjusting it to compensate for distance to the subject, reflectance of the subject and any ambient lighting on the scene. This means the photographer can wander about a room taking shots at varying distances or even use bounce lighting and get perfect exposures without readjusting the camera.

There are limits, of course, depending on film speed, camera aperture, and the maximum output capability of the flashgun. But within these limits, which are adjusted before the shooting session starts, the user has considerably more freedom to manoeuvre than with conventional flashguns.

In theory, the automatic flash control is simple. When the flash is fired, light travels to the subject and is reflected back towards the flashgun. A phototransistor circuit uses this light to control the exposure by measuring the intensity of the reflected light, and using this information to control the time for which the flash tube is allowed to remain illuminated. At the end of this time it causes flash tube to be "quenched".

To see how controlled duration flash is achieved in practice, we took a look at a recent design — the **Mecablitz**, made by Metz of West Germany, one of the pioneers in automatic flashgun design.

The Metz design uses the usual high voltage generator, that is, a DC to DC converter which supplies high voltage power that is stored in a large capacitor until the flash tube is fired.

The trigger circuit is also of conventional design, with one exception which we will explain later. It stores a relatively low voltage in a capacitor and, when the camera contacts close, this voltage discharges through the primary of a step-up transformer to provide the necessary high voltage pulse to start current flowing through the flash tube.

A phototransistor mounted just beneath the flash tube receives a certain amount of the light reflected from the subject and the background, along with ambient light, if any. The quantity of light picked up by the phototransistor will be a function of the distance and the reflectivity of the subject, and of the brightness of the ambient light. The flash tube always fires at full intensity, so flash brightness is not a variable.

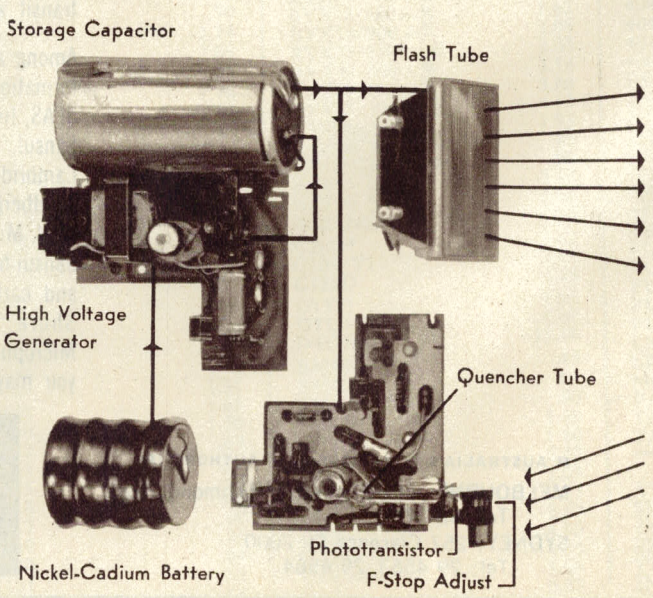
Current generated by the phototransistor, being proportional to the reflected light, is fed into a comparator circuit, and, when the current level reaches a preset limit, a thyristor is activated. The thyristor acts as a trigger for a second flash tube, called a quencher tube, inside the unit. When it conducts, the quencher tube effectively places a direct short across the output of the high voltage storage capacitor and instantly extinguishes the flash tube.

Unwanted triggering is avoided by not providing operating power to the phototransistor and comparator circuits unless the main flash tube has fired. To accomplish this, a small amount of power is "stolen" from the flash tube trigger circuit to operate the light sensing circuits, which are thus energised for the duration of the flash only, after which they revert to a de-energised state until the next flash.

Until recently automatic flashgun control systems had one problem in common: lack of depth-of-field control. They had to be preset to one f-stop which, for colour film, was a relatively large one, such as f/4 or f/5.6. Depth-of-field selection was dictated by distance and film speed. The new Metz designs have solved that problem by including a selection of neutral density filters which can be easily slipped in front of the phototransistor to provide a range of f-stop adjustments.

Three Metz flashguns with adjustable f-stop settings are available in Australia. The Megablitz 202, the professional model, has a choice of five stops. Using 50 ASA film for example, camera stops of f/2.8 to f/11 could be used in conjunction with the compensating filters at the flash head. Use of faster or slower film would shift the range up or down, but the five stops would remain one f-stop apart.

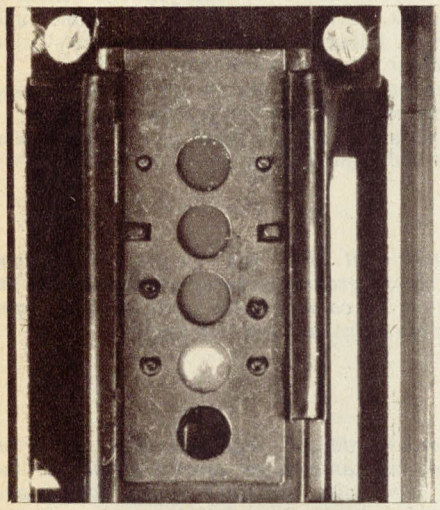
Flash fill in sunlight has always been a problem to calculate. The Megablitz design effectively eliminates calculations, since it measures the total of sunlight and flash fill reaching the camera. Another interesting advantage of the f-stop adjustment capability is that, if you have a leaf shutter camera which is synchronised for electronic flash, you can vary

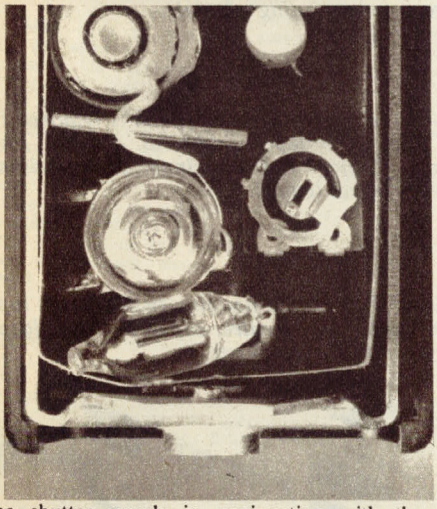


WHAT'S INSIDE. This pictorial block diagram shows the relationship between the major components of the Megablitz 196, a small, camera-mounted automatic flashgun.



VERSATILITY. The Megablitz 202, at left, is a professional automatic flashgun with five f-stop choices and a maximum flash distance indicator. The f-stop adjustment inside the handle, in the form of a slide containing neutral density filters, is shown below. Bottom photo shows the position of the quencher tube, also in the handle of the 202. The neon lamp adjacent to it is a light sensitiser.





the shutter speeds in conjunction with the flashgun f-stop control to take action pictures outdoors with flash fill.

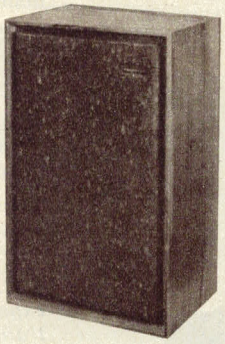
A maximum flash range indicator on the 202 model confirms that there is enough light for a correct exposure — even for bounce lighting. This is done by making a test flash prior to exposing the film. A small green indicator on the flashgun handle lights whenever the quencher tube fires, thus indicating that there must have been enough light to cause the light sensing circuits to quench the main flash tube before it reached its maximum output.

The suggested retail price of the Mecablitz 202 is $197 with a wet cell battery (nickel-cadmium cells are optional). Two smaller units are available for amateur photographers. They are similar in function, but with less light output and fewer f-stop choices. The Mecablitz 192, with a suggested retail price of $75, can be set for two stops; the Mecablitz 196, at $105, can be set for three stops.

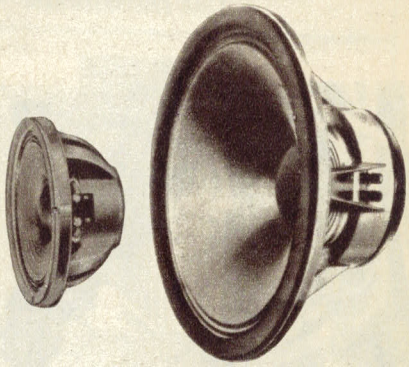
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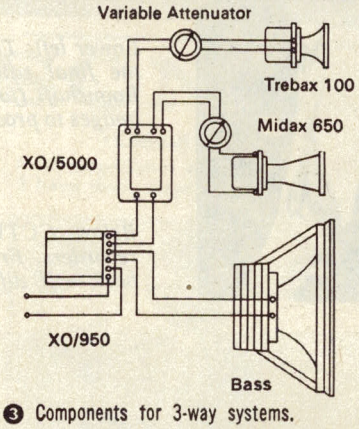
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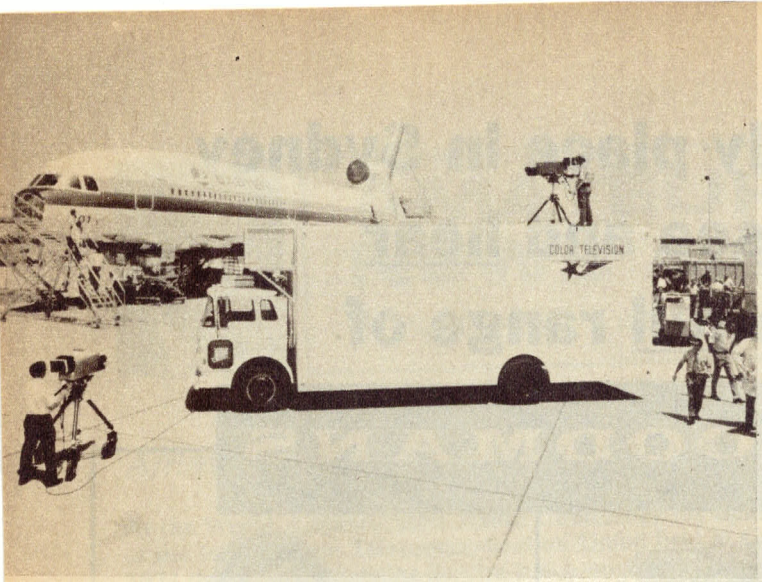
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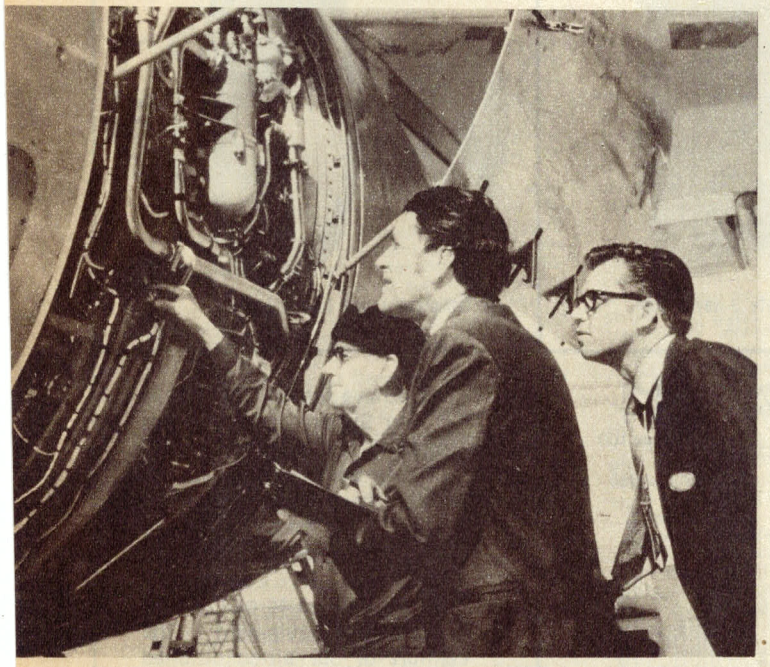
TV TRAINING



When a new airliner is to be put into service, one of the major considerations for airline operators is the training of maintenance crews. In the USA, the Lockheed Aircraft Corporation has established a training school for maintenance personnel of airlines buying the new Tristar jet. The school is equipped with the most advanced equipment available, and training is assisted by a full-scale colour television installation based on the use of colour video tapes and films.

Everett Kelly, manager of the motion picture and closed circuit television department, describes the system this way.

"Our primary job is to provide support to the commercial maintenance training and flight crew training departments. We



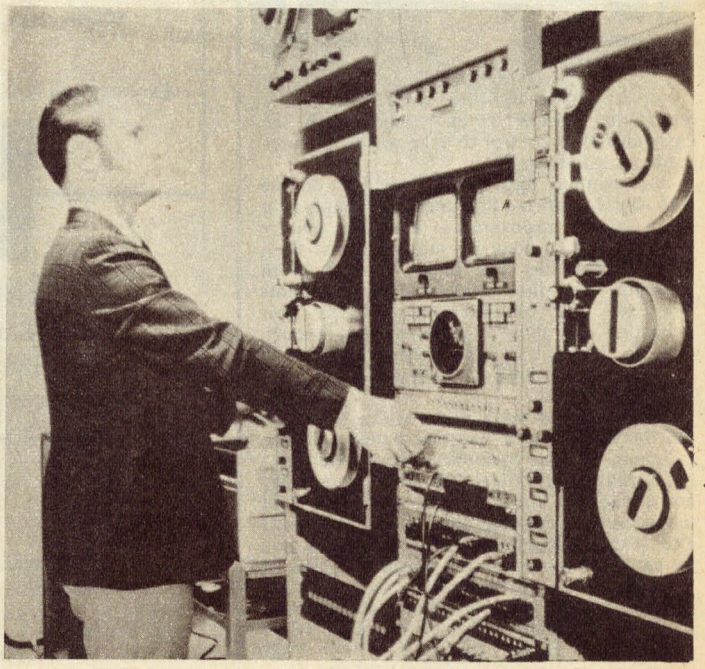
Top left: A closed-circuit TV van brings the colour cameras close in to record ground servicing procedures on the flight line. By taking the TV camera to the scene, training tapes achieve a high degree of realism and training quality.

Left: A CCTV writer-producer team huddles with an experienced flight line mechanic to get precise detail into the training tape. This team also estimates visual values and shooting time, and prepares a shooting schedule.

Lower left: The artistic sense of skilled craftsmen is required in the final editing of the video tape. Technical director Lou Boonshaft (foreground), former "Emmy" winner, blends visual images to produce proper visual impact.

Below: CCTV specialist Bill Smith handles twin master tape recorders. From the master tape centre, tapes can be played back to 10 different receivers in classrooms.





FOR TRISTAR MAINTENANCE

supply video tape and film production services to departments concerned with the training of field service representatives and flight line mechanics, as well as customer airlines".

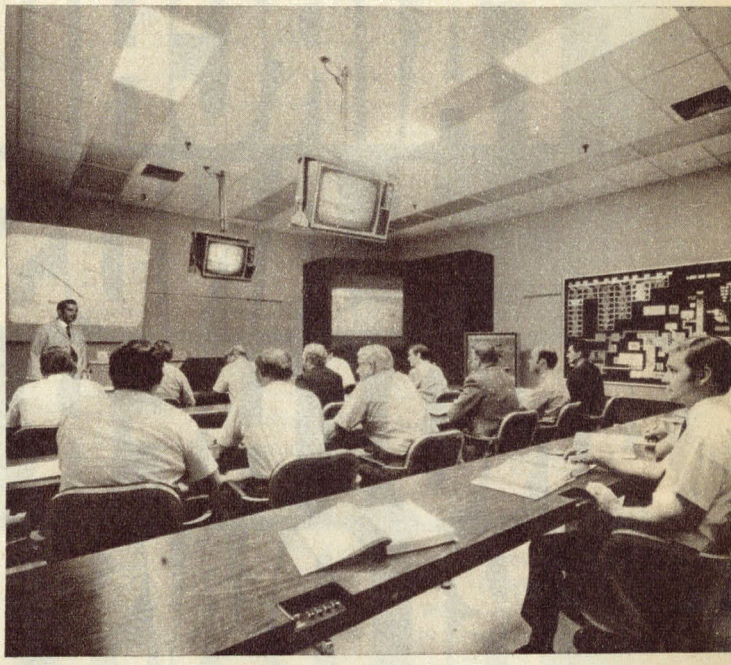
The CCTV system is used to demonstrate servicing and installation procedures. Wherever possible actual hardware and Tristars are used, or sometimes for clarity it is better to use a model or a breakaway sample, but the television system provides an introduction to the systems involved.

The use of video tape allows constant updating of the training to allow for changes in procedures or modifications to the aircraft. Although video tape is considerably less costly and more versatile, film still plays a part in the scheme. One of the advantages of film is that the film camera can be taken into areas where the bulkier television camera cannot go. Film footage is subsequently transferred to video tape.

There are three basic versions of training tapes: Familiarisation, indicating where systems are in the aircraft and what functions they perform; removing and replacing components; servicing procedures.

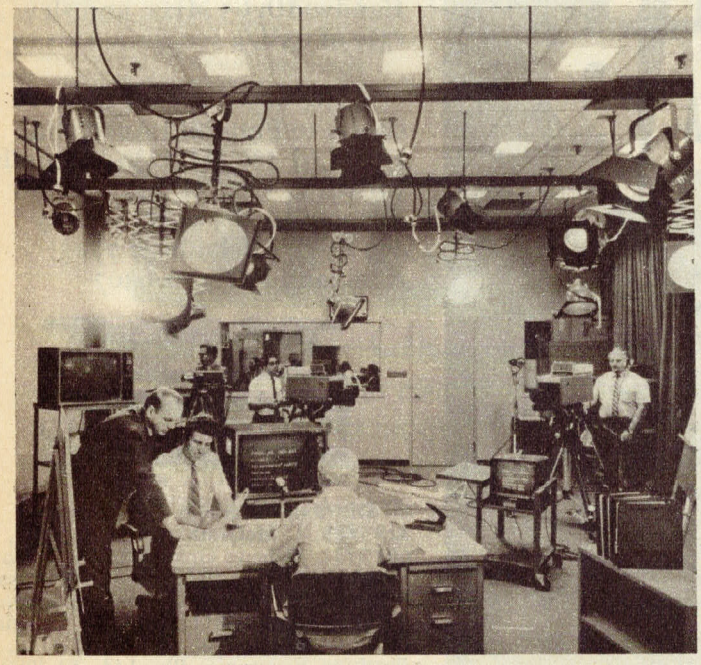
For realism, many shots are taken of actual maintenance procedures in the field, and for this purpose the school has a fully equipped mobile television van, equipped to take video tapes on location. The van has three colour cameras, video recorders, sound mixing equipment and a colour film/slide chain.

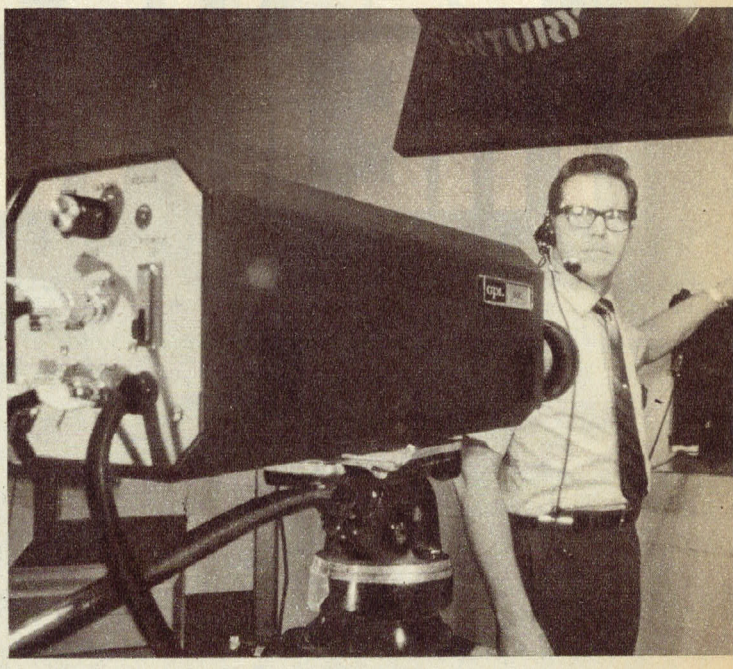
Right: The classroom where the tapes are finally displayed on monitor receivers suspended from the ceiling. In addition to the tapes, the instructor has available a Vugraph projector (left), a rear slide projector (centre), and illuminated models (right). This full range of training aids makes possible very realistic demonstrations having a high order of impact.



Below right: In another part of the studio, production co-ordinator Bill Provin holds up a title board before the TV camera to record a shot for the start of a tape.

Below: In the television studio, Everett Kelly (left), and Bob Ganon go over details on the script as the narrator checks his prompt screen and prepares to add commentary to the action on the video tape.





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SCIENTIFIC AND INDUSTRIAL NEWS

TV pictures from sea bed

Television equipment could play an important part in future underwater salvage operations following experiments with EMI low-light television equipment in recent trials on a midget submarine, Pisces. The EMI camera, claimed to be able to obtain pictures in "half moonlight" conditions, was used by British Government officials and scientists in demonstrations to transmit pictures from the sea bed to a mother ship on the surface. The TV pictures were transmitted by cable from the submarine to a buoy on the surface. From there, they were relayed by radio link to monitors in the parent ship, Venturer. The transmissions were also recorded on video tape for future analysis and record purposes.

The EMI low-light television camera used in the Pisces trials measures only 128mm x 128mm x 152mm. Its ability to obtain clear pictures in very low lighting conditions is provided by an EMI emitron tube. This intensifier-vidicon is 300 times more sensitive than a normal 26mm vidicon tube.

The 20ft long Pisces is operated by Vickers and designed to work at depths down to 3,000ft. It is carried on board the mother ship until required for operations when it is hoisted into the sea by crane. The submarine is equipped with skids to travel along the sea bed, and has telescopic grabs to retrieve objects or shackle lifting wires to wreckage.

Apollo 17 crew

NASA has named the prime crew for Apollo 17, the last scheduled lunar landing mission, as astronauts Eugene A. Cerna, Ronald E. Evans and Harrison H. (Jack) Schmitt. Cernan, the commander, and Schmitt, the lunar module pilot, will explore the lunar surface while Evans, the command module pilot, conducts extensive scientific experiments in lunar orbit. Apollo 17 is scheduled for launch in December, 1972. Final choice of the landing site has not yet been made. Lunar surface stay time will be up to 68 hours, and three exploration periods of up to seven hours each are planned. A lunar roving vehicle will be used, and an ALSEP (Apollo Lunar Surface Experiments Package) will be deployed.

Cernan has 27½ hours in space aboard Gemini 9 and Apollo 10. On Gemini 9 he became the first man to stay outside a spacecraft for a full revolution of the earth. During the Apollo 10 mission, he and Thomas P. Stafford descended to within eight miles of the lunar surface for a final checkout before the first lunar landing. Evans and Schmitt have not yet flown in space. The backup crewmen are David A. Scott, Alfred M. Worden and James B. Irwin, who recently completed the Apollo 15 mission.

Darwin outpost radio

The control and operation of the outpost radio service in the Darwin area, previously operated by the Overseas Telecommunications Commission, was transferred to the Australian Post Office on October 1. The OTC's prime function in the Darwin area is the operation of the coastal radio service, designed to provide assistance to ships in the vicinity, but OTC has also operated the inland outpost radio service for many years. The post office has taken over because of increasing demand on the OTC coastal radio service. At places other than Darwin, the Royal Flying Doctor Service and similar organsiations will continue to operate the outpost radio service.

Mobile hospitals

Ibis M3 Ltd has set up a factory at Newhaven, on the English south coast, to build mobile hospitals to customers' specifications. Ibis M3 (the M3 stands for Mobile, Medical and Marine), a member of the Ibis group of companies, has already supplied medical vehicles to India, Turkey, Zambia and South Korea.

Mobile hospitals are invaluable when disaster strikes remote areas. Within hours such a unit can move in, set up wards, and have operating theatres, laboratories and blood transfusion units at work. In developing countries, mobile hospitals can serve both routine and emergency calls. And, in addition, where numbers of doctors and trained personnel are limited, the travelling unit makes their skills available to more people.

The company's wheeled medical units range from Land-Rover Ambulances fitted with resucitators to mobile clinics with waiting rooms; from mini-operating theatres for field surgery to larger vehicles with all the facilities for major operations, and includes mobile x-ray units and a mobile dental surgery. For countries with sizeable populations accessible only by water, the company is planning medical marine craft. (Ibis M3 Ltd, Avis Way, Newhaven, Sussex, England.)

Oxygen reclaimed

Astronauts on future space missions may breathe oxygen reclaimed from moisture in their own breath and perspiration. A prototype water vapour electrolysis system, developed at NASA's Ames Research Centre, California, USA, has successfully completed more than 2,000 hours of testing, equivalent to an 80-day space mission.

The Ames conversion system has only one moving part, an electric fan which pulls air across a sponge-like material which holds an acid electrolyte. The acid absorbs moisture from the air, and when electric current is passed through it, the water in the acid solution is broken down into its basic components. Oxygen is liberated on one side of the cell, hydrogen on the other. A microporous membrane prevents intermixing of the gases. In a spacecraft cabin, the oxygen would be returned to the cabin airstream for breathing, and the hydrogen either used for spacecraft systems or jettisoned into space.

Pollution in weather reports



Newcastle, NSW, residents will soon have the level of air pollution added to their weather reports. Newcastle University, in conjunction with Newcastle television station NBN3, has equipped a Volkswagen Kombi van (above) with instruments to measure the levels of sulphur dioxide, carbon monoxide, dust and haze. Chart recording equipment will give a continuous indication of pollution levels.

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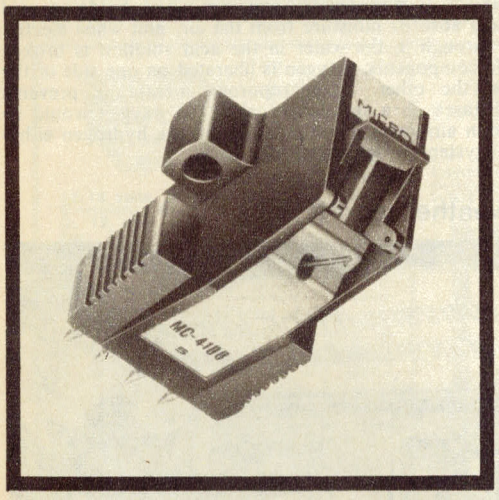
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MICRO MR 211
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MICRO MR 311
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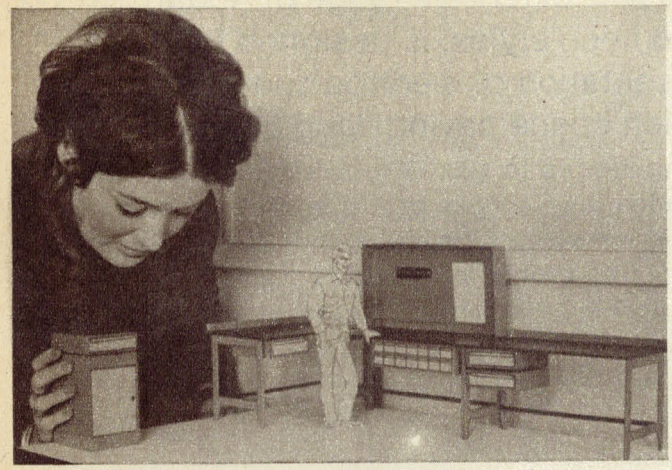
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New consultancy service



Duff Steel Industries (NSW) Pty Ltd has established an advisory service to assist companies expanding their electronics facilities or modernising their existing layouts. A consultant will provide assistance using scale models, diagrams and estimates relating to work benches and storage systems. The total range of equipment includes work stations for electronic and instrument wrok, metrology, tool making, laboratory and heavy engineering applictions. Also included are systems for storing all forms of tooling and jigs, material handling trolleys, operators seats, parts storage cabinets, etc.

The photograph shows scale models being used during the planning of an area suitable for a maintenance instrument fitter. It features an L-shaped work area of steel plate (with bonded vinyl covering) complete with a central parts drawer and three lockable drawer units to house tools. The rear wall can carry power, etc and a pegboard panel will hold frequently used blueprints and tools. A side cabinet is being added as a stand for a small machine with lockable storage facilities built in.

All components are designed in a modular system and brightly finished in oven-baked enamel for durability. Work stations can be set up exactly as needed, but capable of extension and rearrangement in later years. The service is entirely free and withoug obligation. (Duff Steel Industries (NSW) Pty Ltd, Flinders Street. Port Kembla, NSW 2505.)

Commercial radio in UK

The British Government has published a white paper providing for a network of commercial radio stations in Britain over the next few years. Major population centres, such as London, Manchester and Birminghan, are likely to be the first to have such stations. Control of the stations will be vested in an Independent Broadcasting Authority, to be formed from the existing Independent Television Authority, which currently controls the operations of the UK's commercial television stations.

While the white paper provides for commercial broadcasting, it also provides for the continuation of 20 existing BBC local radio stations currently operating in regional centres. In most cases, commercial stations will be set up to serve the same areas as the BBC's local stations so that the two services will be in direct competition. The dual system will serve about 70-75% of the UK's population.

Broadcast stations

The following national broadcasting stations in the Territory of Papua and New Guinea commenced operation on August 14, 1971 on the indicated frequencies: 9GR Goroka, 900KHz; 9LA Lae, 670KHz; 9MD Madang, 860KHz. The call signs and frequencies of two proposed commercial broadcasting stations in NSW are as follows: 2GO Gosford, 1310KHz; 2ST Nowra, 1000KHz. The frequency of 3CV Maryborough will be changed from 1440KHz to 1060KHz in the near future.

Anit-sound window

a new type of complete window unit with a total thickness of only 33mm, called the "Anti-sound window" because of its sound damping qualities, has been developed by Emmaboda glassworks, Sweden. Instead of using thick single panes, Emmaboda designed the new window as a multi-layer unit with two of the individual panes place very close together. This results not only in the same noise reduction as with double-glazed windows 80 to 100mm thick, but also in considerably improved thermal insulation.

Wire drawing process

The winding wires division of British Insulated Callender's Cables Ltd in the UK has developed an in-line wire drawing and enamelling process. Patents have been applied for. Plant using the new process, now in operation at the company's Liverpool factory, can handle all wire sizes from 0.2mm to 1.5mm, and extension of the range is planned. The in-line process is said to produce finished enamelled wire with significant physical and metallurgical advantages over that produced by the conventional process in which wire drawing and enamelling are separate.

Weather Radar

Ansett Airlines will install RCA weather radars, type AVC-30X, in its fleet of 727-200 jetliners and in its future aircraft. First shipments of the equipment are scheduled for the end of this year. The AVC-30 is an all solid-state system that can view weather up to 300 miles. It features a dual system configuration for increased operational reliability.

Plug-in supply for ICs

A plug-in unit to meet the DC supply requirements of IC logic systems has been produced in the UK by Weir Electronics Ltd. The 5V 2A unit, which measures 3.8in x 6.9in x 2.75in, has remote sensing facilities and excellent transient response to load change. Safeguards include transient over-voltage, short circuit, and overload protection. Input supply can be 110V, 220V or 240V (50-60Hz), the operating temperature range is -10° to +55°C, and the unit will fit into the guides of a 3.7in circuit board file. The Australian agent for Weir Electronics is Kenelec Systems Pty Ltd, 142 Highbury Road, Burwood, Vic 3125.

Over 2GW for Vales Point

The Electricity commission of NSW is to install two new 660MW units at its Vales Point power station to lift the capacity of that station from 875MW to 2195MW, making it the most powerful thermal generating station in Australia. The total output of Vales Point will be 195MW more than Liddell which is scheduled for full operation in 1974. The first of the units for Vales Point is scheduled for operation in 1977.

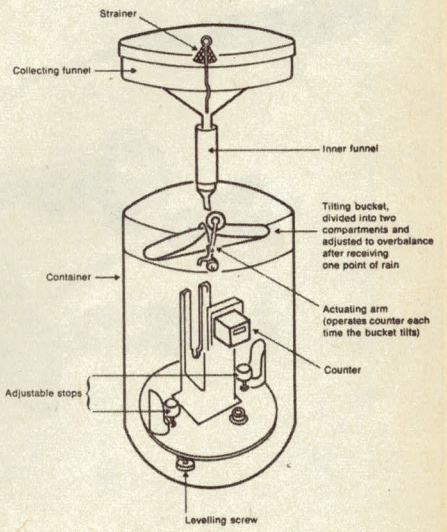
Digital rain gauge for remote areas

CSIRO research workers carrying out shrub regrowth studies on large properties in the Bourke-Cobar region of NSW needed a battery of rain-fall recorders that would give reliable readings when serviced only infrequently. Automatic chart-type recorders, although suitable, were too expensive; standard rain gauges, although cheap, were not acceptable as they need frequent attention to avoid gross errors due to evaporation.

Faced with this problem, Mr S. C. Knedlhans, of the Ecology Division, developed an automatic and accurate rain gauge, costing about $160 and built entirely from readily available components. His gauge records the total rainfall received. It uses a tilting-bucket mechanism coupled to a simple counter. The whole unit fits into a standard rain gauge housing.

Water entering the collecting funnel falls into a tilting bucket (divided into two equal compartments) which is designed to overbalance when one point of rain accumulates. Rain empties from the lower compartment as the upper one receives more rain. Each time the bucket tilts, one digit is recorded on the counter. Tests have shown that the tilting of the bucket provides all the energy needed to do the recording.

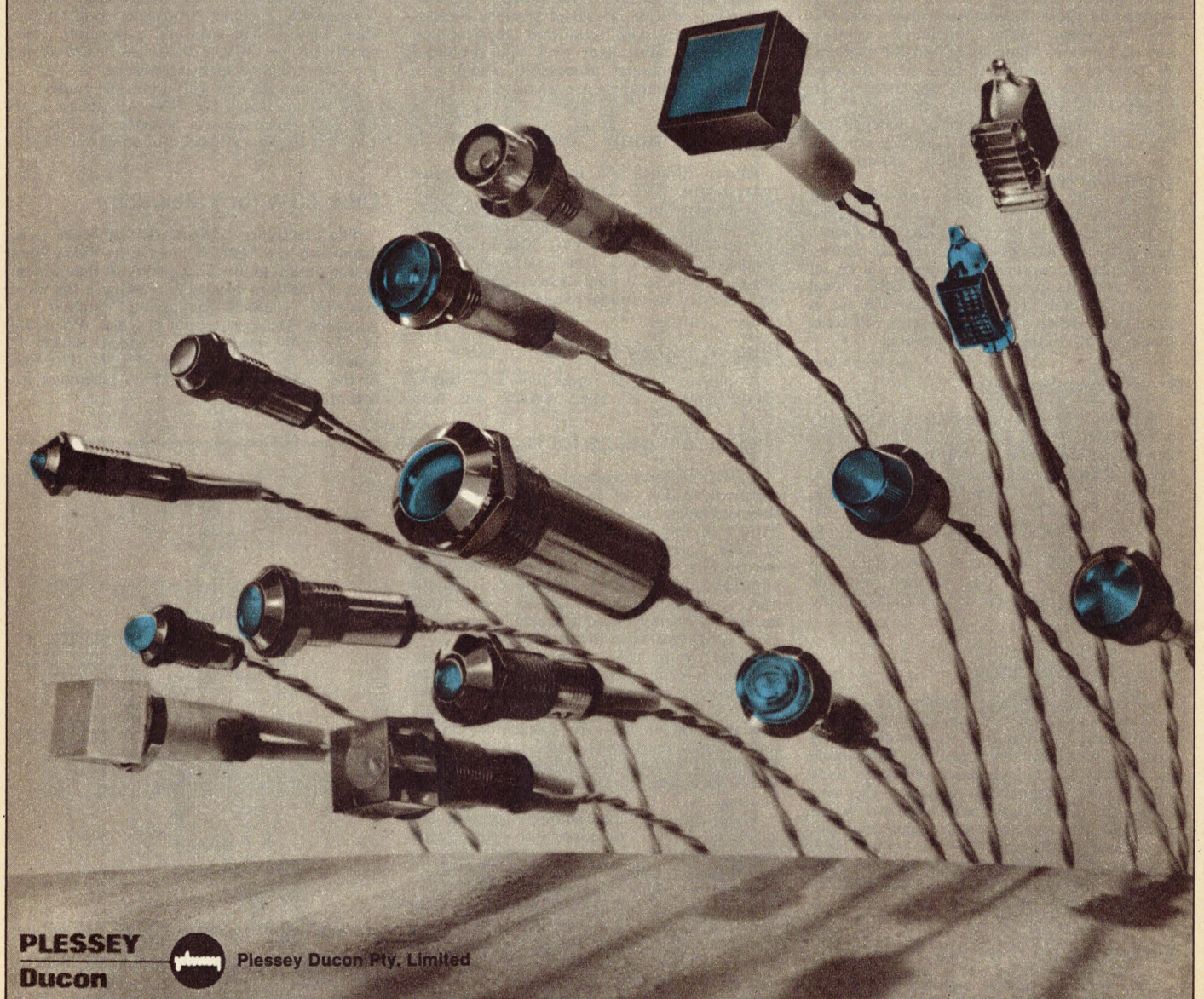
The gauge can be calibrated for a given rainfall intensity, and under field conditions records with an accuracy of ±4% at intensities up to 10in per hour, an acceptable limit for most studies. In addition to its cheapness, the digital gauge has other advantages: it is portable, robust, easily maintained, and needs no power source.



An exploded view of the digital rain gauge.

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The range is available from the Professional Components Department, Villawood, N.S.W. or Plessey Ducon Interstate Offices. Descriptive literature is available on request.



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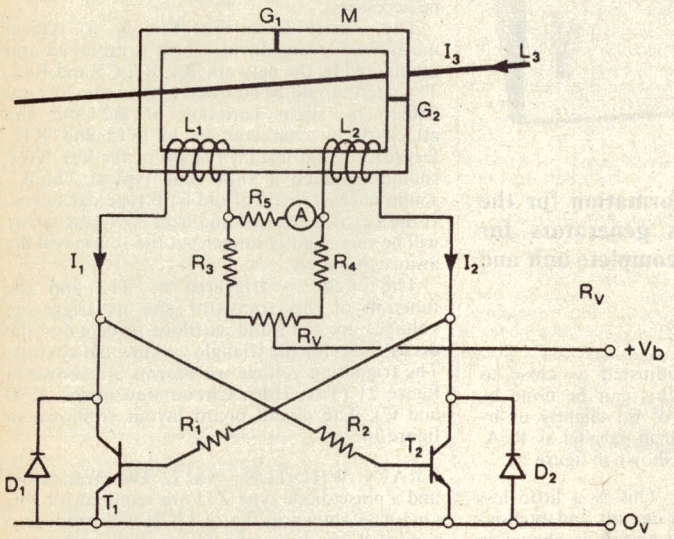
Inductive loop DC ammeter

The use of an inductive loop to measure AC current without breaking the circuit has been common for some time. A method of obtaining the same results for DC circuits, using a magnetic circuit which may be broken to allow it to be placed around a DC conductor, has been developed by the Royal Aircraft Establishment at Farnborough, England.

The RAE instrument is based on a simple relaxation oscillator, with two windings, L1 and L2, which are equal but wound in opposition on a closed-loop magnetic core. These windings form the collector loads of two transistor switches, T1 and T2. The magnetic core is arranged in two co-operating parts which can be sprung apart to admit a conductor in which the current flow is to be measured. When enclosed by the core, the conductor, L3, behaves effectively as a third winding and provides a magnetic bias to the core.

Because L1 and L2 are wound in opposition, the magnetic bias will aid the magnetic field of one and oppose that of the other. Since the flow of current in L3 affects the amount of magnetic bias, the difference in currnets I1 and I2 is directly related to the current, I3, to be measured. A voltmeter, A, indicates the difference between the voltages across the two collector loads, and hence the difference between the average currents flowing in each winding. This meter can thus be calibrated to provide a measure of I3.

The instrument is powered from a 9V battery whose current drain, when measurements are being made, is about 60mA. Currents from 0.5A to 100A can be measured by a range switch which alters tappings on the windings. An accuracy of 2 or 3 per cent is claimed. The potentiometer, RV, is a zero adjustment. A patent application has been filed in the UK.



The circuit of the inductive loop DC ammeter developed by the RAE.

Computer dating

A total eclipse of the sun over 3000 years ago has been precisely dated by a geophysicist using a computer at Newcastle University in England. The eclipse was recorded in the ancient texts of Ugarit, a kingdom just north of Lebanon, which was an important centre for trade until about 1200BC. The geophysicist, Dr F. R. Stephenson, programmed a computer to work out the times and places of the 500 eclipses which occurred during the period covered by the texts. From these he selected four which would have been total in the region of Ugarit. Only one of these could have been at the time of year the text implied, early simmer. The computer calculation gives a precise date by our calendar, May 3, 1375BC.

The calculation will be of help to archaeologists who can now put firmer dates to other events of about the same time. But the scientists can also use the date to detect minute irregularities in the earth's rotation. The difference between the calculated area of totality and the actual area recorded by the Ugarites shows up any unexpected motion of the earth. (From a BBC report.)

North Sea cables

The first of four giant cables, each capable of carrying 1260 telephone circuits between the UK and Europe, was completed earlier this year. It links Winterton, in England, with Wedderwarden, in West Germany, a distance of 285 nautical miles and has 45 transistor two-way repeaters. Laying of the second cable commenced in September from Broadstairs, England, to Ostend, Belgium, a distance of 64 miles with repeaters at intervals of just over seven miles. The other two cables will be between Alderburgh, England, and Domburg, Netherlands (92 miles, 13 repeaters); and between Scarborough, England, and Thisted, Denmark (381 miles, 60 repeaters).

BBC records for sale

A fairly new scheme, now rapidly expanding, is the sale of gramophone discs to the public by the BBC. Among the latest to be released is Liszt's brilliant piano piece Liebestraum No 3 recorded by Valerie Tryon, together with some other Liszt pieces. This is her second record for the BBC label: she has already recorded a Rachmaninov disc. Other classical music recordings issued include a recital by the Romanian pianist Radu Lupu and a historic recording of Dohnanyi's last recital.

The series is strong on history, as the BBC's archive recordings are extensive. Included in the discs now available are some of George Bernard Shaw's broadcasts in which he speaks about money and the way to have a happy life, and Orson Welles reading Walt Whitman's poem "Song of Myself". Another nostalgic record carries the sound of steam railways. The discs may be ordered direct from BBC Records, London SE 99, enclosing the equivalent of £1.75, which includes postage and packing.

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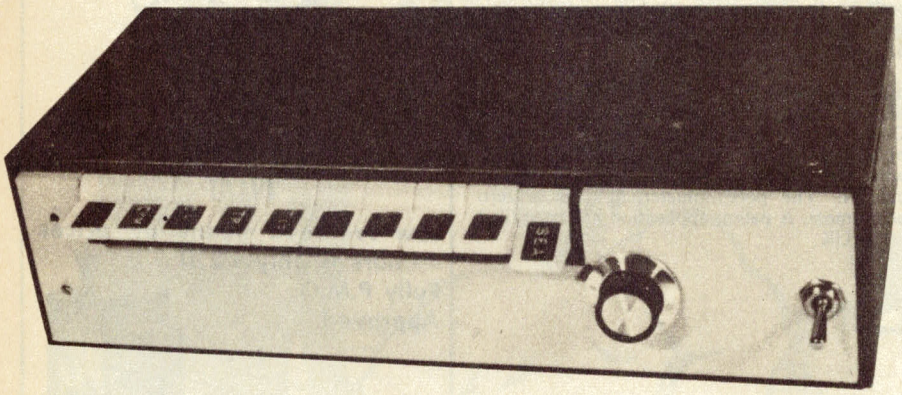
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Sound Effects Synthesiser for



This is the second article in a series giving the essential information for the construction of ten separate percussion and sound effects generators for electronic organs. Part one dealt with the general layout of the complete unit and the first three generators. Five more are described below.

With the exception of the Bell Chime circuit, all the remaining circuits can be constructed and operated individually, as each has a fairly large signal output.

If all the generators are to be used together, as in the original unit, they must be finally connected together via a mixing output pre-amplifier which will be dealt with later.

The next circuits to be described are the Triangle No 4, Wood Block No 5, Taxi Horn No 6, Train Whistle No 7 and Bell Chime No 8. Each is assembled on a board as those in part 1. As will be seen from the board layout diagrams given in this article, some boards are full with components. For this reason the components used should be as small as possible.

TRIANGLE—No 4: The sound of a triangle is clear and high pitched and the waveform almost sinusoidal. The circuit as in figure 11 therefore, employs a phase shift oscillator adjusted for a frequency of approximately 4500Hz.

The output from the oscillator Tr1 is first attenuated via R21 and then taken to the control amplifier Tr3. This amplifier is triggered by Tr2 which generates a control voltage waveform as shown in the Triangle Circuit waveform B figure 21.

When the key No 4 is closed, a pulse (Triangle Circuit waveform A) is generated which causes Tr2 to conduct. This brings the emitter of Tr2 almost up to the supply voltage and C9 becomes charged. Tr3 takes its HT from C9 which then slowly discharges and produces the required decay effect.

The sine-wave output from Tr1, although considerably attenuated, does slightly overdrive Tr3 and this helps to provide the characteristic metallic sound of a triangle. Note that the key click filter C7/R9 must be included. The resistor R14 in series with C9 reduces the otherwise very hard attack and C9 itself determines the decay time. If C9 is made larger the decay time will be larger and vice versa.

The pitch should be adjusted as close as possible to 4500Hz and this can be done by either reducing the value of R1 slightly or by connecting another resistor in parallel as R1A. The circuit board layout is shown in figure 12.

WOOD BLOCK—No 5: This is a little less complicated than the other circuits and employs only two transistors. The circuit is shown in figure 13. In this Tr1 is a phase shift oscillator biased to cut off and is turned on only when Tr2 conducts, ie, when the key (No 5) is closed.

The pitch and decay time are both very important if a realistic sound is to be produced. For instance, if the decay time is too long the sound will be too much like a bell and if too short will sound like a click. Some adjustment of R9 may be necessary to achieve the right period of decay.

Pitch can be altered by slight variation of R1 which is nominally 8.2K. Adjustment of both decay time and pitch rather depends on aural estimation of the sound.

The strike and decay control voltage and output waveforms are shown in figure 21. (Woodblock Circuit waveforms A and B respectively.) The circuit board layout is shown in figure 14.

TAXI HORN—No 6: This is another of the more complex circuits and employs four transistors as shown in figure 15. First however, note that the signal from the multi-vibrator Tr1-Tr2 is also used for the bell chime circuit No 8. If the taxi horn circuit is to be used by itself the lead out to R16 on the bell chime circuit will not be necessary.

The signal from Tr1-Tr2 is a typical multivibrator waveform, which is modified and attenuated by the network R6, R7, C5 and R12. The pitch should be adjusted to between 200 and 250Hz by slight variation of R2 and the attack/decay characteristic by R15 and R16. Depression and instant release of the key No 6 should produce a short but typical "honk" sound characteristic of old bulb type car horns. If the key is depressed and held down the decay will be very slightly longer but the sound will die away completely.

The circuit is triggered by Tr3 and the function of this transistor and its triggering voltages are the same as those (except for the decay time) for the triangle and cymbal circuits. The triggering voltage waveforms are shown in figure 21 (Taxi Horn Circuit waveforms A, B and C). The circuit board layout is shown in figure 16.

TRAIN WHISTLE—No 7. Two transistors and a noise diode type Z1J are required for this circuit as shown in figure 17. It will produce a typical steam train whistle complete with noise content and pitch variation. The transistor Tr1 is a phase shift oscillator, the output of which is attenuated via R9. The pitch should be approximately 1000Hz and adjustment to attain this can be made by slight variation of R1.

The noise generator ND1 is the same as used for the cymbal and snare drum circuits and its output is slightly attenuated by R11. The transistor Tr2 takes the signal from Tr1 and ND1 simultaneously but is normally biased to cut off by R14/R16. When Key No 7 is depressed Tr2 conducts and passes the combined sinewave and noise signals.

However the signal output from Tr2 is also directed via C10 to the diode rectifier circuit

ABOUT THESE ARTICLES:

This article by F. C. Judd on a Sound Effects Synthesiser is reproduced by special arrangement with "Practical Wireless". An editorial note indicates that all the circuits have been thoroughly checked out and that the prototype was demonstrated at last year's International Audio and Music Fair at Olympia.

The circuits have not been duplicated in our own laboratory and we are not in a position to answer technical questions about their operation. However, the circuits should provide an excellent starting point for readers who wish to experiment with sound effects circuits for use with electronic organs or in music group situations.

There are references in the text and parts list to components which are available to constructors in the British Isles. Australian constructors could undoubtedly import these components but they would have to make their own arrangements about ordering, payment, freight, possible duty, etc. In most cases it will be simpler to determine by experiment suitable alternatives from local sources.

Organs

by F. C. Judd — PART TWO

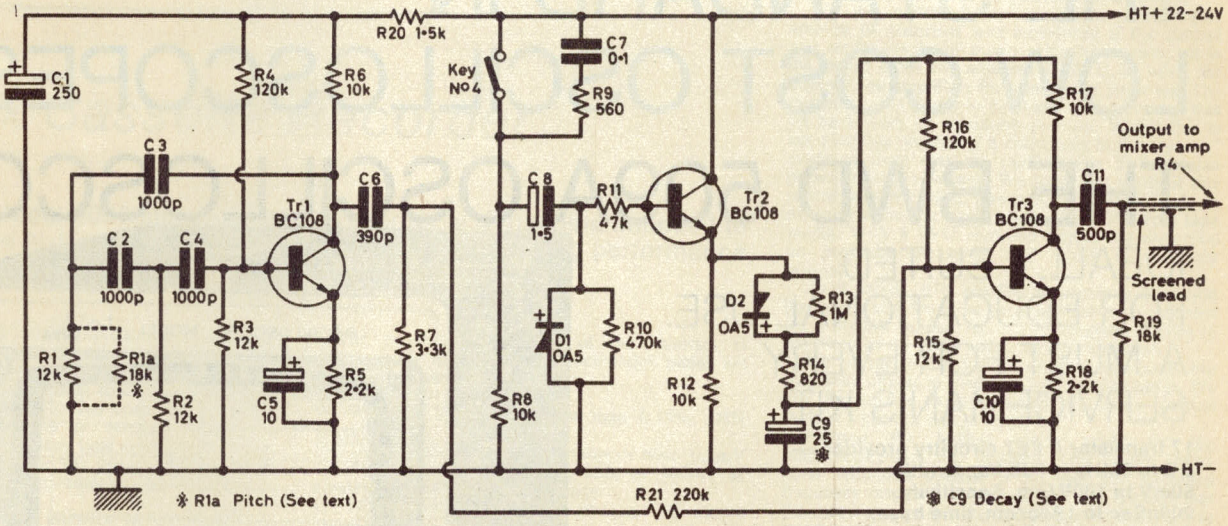


Figure 11: The circuit of the triangle sound synthesiser.

R22, D1 and C13. The negative voltage derived from this via R21 is applied to the base of Tr1 and produces a slight change in the pitch of the whistle frequency a fraction of a second after its initial sound.

It is however, important that the white noise content of the whistle is not too great. The effect, which is that of hissing steam, should be only just apparent and should appear on the output waveform as shown in figure 21. (Train Whistle waveform B.) The output waveform should also appear slightly clipped at the top. Adjustment to the level of the white noise content can be made by altering the value of R11 slightly, ie, increase R11 for a decrease in noise content and vice versa. The circuit board layout is given in figure 18.

BELL CHIME—No 8: A deep bell chime, similar to that produced by a large clock for

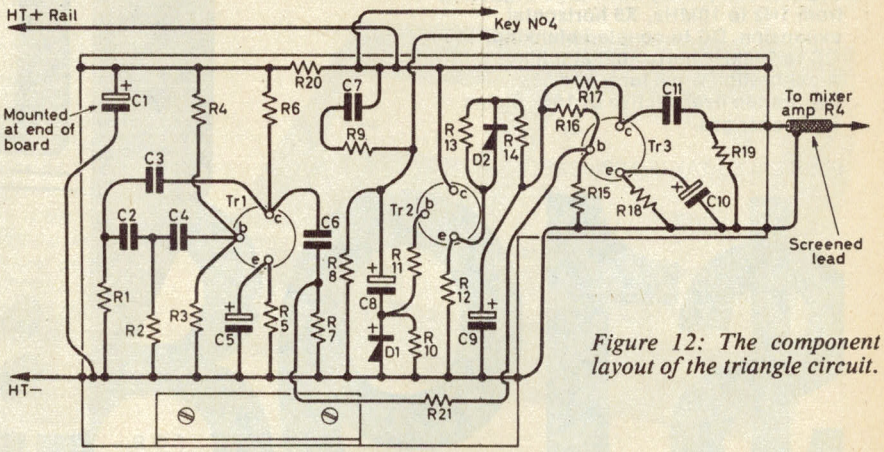


Figure 12: The component layout of the triangle circuit.

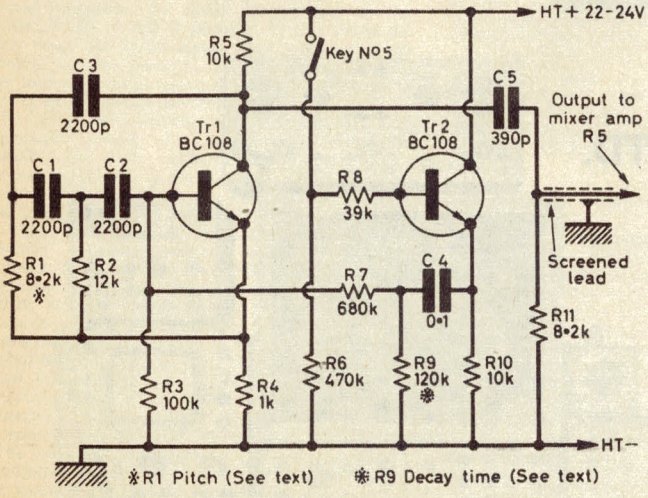
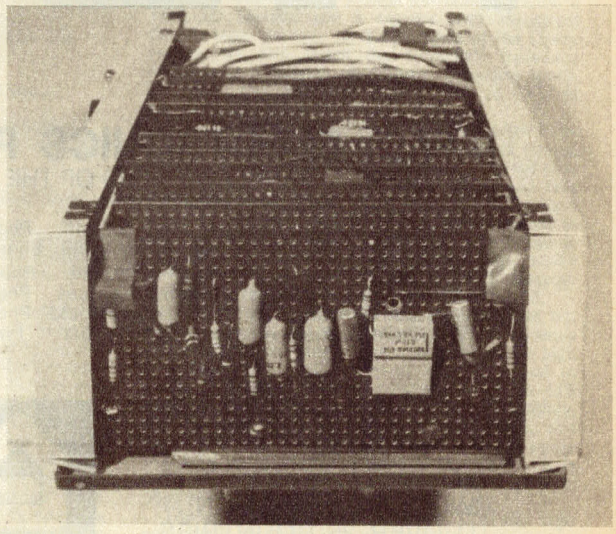


Figure 13: The wood block sound circuit.

An internal view of the completed project. The board shown is for the castanets circuit.



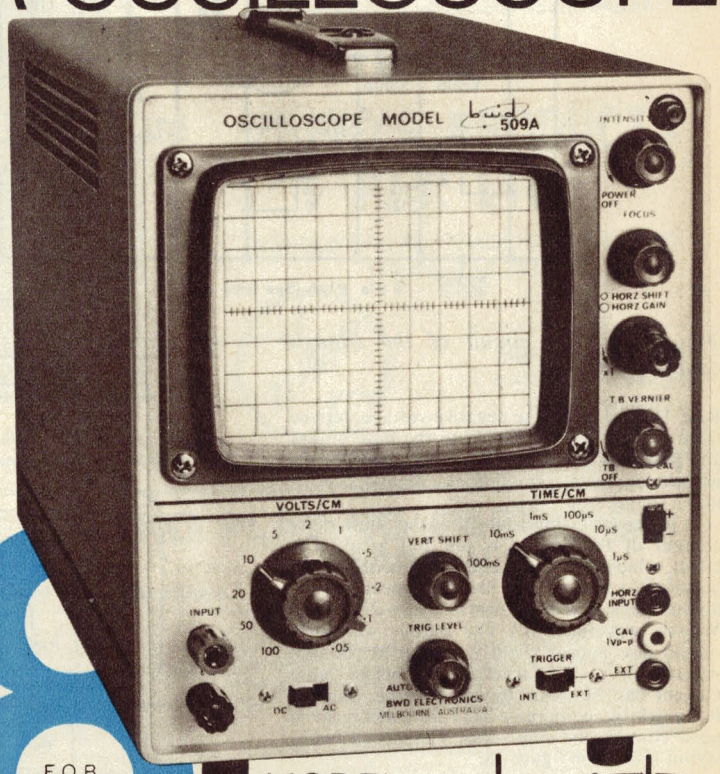
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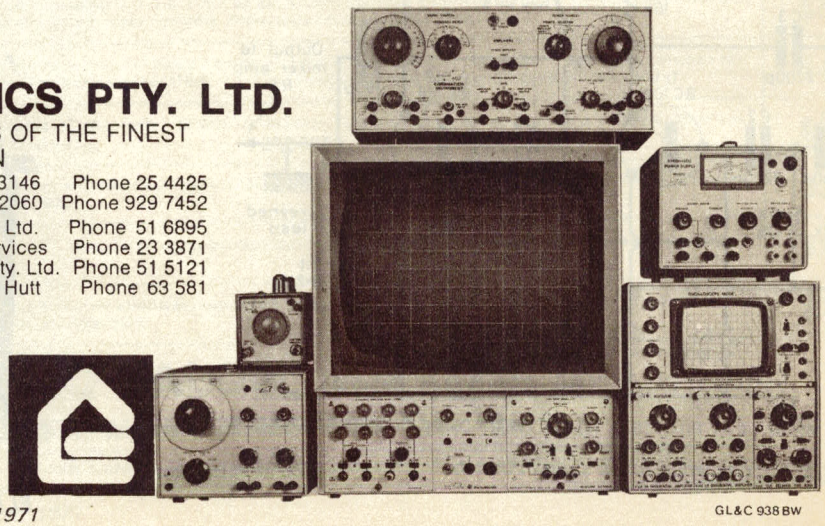


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instance, is a complex sound made up of an undulating fundamental and many overtones.

To achieve a close approximation of this without having to resort to the use of filters and/or a number of tone generators, a multivibrator has been used for the fundamental pitch and overtones. A strong beating or undulating effect is produced by adding another signal at almost the same frequency as the fundamental.

This extra signal is obtained from the taxi horn oscillator. The harmonics of this also add considerably to those produced by the bell chime oscillator and the result, after suitable attentuation and "voicing", is a deep undulating but strident clock chime.

The triggering circuit for the bell chime is produced by Tr3 which is switched on by key No 8. The action of the circuit is the same as that used for the cymbal and triangle circuits and the decay time about the same, ie, two to three

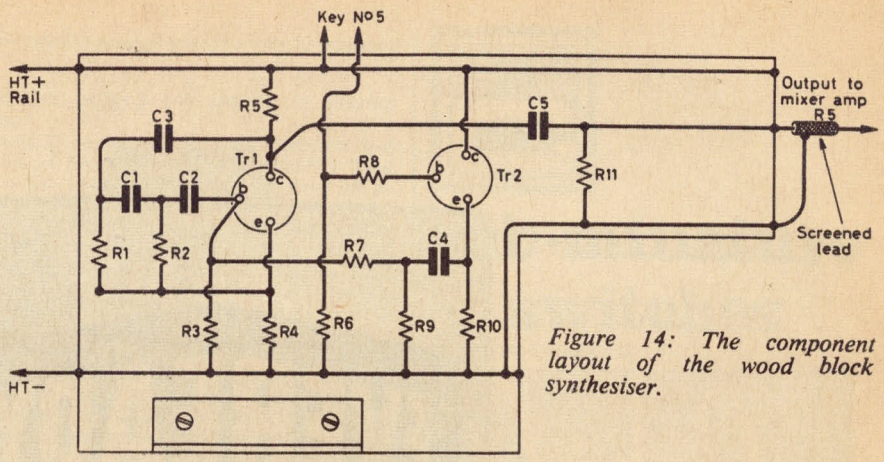


Figure 14: The component layout of the wood block synthesiser.

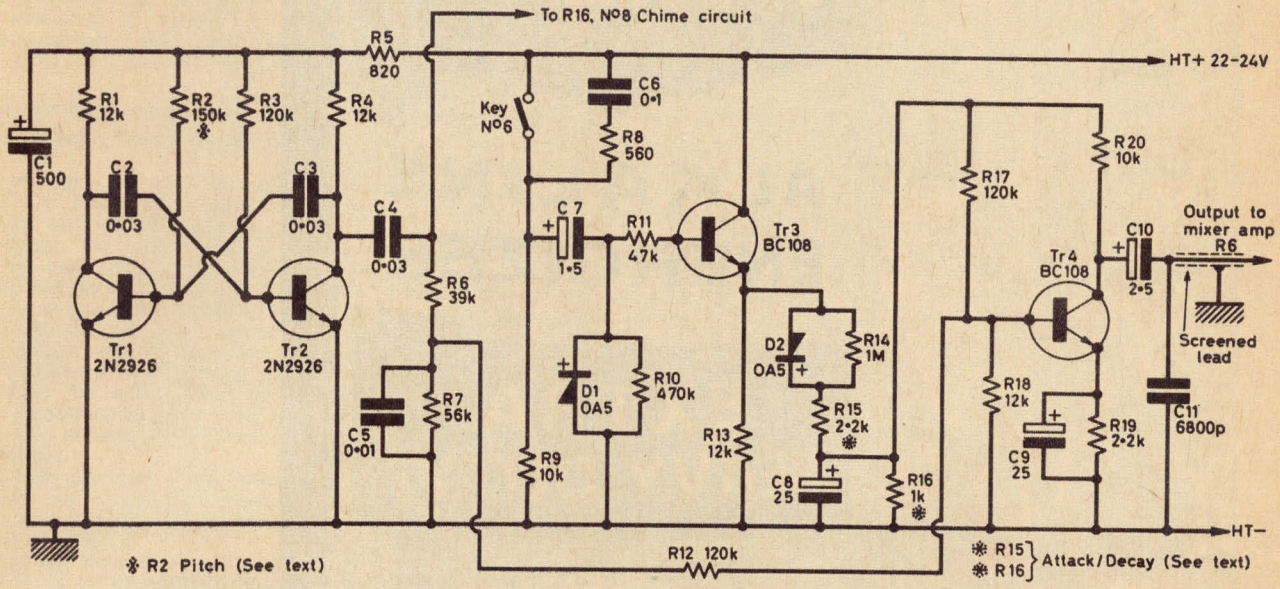


Figure 15: The taxi horn sound synthesiser circuit. The various waveforms produced are shown in figure 21 on page 37.

seconds.

The output from the bell chime oscillator Tr1-Tr2 is voiced by R6/C5 and attenuated by R12. The signal from the taxi horn oscillator is treated in much the same way by R16, C8 and R15. Both signals are fed to the base of Tr4. Further attenuation and voicing is introduced at the output from Tr4. The frequency of the signal produced by Tr1 and Tr2 should be adjusted by slight variation of R1 so that a slow audible beating effect is obtained when the sound is keyed.

Do not alter the pitch of the taxi horn circuit which should have been adjusted to between 200 and 250Hz. The pitch of the bell chime oscillator is best adjusted by substituting R1 with a variable of say 100K in series with a fixed resistor of not less than 18K, to prevent the base of Tr1 being taken straight to the positive rail. Pitch should then be adjusted until it is very close to that of the taxi horn oscillator frequency, ie, until a slow beat becomes audible.

Check the amount of resistance in circuit and replace with an appropriate value fixed resistor. It might be better to replace R1 completely with a small pre-set of say 50K in series with a fixed resistor of 18K. Again the effectiveness of the sound is best judged aurally but the output waveform, if displayed on an oscilloscope, should appear complex and with considerable fluctuation in the amplitude of the harmonics.

The triggering and output waveforms are

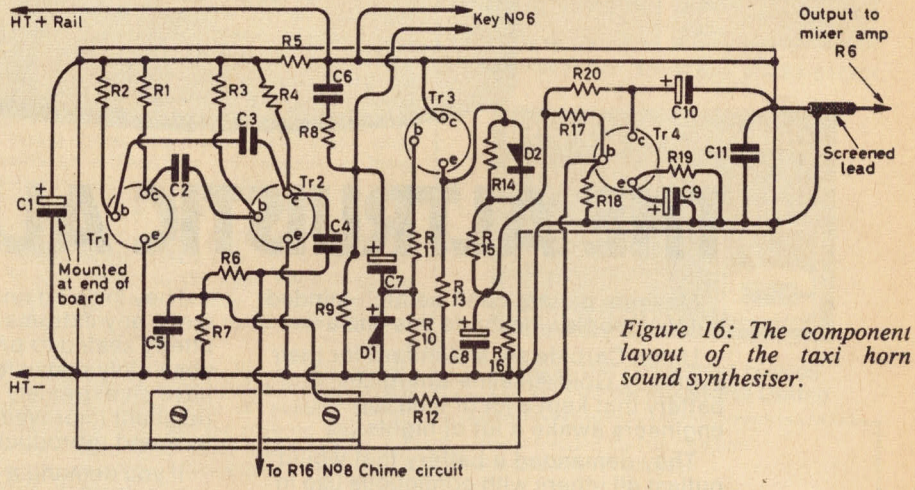


Figure 16: The component layout of the taxi horn sound synthesiser.

shown in figure 21. (Bell Chime circuit waveforms A, B and C.) The circuit board layout is shown in figure 20.

PARTS LIST, PART 2

TRIANGLE CIRCUIT No 4

Transistors

Tr1, Tr2, Tr3	BC108

Diodes

D1, D2	OA5

Resistors

R1	12K	R11	47K
R1A	18K	R12	10K
R2	12K	R13	1M
R3	12K	R14	820
R4	120K	R15	12K
R5	2.2K	R16	120K



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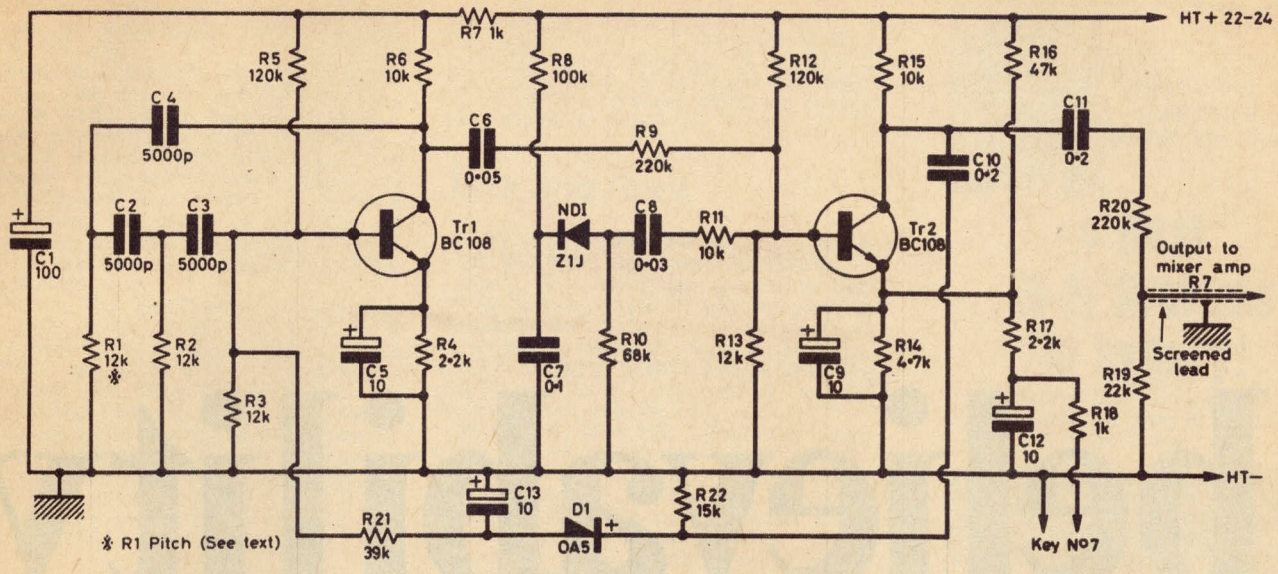
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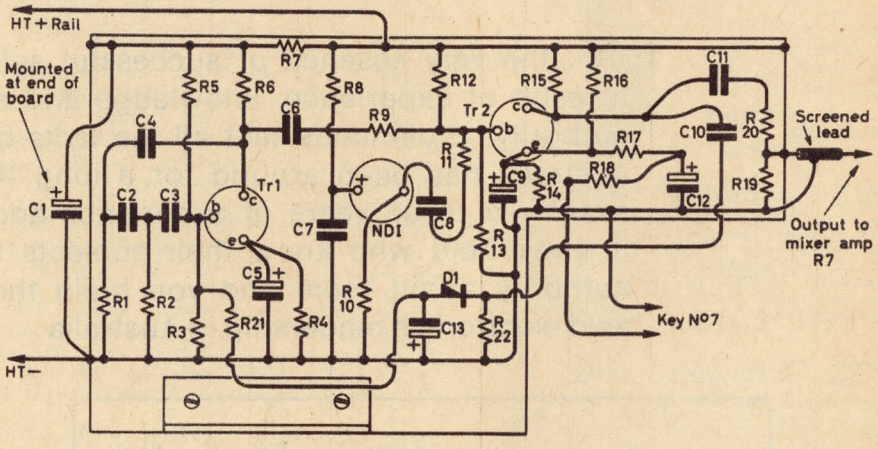
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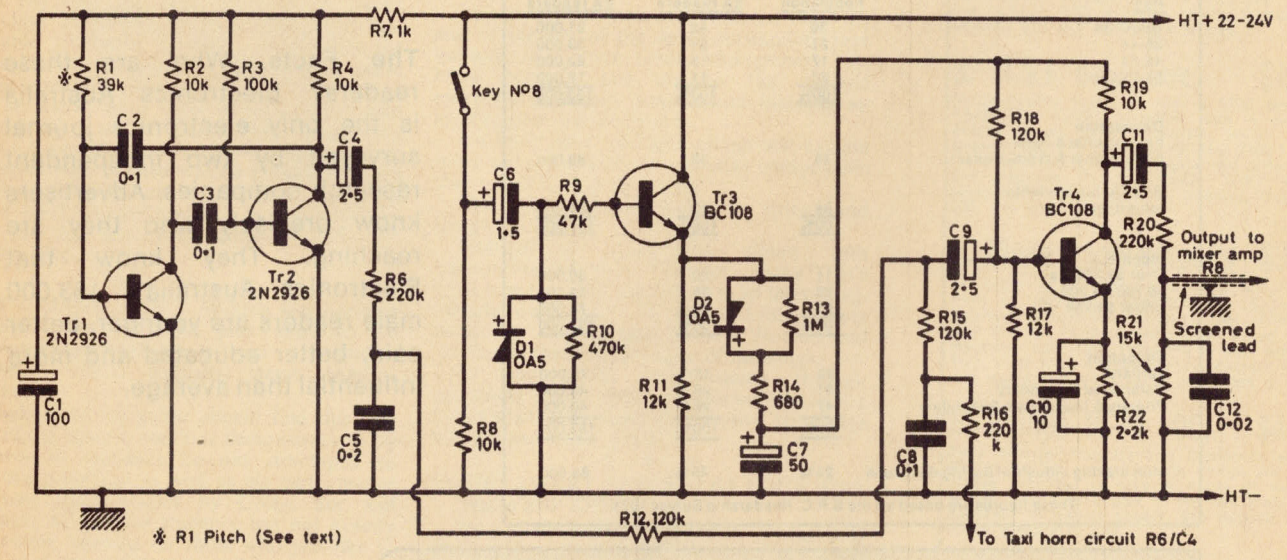
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ABOVE. Figure 17: The circuit used for simulating the train whistle sound.



RIGHT. Figure 18: The component layout for the train whistle synthesiser.



BELOW. Figure 19: The circuit of the bell chime synthesiser. The waveforms of the various stages are shown in figure 21 on page 37.

Resistors

R1	8.2K	R6	470K
R2	12K	R7	680K
R3	100K	R8	39K
R4	1K	R9	120K
R5	10K	R10	10K
R6	10K	R17	10K
R7	3.3K	R18	2.2K
R8	10K	R19	18K
R9	560	R20	1.5K
R10	470K	R21	220K

All ¼W, 10% tolerance

Capacitors

C1	250uF	C7	0.1uF
C2	1000pF	C8	1.5uF
C3	1000pF	C9	25uF
C4	1000pF	C10	10uF
C5	10uF	C11	500pF
C6	390pF		

WOODBLOCK CIRCUIT No 5

Transistors Tr1, Tr2 BC108

All ¼W, 10% tolerance

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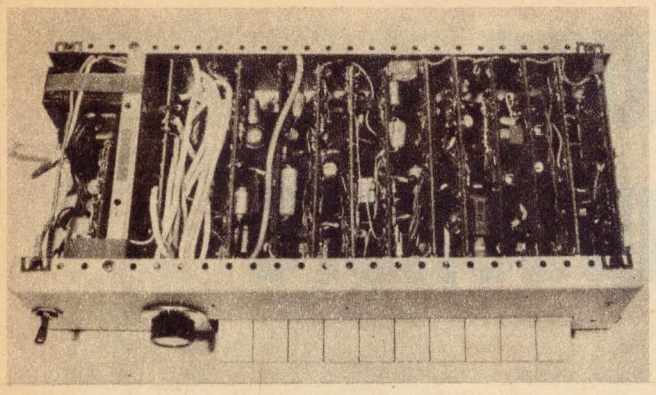
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45-54	17	15	22,000
55 & over	23	11	17,000
	100%	100%	153,000
Occupation			
Professional & Semi-professional & White Collar	46	58	89,000
Blue Collar, students, retired, etc.	54	42	64,000
	100%	100%	153,000
Income			
Over $6,700 p.a.	11	20	30,000
$6,700-$4,200	28	35	53,000
Under $4,200	61	46	70,000
	100%	100%	153,000
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Tertiary	22	45	70,000
Completed Secondary	31	29	45,000
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The various boards are shown at the centre and right, the power supply on the left.

Capacitors

C1	2200pF	C4	0.1uF
C2	2200pF	C5	390pF
C3	2200pF		

TAXI HORN CIRCUIT No 6

Transistors

Tr1, Tr2	2N2926
Tr3, Tr4	BC108

Diodes

D1, D2	OA5

Resistors

R1	12K	R11	47K
R2	150K	R12	120K
R3	120K	R13	12K
R4	12K	R14	1M
R5	820	R15	2.2K
R6	39K	R16	1K
R7	56K	R17	120K
R8	560	R18	12K
R9	10K	R19	2.2K
R10	470K	R20	10K

All ¼W, 10% tolerance

Capacitors

C1	500uF	C7	1.5uF
C2	0.03uF	C8	25uF
C3	0.03uF	C9	25uF
C4	0.03uF	C10	2.5uF
C5	0.01uF	C11	6800pF
C6	0.1uF		

TRAIN WHISTLE CIRCUIT No 7

Transistors

Tr1, Tr2	BC108

Diodes

NDI	Noise Diode Z1J Semitron (see Part 1)
D1	OA5

Resistors

R1	12K	R12	120K
R2	12K	R13	12K
R3	12K	R14	4.7K
R4	2.2K	R15	10K
R5	120K	R16	47K
R6	10K	R17	2.2K
R7	1K	R18	1K
R8	100K	R19	22K
R9	220K	R20	220K
R10	68K	R21	39K
R11	10K	R22	15K

All ¼W, 10% tolerance

Capacitors

C1	100uF	C8	0.03uF
C2	5000pF	C9	10uF
C3	5000pF	C10	0.2uF
C4	5000pF	C11	0.2uF
C5	10uF	C12	10uF

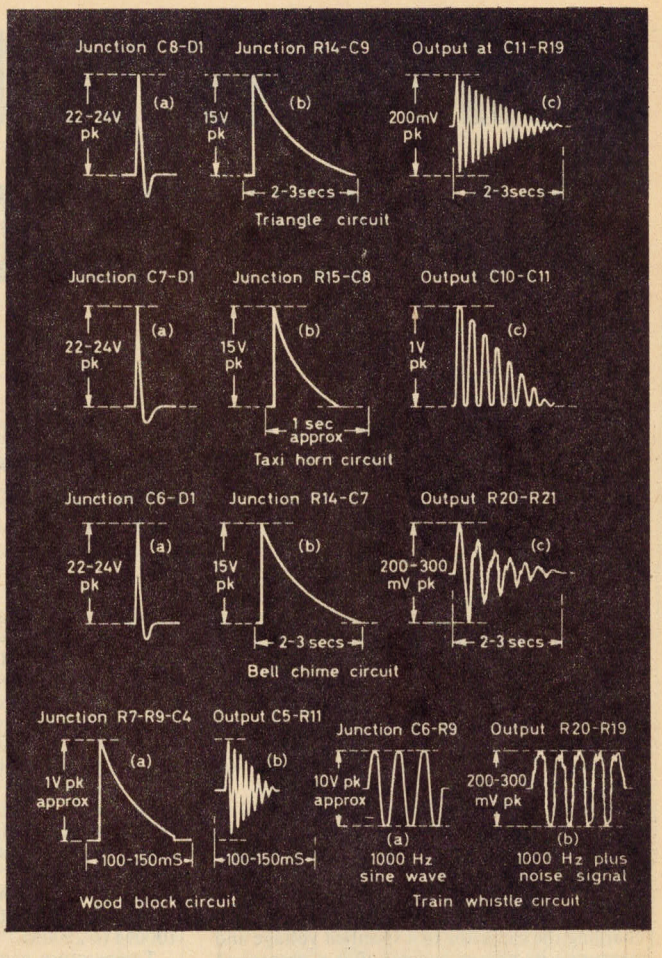


Figure 21: The waveforms produced by the circuits described in Part 2. If possible, these should be checked on an oscilloscope.

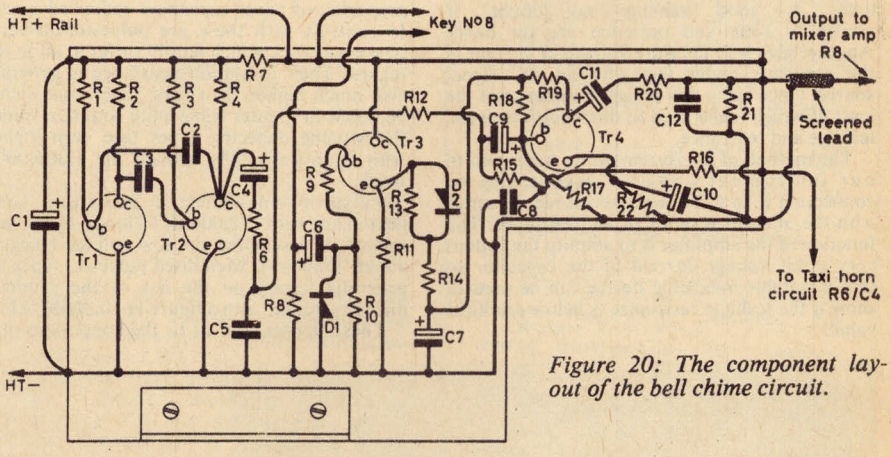


Figure 20: The component layout of the bell chime circuit.

C6	0.05uF	C13	10uF
C7	0.1uF		

BELL CHIME CIRCUIT No 8

Transistors

Tr1, Tr2	2N2926
Tr3, Tr4	BC108

Diodes

D1, D2	OA5

Resistors

R1	39K	(see text)		
R2	10K		R13	1M
R3	100K		R14	680
R4	10K		R15	120K
R5	omitted		R16	220K
R6	220K		R17	12
R7	1K		R18	120K
R8	10K		R19	10K
R9	47K		R20	220K
R10	470K		R21	15K
R11	12K		R22	2.2K
R12	120K			

All ¼W 10% tolerance
(Note: R5 omitted following circuit modification.)

Capacitors

C1	100uF	C7	50uF
C2	0.1uF	C8	0.1uF
C3	0.1uF	C9	2.5uF
C4	2.5uF	C10	10uF
C5	0.2uF	C11	2.5uF
C6	0.5uF	C12	0.02uF

TO BE CONTINUED

Build this Leakage Checker for capacitors

Although leaky capacitors are often responsible for many of the fault symptoms which appear in aging electronic equipment, testing capacitors quickly is not easy. This simple transistorised unit performs a full 500V leakage test, yet is small enough to slip into a serviceman's tool-bag.

by PHILIP PIK

Leaving aside the more sophisticated laboratory measurement techniques, detection of the leakage current of a capacitor with the full rated working voltage applied is probably the simplest means of indicating its general condition. At least it tells the serviceman if there is a troublesome leakage or if he has a potentially faulty capacitor in hand — this last point being of particular importance to him.

One could add, of course, that it is helpful to know the exact capacitance as well, but equipment which applies a simultaneous leakage and capacitance test is necessarily more elaborate than we have in mind at the moment.

One testing method involves, for example, charging the capacitor to a specified voltage and measuring its charge current after a prescribed time. A good scheme no doubt, if plenty of time and patience are on hand. Another idea is to measure voltage or current in the capacitor under test with an AC signal source. Once again this brings problems, not the least of which is the need to distinguish between leakage and reactance.

The method of measurement we have used in our instrument consists essentially of connecting it to a DC voltage source, in series with the input of a sensitive DC amplifier. The function of the amplifier is to amplify the (often) very small leakage current of the capacitor so that a suitable indicating device can be used to show if the leakage resistance is below a critical value.

Leakage or insulation resistance is the actual DC resistance between the two "plates" of a capacitor, and is therefore a function of the insulating properties of the dielectric material used. A perfect capacitor would be one having no leakage at all, and whilst perfection in such matters is never attained, the leakage resistance of a good capacitor is very high indeed.

To quote some examples, the insulation resistance of most paper dielectric capacitors is in the range of 2000 to 5000 megohms per microfarad. This means that an 0.1uF capacitor in good condition should have an insulation resistance in the range of 20,000M to 50,000M, whilst a 2uF capacitor should lie in the range of 1000M to 2500M.

Temperature generally effects the insulation properties of paper capacitors rather adversely. In contrast with these are polyester-dielectric type capacitors, which hardly suffer at all in this regard. Their insulation resistance is generally also much higher than their paper equivalents, 50,000M or greater being quite common values. Polystyrene dielectric types rate even higher, with figures typically around the 1,000,000M mark.

Polypropylene-dielectric capacitors come next in line with 250,000M, followed by ceramic capacitors (excluding the low voltage types) at about 100,000M. Metallised polyester types are generally lowest on the list of the synthetic dielectric range, with a figure of 10,000M/uF.

These figures lead us to the conclusion that, ideally perhaps, we should be capable of measuring insulation resistance over the range of about one thousand to one million megohms.

However, practical limitations place a limit on the upper range that can easily and economically be achieved. Another point to consider is that whilst it may sound ideal to test every type of capacitor to its limit, in many of their applications insulation properties anywhere near their upper limits are not required. Take as an extreme example the case of a polystyrene capacitor bypassing a 1K emitter resistor. Quite clearly, an insulation resistance of only a few megohms would be more than adequate in this case.

At the other end of the scale is the case where a capacitor is used in timing circuits with long periods. Here insulation properties are of extreme importance as they directly effect the upper limit of the performance of the circuit.

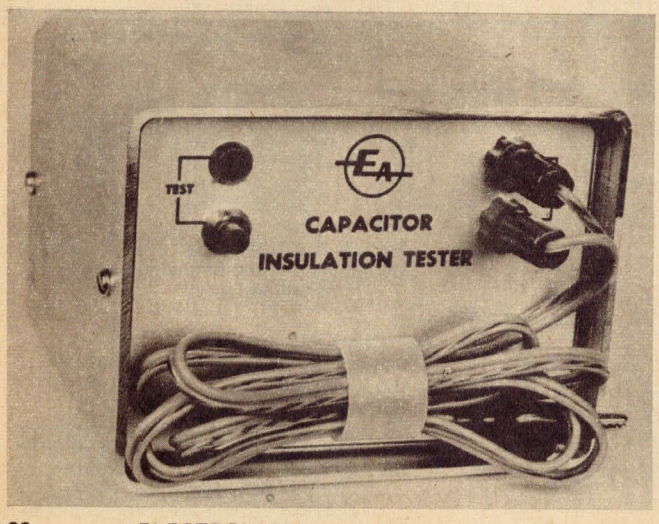
With these two extreme conditions in mind, in developing the tester shown we settled for an "in between" value of 1000 megohms, this order of resistance being what we believe is a reasonable compromise between the demands of most circuits encountered in the domestic entertainment field and that which can be practically achieved in a measuring instrument without undue complexity and cost.

Admittedly, most bypass applications do not require capacitors with this order of insulation resistance, but it must be remembered that once a capacitor shows a leakage resistance below about 1000M it must be suspect. This applies particularly to paper capacitors which have a habit of deteriorating very rapidly with elevated temperatures once they exhibit some leakage.

Lastly, whilst on the subject of capacitors, mention should be made of test voltages. Although it may seem at first that capacitors with different voltage ratings would require different test voltages, this is not necessarily the case. Virtually any capacitor with a working voltage rating of 100 volts or more may be tested at the "Standard" 500 volts common to nearly all "meggers", for short periods of time. Testing capacitors at many times their rated voltage is in fact a standard procedure adopted by manufacturers. Hence, in view of this and the fact that 500 volts is the generally recognised "standard" test voltage, as mentioned before, we have provided our instrument with a single 500V test voltage facility.

Having dealt with the various basics on capacitors and the test instrument, let us now turn to the main circuit details.

From the circuit diagram it may be seen that the necessary high voltage is generated by a DC to DC converter, comprising Tr1, Tr2, and T1, the inverter transformer. Some readers may already have recognised this transformer to be the same as that used in the High Efficiency



The completed leakage checker, a little smaller than half actual size. It is fully self contained, with an internal battery supply.

Flasher published in the August 1971 issue. But more on this when we give the transformer details later.

Operation of the converter is conventional and will not be dealt with here. Note, however, the addition of a 0.001uF capacitor across the common lower base bias resistor (the 68 ohm resistor) to prevent high frequency crosscoupling between the two transistors. Without this capacitor self-starting of the converter can prove unreliable.

The output of the inverter transformer is fed into a ladder multiplier rectifier network which boosts the voltage to the required 500 volts DC. Filtering of the output voltage is achieved by the 0.047uF filter capacitor. The 3.9M resistor in parallel with this capacitor discharges the stored energy once the converter is switched off.

The capacitor under test is connected across terminals A and B, ie, between the 500V source and the input circuitry of the high gain DC amplifier formed by Tr3, Tr4 and Tr5.

PARTS LIST

1 Case measuring 4in x 3in x 4in (WxHxD). See text for details.
1 Front label.
1 Miniature lamp bezel 14V Red, low consumption type. Plessey type BFB or similar.
1 Miniature DPDT pushbutton switch. C&K type P8221 or similar.
2 Banana jacks (sockets), red.
2 Banana plugs, red.
4 ft miniature figure 8 flex.
2 Crocodile clips, red.
1 276P Eveready battery or equivalent.
1 Plug to suit above battery,
2 FX2240 ferrite half-cups.
1 DT2179 bobbin to suit above cups, or converter transformer (RCS part no 130).

SEMICONDUCTORS
2 TT801 or AY8139 transistors, or similar.
2 TT108 or BC108 transistors.
1 BC179 transistor
3 EM404 silicon diodes, or similar

RESISTORS (½ watt)
1 3.9 meg.
1 1.5 meg.
1 470K
1 330K.
1 560 ohm.
1 68 ohm.

CAPACITORS
1 0.1uF/50VW polyester.
1 0.047uF/630VW polyester.
2 0.01uF/400VW polyester.
1 0.001uF/50VW polyester.

The operation of this part of the circuit is as follows. If a capacitor is connected across the terminals A and B and the TEST button pressed, the output voltage will be applied across the capacitor under test. The initial charging current will flow through the 470K current limit resistor and R1, the 1.5M bias resistor for Tr3. This transistor is connected in the "upside down" emitter-follower configuration, and is normally conducting heavily.

The initial voltage developed across R1 by the charging current turns Tr3 off. This in turn causes Tr4 and Tr5 to turn on, lighting the indicator lamp. If the capacitor under test is a good one, the charging current will steadily decrease to zero (for large capacitors this may take several seconds) finally allowing Tr3 to become forward biased once more and hence go back into conduction. Tr4 and Tr5 will then be turned off, also turning off the indicator lamp. But if the capacitor is faulty, ie, has an insulation resistance less than 1000M, Tr3 will remain off, causing the indicator to remain on.

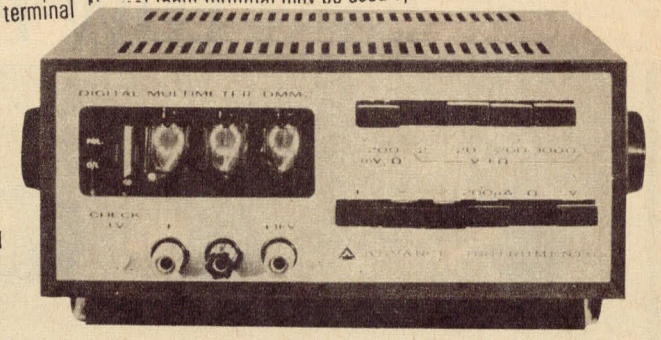
Should the terminals A and B become

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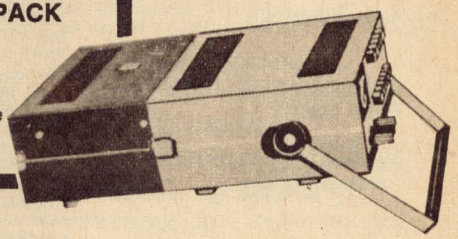
DMM 2 DIGITAL M/METER

The DMM2 is a compact instrument which provides a clear reading of AC and DC voltage and current, and resistance—with all push-button selection. The SP-2 Current Shunt extends normal current ranges by eight and is available as an optional extra.

- **DC & AC Voltage Ranges—** 200.0 mV-1,000V each in 5 ranges
- **DC & AC Current Ranges—** 200.0 μA each with an extra 4 ranges each up to 2,000A with SP-2 Current Shunt
- **Resistance Ranges—** 200.0 Ω-2,000 KΩ in 5 ranges
- **Sample Rate—** approx. 5 readings/sec.
- **Response Time—** DC ranges, less than 1 sec. AC ranges, approx. 3 sec.

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When fully charged, Battery Pack BP2—an optional extra—gives 5 hours' field operation. Easily fitted to the rear of the DMM2 . . . gives you completely portable operation.



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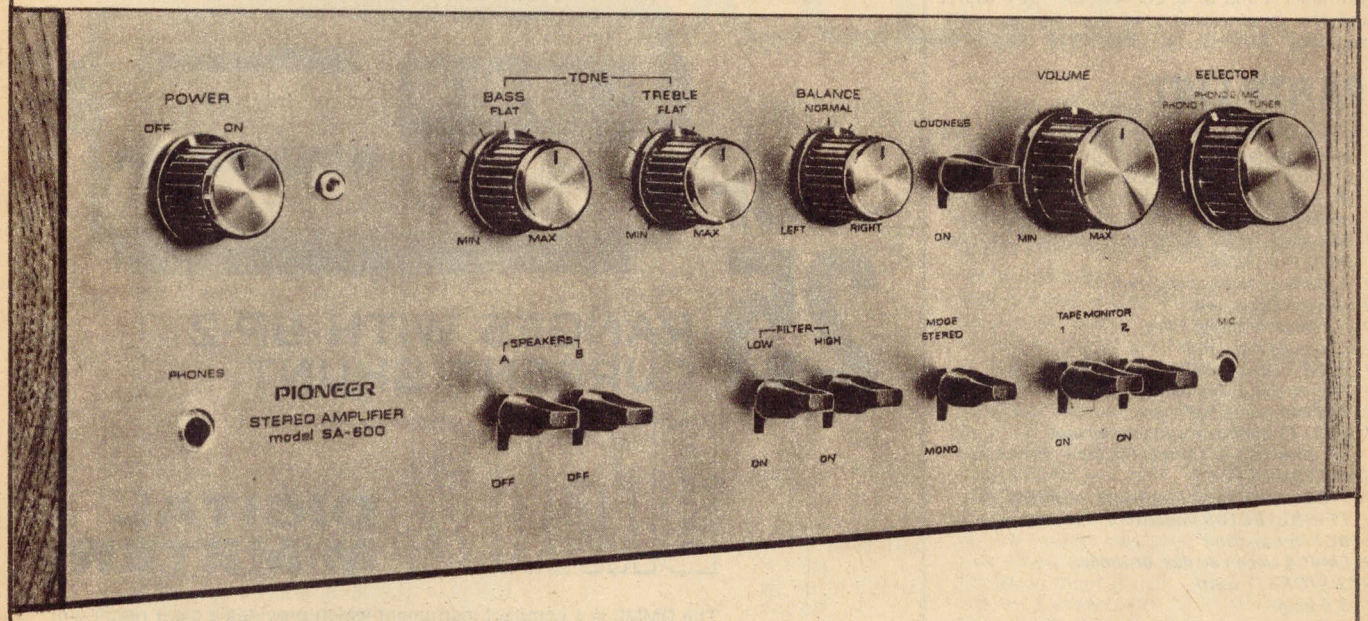
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SPECIFICATIONS:

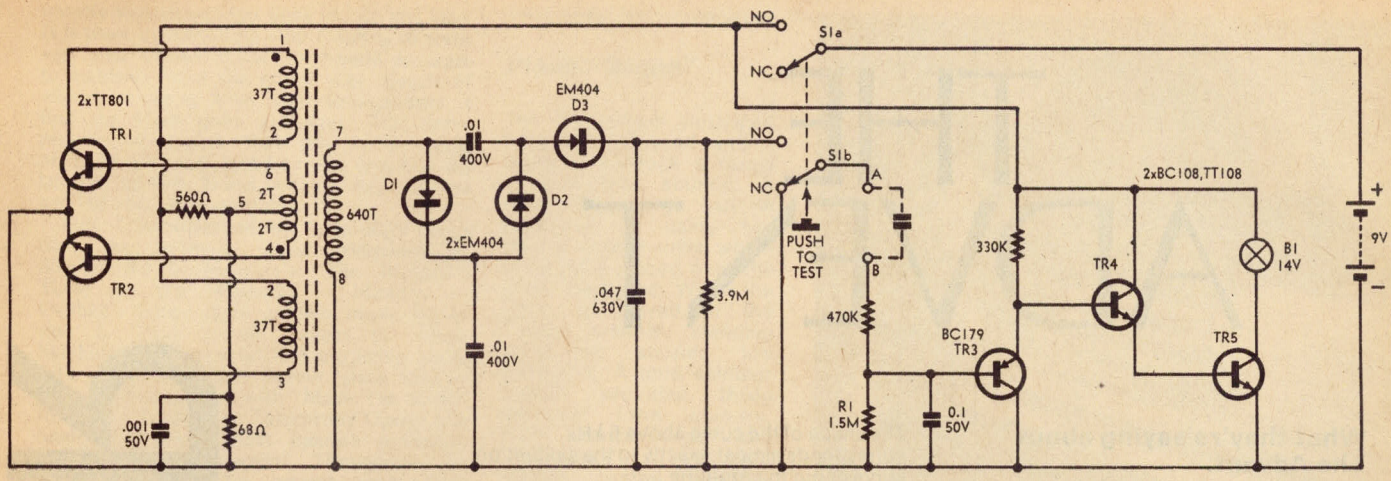
Continuous Power Output: (both channels driven) RMS	19 watts + 19 watts (8 ohms)
Harmonic Distortion:	Less than 0.5%
Inter Modulation Distortion:	Less than 0.5%
Power Bandwidth (1 HF):	10 to 50,000 Hz (8 ohms, harmonic distortion less than 0.5%)
Frequency Response:	15 to 70,000 ± 1dB
Damping Factor:	30 (8 ohms, 1 KHz)
Input Sensitivity/Impedance: (1 KHz, rated output)	PHONO: 1, 2: 2.3 mV/50 k ohms MIC: 3.3 mV/20 k ohms TUNER: 200 mV/95 k ohms AUX: 1, 2: 200 mV/95 k ohms TAPE MONITOR: 1, 2: 200 mV/95 k ohms
Recording Output:	TAPE REC: 1, 2 (pin jack): 200 mV TAPE REC: (DIN connector): 30 mV
Bass Control:	— 15 dB, + 13 dB/50 Hz
Treble Control:	— 10 dB, + 9.5 dB/ 10 KHz
Low Filter:	— 6.5 dB/50 Hz
High Filter:	— 8 dB/10 KHz
Loudness Contour:	+ 13 dB/50 Hz, + 7 dB/ 10 KHz, with volume control set at — 40 dB position
Hum and Noise (1HF):	PHONO: better than — 80 dB TUNER, AUX: better than — 95 dB
Channel Separation (1 KHz):	PHONO: more than 50 dB TUNER, AUX: more than 55 dB

This handsomely styled unit from **PIONEER** is perfect for the stereo enthusiast who is building his system within a stipulated budget. The **SA 600** provides professional performance at a very practical price. It uses only long-life, low-noise silicon transistors, thus the frequency response and signal-to-noise ratio are superb. Two tape decks or two speaker systems may be used with the **SA 600** and the unit may also be adapted for multi-amp use. Equipped with two pairs of PHONO, TAPE and AUX input terminals it may be used for tape-to-tape duplications or two sets of speakers may be used simultaneously to compare the qualities of each system.

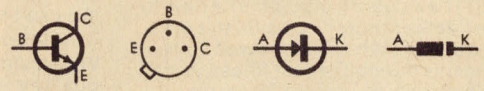
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V4279



EA CAPACITOR INSULATION TESTER



7/CM/6

The circuit of the leakage checker. It uses a simple DC-DC converter to produce 500VDC, and a three-transistor lamp driver circuit to detect any leakage current drawn by a capacitor with this voltage applied.

shortcircuited either through a faulty capacitor or by accidentally short-circuiting the terminals, no harm is done as transistor Tr3 is protected by the 470K series resistor. This resistor, in conjunction with R1, also serves to discharge the capacitor at the end of the test. From the circuit it can be seen that with the TEST button in its rest position, terminal A is connected to ground. Hence, the capacitor is discharged via the 470K resistor and the base-collector junction of Tr3.

To prevent Tr3 from being unduly sensitive to hum voltage picked up externally (via the connecting leads), and also to prevent it responding to internally generated voltage spikes from the inverter, an 0.1uF capacitor has been connected across R1, effectively bypassing these unwanted voltages.

As the circuit diagram indicates, the operating voltage for the entire instrument is 9 volts. Current drain of the inverter stage is 60mA. The indicator circuitry draws an additional 20mA when the pilot light is operating, but negligible current when the light is off. To achieve this low current drain a low consumption 14V indicator lamp is used.

To adequately supply the current drain of the tester on an intermittent basis, we have selected the Eveready 276P battery. This battery presents a good compromise between physical size, power output and life expectancy. It is difficult to predict the service life that can be expected, as current is required only on an intermittent basis, but as a guide Eveready predict an expected life of some 50 hours under **continuous** operating conditions. Under intermittent operating conditions a much longer service life may be expected. These figures relate to a terminal voltage of 1 volt per cell, or 6 volts for the complete battery.

Operation of the instrument at this voltage is quite satisfactory and not effected by the rise in the battery's internal impedance. Naturally, the full 500V will not be available, but the circuit's response to leakage resistance will be much the same in spite of low operating voltages because the sensing or indicator circuitry is to a large extent self-compensating. Likely variations to be encountered are only in the order of ±10% for supply voltages between 6 and 9 volts.

The sensing circuitry is also self-compensating to a moderate degree against temperature variations. Typically, the worst likely deviation to be encountered in sensitivity to leakage resistance is about ±20% over a temperature range of 10 to 50 degrees C.

Some constructors may wish to check the

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THE ADVENT LOUDSPEAKER

What they're saying about The Advent.

Although The Advent Corporation is new to the high-fidelity scene, its president is well known to anyone who has followed audio developments during the past fifteen years. Henry Kloss, a co-founder of Acoustic Research and later of KLH, is back with what promises to be an unusually diversified line of audio components. To no one's surprise, one of the first Advent products is a speaker system. It is more evolutionary than revolutionary in design, incorporating new materials and processes rather than new principles. The Advent speaker measures 25½" x 14¼" x 11½", and is suitable for use on the floor or on a bookshelf. It's a two-way system, with a newly designed woofer that has an effective cone diameter of 7½", although its overall diameter would usually cause it to be classified as a 10" speaker. The cone surround (outer suspension) is a specially processed polyurethane, quite different from the rubber-like compounds used with most speakers. The woofer's smallish diameter did not impair its low-frequency performance in the least, as our tests subsequently proved.

The tweeter is a direct radiator with a phenolic-resin cone 2 inches in diameter, also designed specially for this system. A three-position toggle switch in the rear of the cabinet selects normal highs, reduced highs, or extended highs, to suit one's taste.

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JULIAN D. HIRSCH

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We can't recall having heard another speaker in its price class that can match it . . .

We would consider that it ranks in sound quality with most speakers at twice its price.

ELECTRONICS WORLD

The lows, . . . remained strong and clean all the way down to 20 kHz with very low distortion . . . Without a doubt, The Advent is one of the smoothest and widest-range speakers we have had the pleasure of testing . . .

The tone-burst response was excellent throughout, ranking with the best we have seen from any speaker. **STEREO REVIEW**

. . . the frequency response was flat, with only ±3 dB variations over the major portion of its range. What is more important is that the 45-degree off-axis response follows the on-axis response to a remarkable degree, denoting excellent high-frequency power response . . .

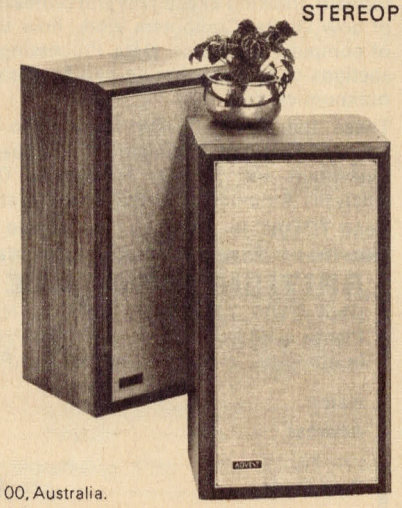
One could say that at twice the price The Advent speaker would be a good value.

AUDIO

After several weeks of listening, we still hadn't found anything to complain about. They were, in fact, the least-coloured loudspeakers we have ever heard, and this includes the highest-priced systems currently available.

Probably for just that reason, The Advents proved eminently easy to live with. Dispersion was excellent and so, as a consequence, was the stereo imaging.

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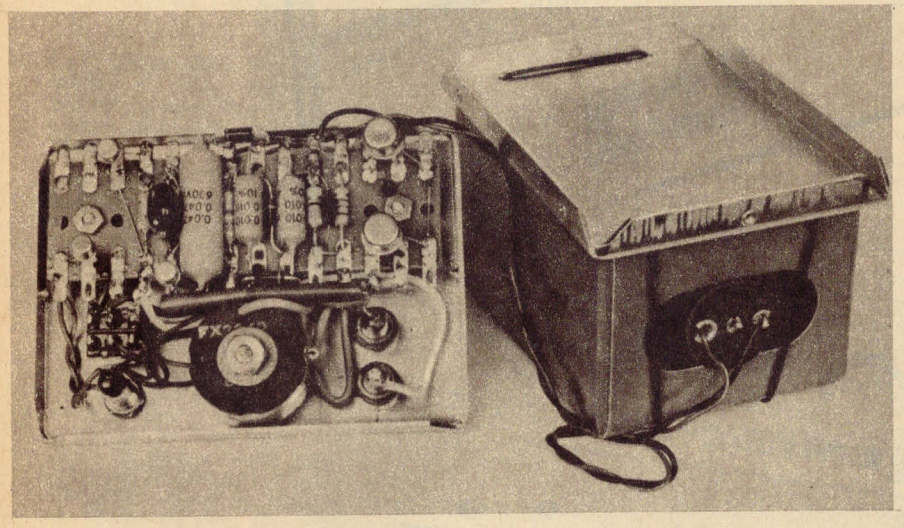
AU109

calibration of their instrument. To do this accurately a 1000M resistor is required. Resistors of this magnitude are generally not easy to come by, but if an EHT probe is on hand it can be pressed into service as these more often than not have a built-in resistor of 990M—a figure quite close enough for our purpose.

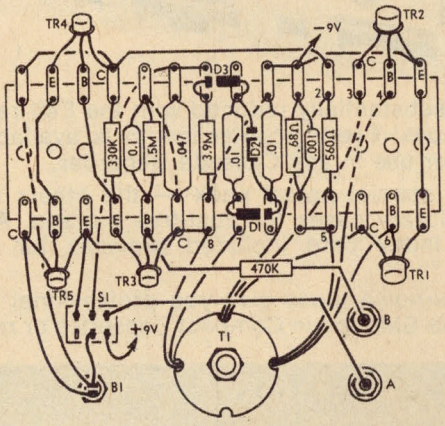
To adjust the sensitivity of the sensing circuit, connect the probe between terminals A and B and trim R1 such that the indicator light just comes on. Lowering its value results in decreased sensitivity, ie, an insulation resistance less than 1000M will be required to turn the indicator on. Conversely, increasing the value of R1 will result in an increase in sensitivity.

especially if one of the ready made transformers is employed. The complete unit is housed in a case measuring only 4in wide by 3in high by 4in deep. It consists essentially of a 4in length of 4in by 3in rectangular section extruded aluminium, available from most of the larger hardware stores. The ends consist of two pieces of 18SWG aluminium with $\frac{1}{8}$in flanges turned over at right angles around the edges. Ready-made units of this type are available from at least one supplier in Sydney.

All components are mounted on one of the end panels, as the illustrations show. The same end panel also serves as the front panel. The transformer mounting bolt and tagboard

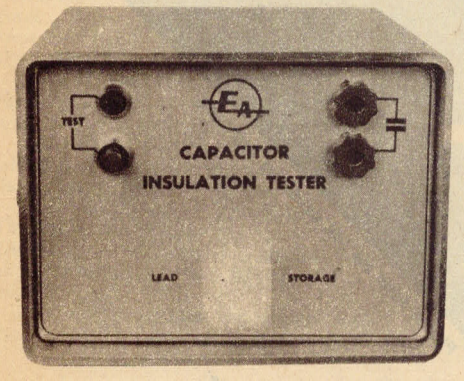


Above is a view of the interior of the checker, showing the wiring and the battery. At right is a wiring diagram to help the reader in locating the parts.



As mentioned earlier, this instrument uses the same inverter transformer as used in our High Efficiency Flasher published in the August issue last. These transformers are now available ready-made from at least one supplier, RCS Radio Pty Ltd of 651 Forest Road, Bexley, NSW. A sample was submitted by this firm and was in fact used in this project. Although identical in construction to our prototype in the August issue, the lead coding differed. We have therefore included connection details for this particular transformer in the Transformer Information panel.

Construction of the tester is straightforward,



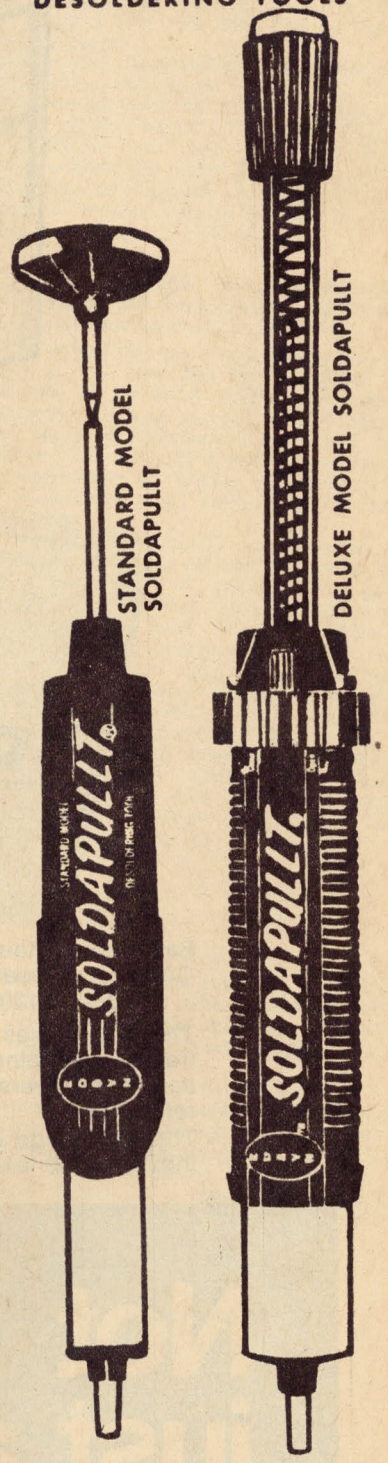
A view of the front of the checker, showing the lead storage loop.

securing screws pass through the panel, and in view of this it is suggested that countersunk-head screws be used to give a flush surface over which the front label can be fitted.

Once the front label is in position, the banana sockets, indicator lamp and pushbutton switch may be mounted. Be sure to correctly orientate the pushbutton; the "common" lugs should face the transformer. Finally, in the way of front panel details, secure a short length of $\frac{1}{8}$in flexible tubing, or a short length of plastic sleeving formed into a loop, to the panel in between the words "Lead Storage." This little aid will be found extremely handy to store the clip leads whilst they are not in use.

Nearly all circuit components are mounted on a short length of miniature tagboard, 14 lugs long. Wiring the board should present few problems provided the wiring diagram is followed carefully. Note the 470K resistor which runs from the lower of the two banana jacks to the base of Tr3. For safety reasons this

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TRANSFORMER WINDING DETAILS

Order of windings: Secondary, Primary, Feedback.
Secondary: 640 turns, 38B&S DTE. Code start with knot.
Interleave: One wrap of electrical tape or polythene film between secondary and primary.
Primary: 37 turns, 37 turns, bifilar (two in hand). 26B&S DTE. Place two knots in one start.
Feedback: 2 turns, 2 turns, bifilar (two in hand). 26B&S DTE. Place three knots in one start.
Outer wrap: One wrap of electrical tape.

Transformers of this kind are quite simple devices to construct, partly because the number of turns is relatively small, but mainly because they are designed to use a ready-made bobbin and core.

When winding coils of this type, counting and handling can be made easier by clamping the bobbin between two large washers, using a long bolt, and rotating this assembly in the chuck of a small hand drill held in a bench vyce. This leaves one hand free to guide the wire, so that an even winding results.

Count the number of times the drill chuck rotates with one turn of the handle. Divide the number of secondary turns by this number. If your drill ratio is, say, 5:1, it will require 128 turns of the handle to place the required 640 turns on the bobbin.

Commence construction of your transformer by clamping the Delrin bobbin between two large washers as mentioned earlier. The washers prevent collapse of the side cheeks of the bobbin as the winding proceeds.

Take the 38B&S DTE (Double Tough Enamel) wire, tie a knot in it about two inches from the end, and lay the wire in the bobbin so that the end passes through a deep cheek notch for about three inches. Anchor the start with a small piece of electrical tape. Secure the free end of the wire on the drill chuck with ordinary cellulose tape or a rubber band.

Make sure that the wire passes through a deep cheek notch and not a half deep one, as the build-up of wire against this lead for about half the winding will place too high a voltage stress on the wire insulation when the converter is operated.

Proceed to wind the secondary, guiding the wire carefully to keep an even build-up. Finish off the winding with a small piece of tape so that the last turn will come out on the same side as the start. Place one wrap of polythene film or electrical tape over the completed winding.

The primary winding is of thicker gauge wire, and cannot be conveniently wound with the hand drill. A tighter, more even winding will be achieved by hand winding.

Take two 5ft lengths of 26B&S DTE wire and lay them side by side. Tie two knots in the start end of one and twist lightly with the other for about two inches. With the bobbin assembly still mounted on the bolt, but placed in the vyce instead of the drill chuck, wind on the required number of turns in the same direction as the secondary winding. Anchor the start in the same way. Avoid crossing the two wires and keep each turn as close to the previous turn as possible. Count off the winding as though the two wires were one wire. Anchor the finish with electrical tape.

The feedback winding consists of two turns, bifilar wound in the same way as the primary, using 26B&S DTE wire. One start should be designated with three knots.

Place a final wrap of electrical tape over the outside of the completed winding.

Before assembling the transformer, the following points should be observed: (1) that there are no traces of foreign matter on either of the two core faces, as the cores can be cracked on tightening if such material exists; and (2) that the secondary lead-out wires are laid in the notches provided inside the cores. Inspection of the inside of each core will reveal these lead-out notches.

Before finally placing the core halves together, place two pieces of coloured PVC sleeving on each lead of the secondary winding as close as possible to the bobbin. Use different colours for the start and finish. Suitable small diameter sleeving can be stripped from scrap pieces of thin hookup wire.

When the leads have been led out in their correct positions, press the cup-core halves together with the fingers and anchor the halves with electrical tape around the outside, or alternatively, provide a temporary clamp in the form of a 1in long x 1/8in Whitworth screw and nut through the core assembly. This screw will be removed when the transformer is finally mounted, one of the tagboard mounting screws serving as a support.

TRANSFORMER CONNECTION DETAILS

Secondary (Gn-Bk):	Start – Green sleeving (8)
	Finish – Black sleeving (7)
Primary (Bk-Rd):	Start – Black (3) On same side as Sec. Green start
	Join Red on above side to Black on other side of transformer. This pair becomes (2)
	Finish – Red (1)
Feedback (Rd-Gd):	Start – Red (6) On same side as Sec. Green start.
	Join Gold on above side to Red on other side of transformer. This pair becomes (5)
	Finish – Gold (4)

(Based on RCS Radio Pty Ltd type 130.)

resistors should be placed inside some sleeving as shown in the photograph.

The battery, Eveready type 276P or equivalent, is mounted on the other end panel, or the "bottom" of the case. We used some insulated hookup wire to secure the battery, passing it through four small holes drilled close to the edges of the shorter sides of panel. Should some constructors wish to run the instrument from the mains, there is ample room to build a small power supply in the space presently occupied by the battery. As stated before, the power requirements of the unit are 9 volts at 80mA.

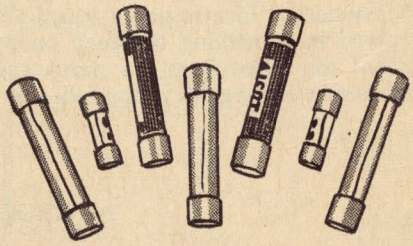
This completes the description of our transistorised insulation tester or "megger". We are confident that it will prove itself one of the most popular test instruments we have described to date.

Its simplicity and low cost, combined with compactness and the ability to make rapid checks on most of the common types of capacitor should make it invaluable both for the service technician and for the home constructor. It will not check electrolytic capacitors, of course, but then these can be checked without too much difficulty using either a multimeter or the substitution method.

READER SERVICE COUPONS

On page 144 of this issue you will find four Reader Service Coupons. Should you require to find out more information about any of the products advertised in this issue, print the advertisers name, the product in which you are interested, and the page number on one of these coupons. We will ensure that all coupons are forwarded to the appropriate companies.

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by GEORGE HUGHES

Party gadgets and "crowd stoppers" have always been popular, particularly where an element of competition exists. The device described in the following pages presents an air of challenge, even to those who fail miserably in their attempts to beat or outwit it.

The Hot Seat is a simple reaction time comparison device, whereby two contestants can match their reaction times one against the other. There is nothing really new about this. Television and radio quiz programs have long used electronic devices to establish, without room for question, the first contestant to respond to a particular stimulus. The stimulus, usually, is the posing of a question, and the reaction time is that needed for the contestant to decide that he can answer it.

Alternatively, a simple visual stimulus may be used, such as the turning on of a light or the changing of a light from red to green. In this case, the reaction time is the purely physical one which is a natural limitation of all human nervous systems. This is a measure of alertness, among other things, and can win or lose many simple games or contests.

The novel feature of the Hot Seat is the manner in which the loser is encouraged to announce this fact. The two contestants are seated on special chairs or stools, and face a simple control panel on which are a pair of lamps, one red and one green. Each contestant is provided with a press button and told to press his button immediately the light changes from red to green. The contestant who is fortunate enough to press his button first is allowed to remain seated; the loser is propelled to his feet with a well delivered electric shock in the seat of the pants!

We can vouch for the fact that this gadget will make any party go with a bang. Similar units have been used in Youth For Christ "Campus Life" rallies at home and abroad and have proved tremendously popular; so popular that some groups have installed counters to register the number of contestants that have used them.

Where any degree of electric shock is involved, many people are unduly fearful, and may take a lot of convincing that such a shock can be, at one and the same time, uncomfortable yet perfectly safe.

The Hot Seat delivers its message in the form of a short sharp pulse. While leaving no doubt in the mind of the victim that he has been bitten, it does so in a manner which is perfectly harmless.

In considering the safety of such a device, four major factors need to be considered. These are:

(1) The voltage of the pulse
(2) The energy content of the pulse
(3) The duration of the pulse
(4) The repetition rate of the pulse

As a guide to the design of our unit we took the safety specifications for electric fences, as laid down by the Australian Standards Association. These are particularly stringent and conservative, as well as being based on "worst case" conditions far in excess of any likely to be encountered in an application such as ours.

The figures laid down by the ASA, together with those for our own device, are as follows:

PULSE	FENCE	HOT SEAT
Length	< 100mS	3uS
Energy	< 2.5mC	0.15mC
Voltage	< 5KV*	4.5KV*
Time between pulses	> 0.75S	1S

* Across 1M load

With regard to the last item, the figure of 1 second for the Hot Seat is the shortest time between pulses which could occur but, in practice, the device delivers only one pulse per contest. There is no automatic repetition rate.

In addition we must consider the manner in which a shock might be applied to the body, either deliberately or accidentally. The deliberate application is to the thighs and this in itself provides a high safety factor. Thus applied it does not direct a flow of current across the heart area, nor does it permit the person to grasp the contacts as the result of any muscular contraction, even assuming that these latter were energised for long enough to constitute a hazard.

Finally, to remove the last element of risk, we operate the Hot Seat from batteries, thus eliminating any possibility that the mains might become involved, no matter how remote this possibility might be.

So that the time of pulse, voltage and energy level could be predicted, we decided to use the now well-known automotive CD ignition circuit. With this circuit it was easy to scale down the voltage and energy to safe levels.

Following the dump capacitor, the circuit divides into two identical sections involving two thyristors, two ignition coils, and two interconnected triggering circuits.

These two circuits share the one dump capacitor, and it is obvious that the discharge can be applied to only one coil at a time, depending on which thyristor is triggered first.

Apart from the DC power supply, we can divide the circuit into four parts: A timer; logic flip-flop; trigger circuit 1; trigger circuit 2.

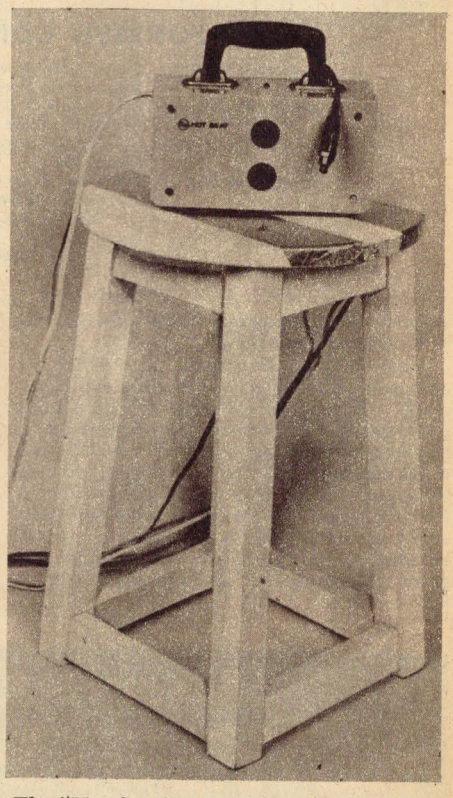
The timer, set for a count-down of approximately 30 seconds, uses a BRY39 SCS (silicon controlled switch) as its active device.

When activated, the 2uF polyester capacitor is slowly charged via the 6.8M resistor towards the 12 volt supply rail. Because the SCS anode gate is connected to a voltage divider which sets its potential at about half voltage (6 volts), the anode (connected to the junction of the resistor and capacitor) can reach a potential only about 600mV higher than this, at which point the device "fires".

This discharges the capacitor via the SCS, producing a pulse of about 5V (positive at the cathode) across the 1K cathode resistor. This pulse is fed to the logic flip-flop to change its state.

The logic flip-flop is a bistable multivibrator circuit formed around a pair of BC108 (or similar) transistors (TR2 and TR3). Its state is controlled by pulses from the timer or chair button switching circuits.

The positive pulse from the SCS cathode is fed to the base of TR2 which, previously being cut off, is now switched to saturation. This causes the collector voltage of TR2 to fall towards the negative rail (to typically, about 1V positive) bringing the anode gate of the

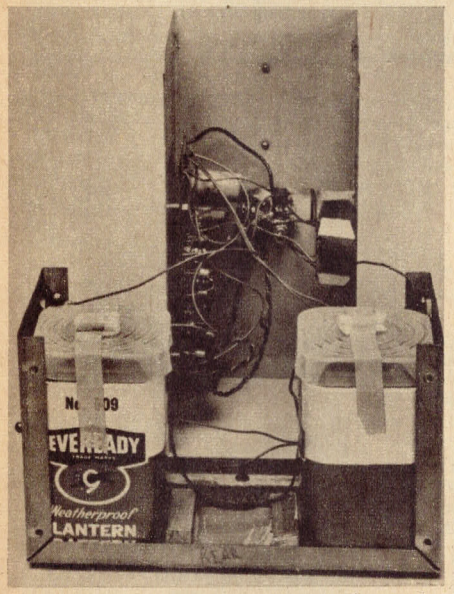


The "Hot Seat" control box with one of its associated stools. Note the metal contact strips on the seat.

SCS down with it. With both the anode and anode gate at a low voltage, the SCS is held off, preparing the way for another charging cycle.

The collectors of TR2 and TR3 are connected to the bases of TR4 and TR5 respectively. These two latter transistors control the red and green lamps used to provide the visual stimulus. They also connect to the diode matrix which forms part of the decision-making circuitry.

It is more satisfactory to drive the diode matrix from TR4 and TR5, rather than directly



Inside the control box. Note how the batteries are accommodated to allow room for the circuit board.

from the flip-flop. We can achieve lower circuit clamping resistance and lower collector to emitter potential (higher collector saturation current) by using TR4 and TR5 than we could from TR2 and TR3, even though they are the same transistor types.

The lamps are connected as collector loads for TR4 and TR5; red in TR4 and green in TR5. The 33 ohm resistors in series with the lamps are to limit the collector current at the moment of switching on, when the resistance of a cold lamp filament is low.

If the flip-flop was in a state where TR2 was cut off and TR3 saturated, the high and low potentials of their respective collectors would cause TR4 to be saturated (red light on) and TR5 to be cut off (green light off).

When the timer capacitor discharges and switches TR2 into saturation, TR3 is cut off. TR2 now cuts off TR4 (red light off) and TR3 switches TR5 into saturation (green light on).

As already stated, the flip-flop is interconnected with the decision-making circuitry. The reason for this is to provide an "anti-cheat" function, against the possibility that a player will try to beat his opponent by pressing his button before the light changes from red to green.

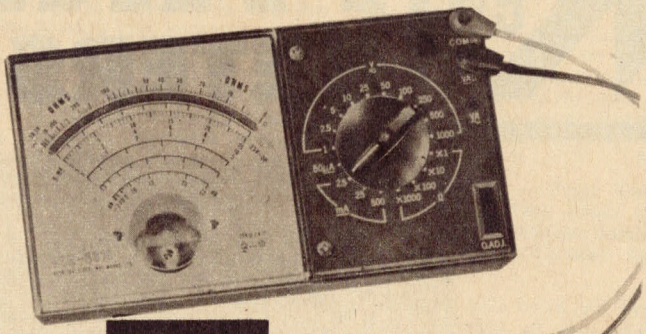
To forestall this, the circuit is so arranged that, while the flip-flop is in the "red" mode, the trigger circuits are transposed. Thus, any competitor who presses his button before the lights change, will direct the shock to his own posterior, rather than to that of his opponent. Needless to say, not many players try to cheat once they appreciate the implications.

The diode matrix may be divided into two trigger circuits; trigger circuit 1 and trigger circuit 2. Trigger circuit 1 is controlled by the button "Play 1" and consists of diodes D3, D7

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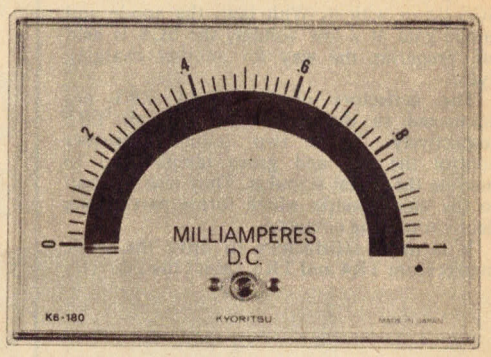
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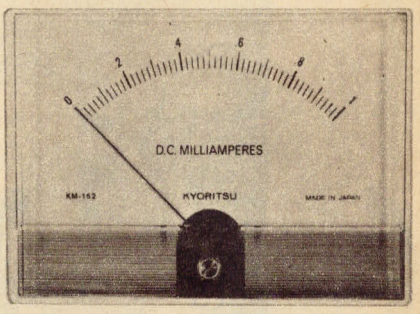
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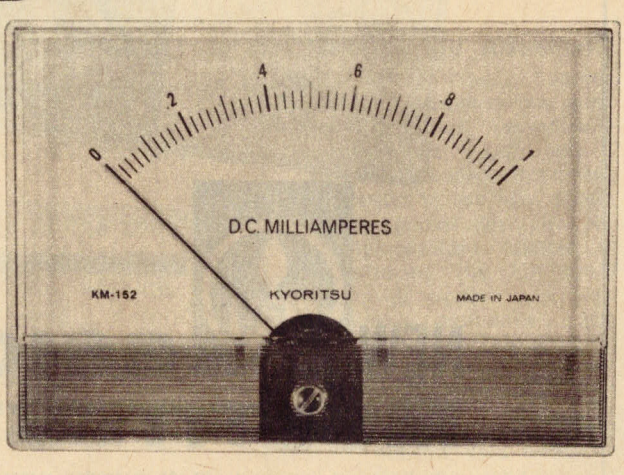
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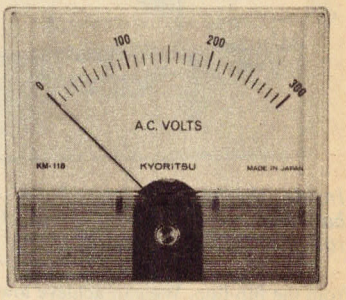


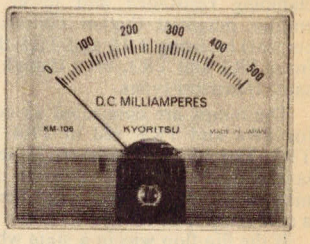
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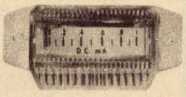
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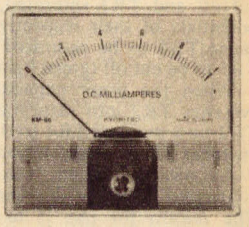


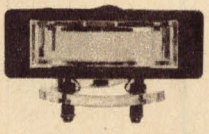


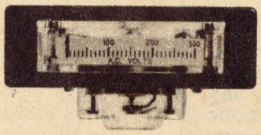
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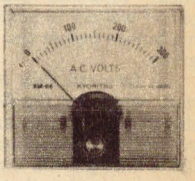
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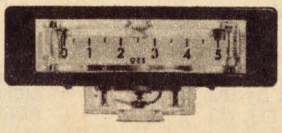


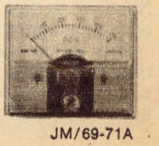












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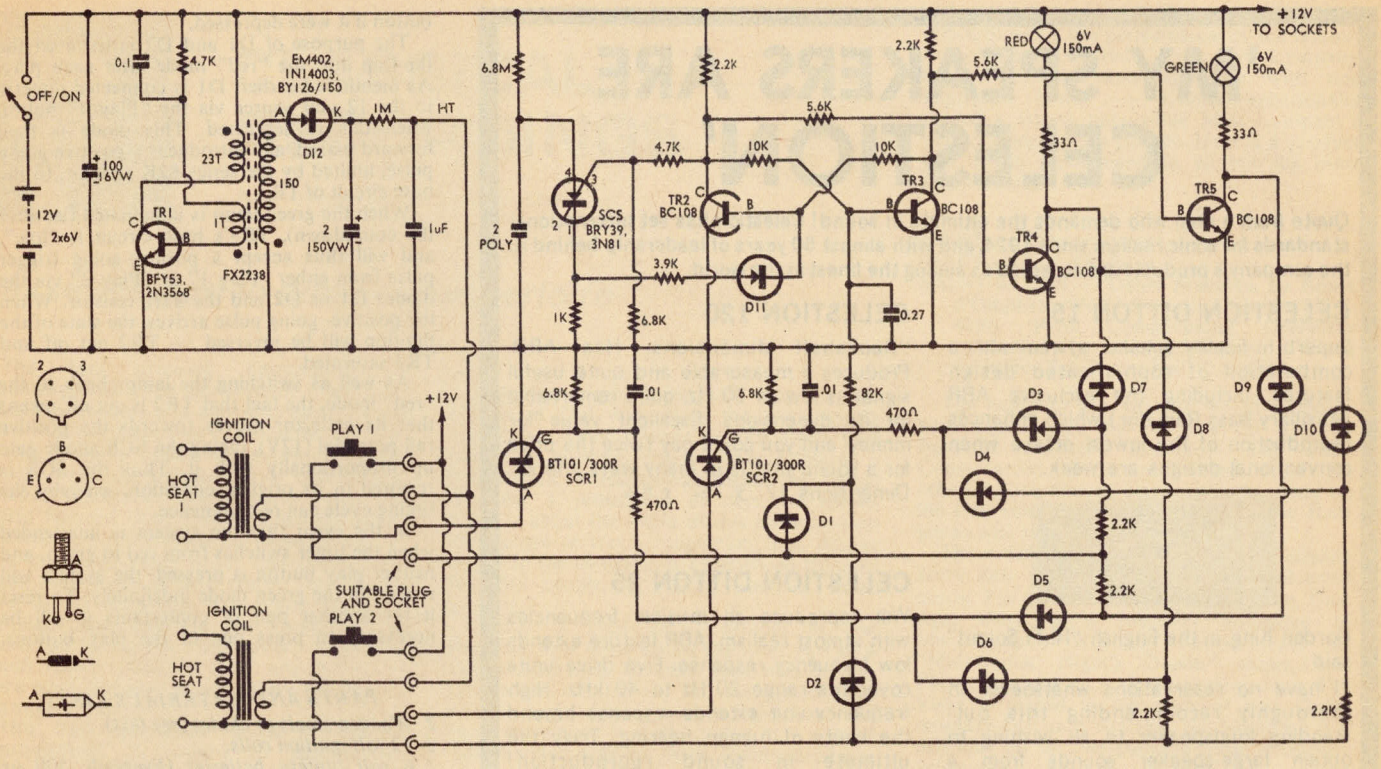
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HOT SEAT

The operation of each circuit section is explained in the article. Study the circuit carefully in conjunction with the text.

and D5, D9. Trigger circuit 2, controlled by button "Play 2", consists of diodes D4, D10 and D6, D8.

When the flip-flop is in the "red" state trigger circuit 1 is capable of triggering SCR1; when in the "green" state, trigger circuit 1 is capable of triggering SCR2. The reverse applies to trigger circuit 2.

Referring to the circuit diagram, if we press "Play 1" button, 12 volts is applied to a pair of 2.2K resistors connected to diodes D3, D7; D5, D9; and directly to D1. Because TR4 is saturated and its collector potential is low (about 1 volt), D7 will be forward biased and will remove any trigger potential capable of triggering SCR2 via D3.

At the same time, TR5's high collector potential will reverse bias diode D9, allowing current to flow via D5 into SCR1's gate circuit causing it to trigger.

The same reasoning could be applied to SCR2's trigger circuit via D4 from "Play 2"

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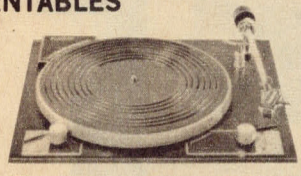
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button if it were depressed.

The purpose of D1 and D2 is to re-set the flip-flop into the "red" mode after each play. As mentioned earlier, D1 is connected directly to the 12 volt source via the "Play 1" button when this is depressed. This diode is then forward biased, and introduces a positive-going pulse, limited by the series 82K resistor, to the base circuit of TR3.

When the green lamp is illuminated (ie, after the countdown), TR3's base circuit is "low", and will thus accept a positive-going trigger pulse from either "Play 1" or "Play 2" via the diodes D1 or D2 and the 82K resistor. When the positive-going pulse arrives, the state of the flip-flop will be reversed — TR2 cut off and TR3 saturated.

As well as switching the lamps back to the "red" mode, the fact that TR2 is cut off means that its collector moves towards the positive rail potential (12V), taking the SCS anode gate up proportionally with it. Thus the SCS is restored to its original condition, whereby the timing cycle can re-commence.

In the event that the system is unattended when the timer switches from red to green, and neither play button is pressed, the system will remain in the green mode indefinitely. To reset it for another pair of contestants it will be necessary to press one of the play buttons,

PARTS AND MATERIALS LIST:

2 Wooden stools or chairs (see text).
2 12 volt ignition coils.
2 6 volt lantern batteries (Eveready 509 or similar).
2 Miniature 4 pin speaker sockets, with matching plugs.
2 Pushbutton switches (normally open).
1 Single pole toggle switch.
2 Indicator lamps, one red, one green (see text).
1 Carrying case with handle.
2 FX2238 pot core halves.
1 DT2178 bobbin.
2oz 34 B&S double tough enamel copper wire.
1oz 28 B&S double tough enamel copper wire.
2 BT101-300R or similar thyristors.
2 BFY53, 2N3568, AY8139 or similar.
4 BC108, BC208, TT108 or similar.
1 BRY39 or 3N81.
11 BA100, OA202, or similar small signal diode.
1 1N14003, BY126-150 or similar silicon rectifier diode.

RESISTORS (½ watt, unless specified):

1 6.8M	*2 4.7K*
1 1M	*1 3.9K*
1 82K	*6 2.2K*
2 10K	*1 1K*
3 6.8K	*2 470 ohm*
2 5.6K	*2 33 ohm*

CAPACITORS (Polyester 160V unless specified):

1 100uF 16VW electrolytic.	*1 0.27uF.*
1 2uF 150VW electrolytic.	*1 0.1uF.*
1 2uF (or 2.2uF).	*2 0.01uF.*
1 1uF.	

1 Piece Veroboard (0.15in), 5½in x 2½in.
8yds brown figure 8 power flex.
12 yds white figure 8 power flex.
8 yds 4mm plastic sleeving.
Hookup wire, nuts, bolts, packing strap, flat head nails aluminium foil strip, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.

being careful not to deliver an unwarranted shock to any contestant who may be already seated.

At this point, it should be fairly obvious as to how the game is played.

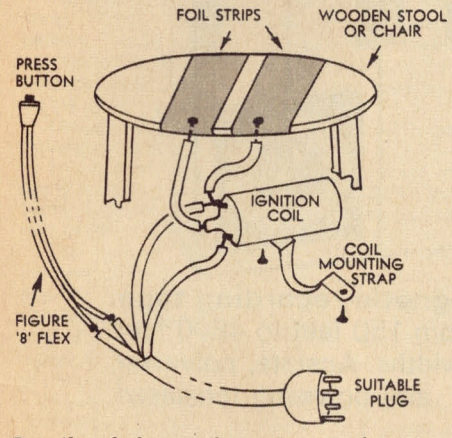
We have two opponents "A" and "B" seated on their respective chairs or stools. If we assume that the timer is timing out (the RED indicator illuminated), the trigger circuit of "A's" chair will be operable by "A's" button (of "B" with "B's" button). If, during this period, "A" or "B" depresses his button, the player responsible will receive the charge — with the appropriate surprised reaction!

If either contestant does not trigger the system before the timer times out, the flip-flop, through the diode network, will arm "A's" trigger button with "B's" trigger circuit, and vice versa. Whoever triggers the system first will have the delight of seeing his opponent stand to attention in no uncertain manner!

Although we have nominated currently available transistor types, there is no reason why some experiment cannot be done with disposal "computer" types readily obtainable for a moderate cost from various sources. NPN silicon types are preferable, but NPN germanium types would probably work just as well. Suitable diodes could also come from the same source.

The main disadvantage of using computer transistors is that more often than not, the leads on these devices are extremely short, and extension wires will have to be soldered to them to make comfortable connection to the Veroboard circuit board. Similar treatment may have to be given to the small diodes extracted from similar boards.

Each seat, in our case, was made from a robust wooden stool. The legs were shortened so that the normal seating position was optimum for a fast stand. Under each of these a 12 volt automotive ignition coil was mounted by a simple metal strap made from crating

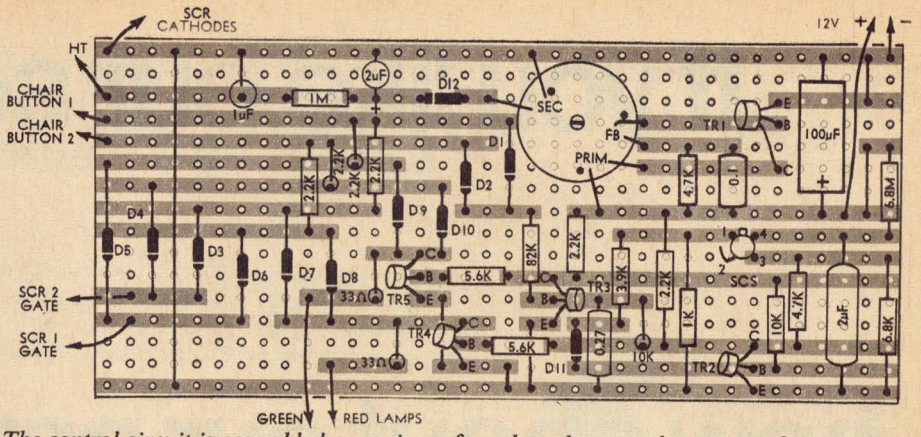


Details of the stool contacts and wiring associated with them. The ignition coil is mounted under the seat.

strip. The secondary of each coil is wired to two aluminium foil strips placed about six inches apart in the sitting area. Connection to the foil is made by flat headed nails driven through the stool from the top.

We found that the best source of suitable ignition coils was a motor wrecking yard. We paid a dollar each for these, and were guaranteed exchanges if these were open-circuit or defective. This is the basis on which most motor wrecking yards operate for spare parts. For the low price paid, it was a fair deal.

There is little advantage to be gained in using new ignition coils, as the money spent on a pair of new coils will possibly buy all the components, including the two second-hand coils.



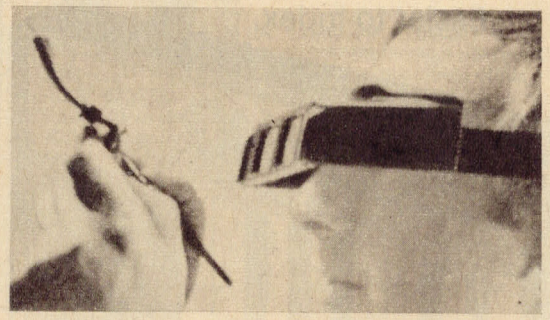
The control circuit is assembled on a piece of veroboard, cut to the pattern shown on the grey overprint. The location of the components is shown in relation to this pattern, being viewed from the components side.

Although the layout drawing of one "hot seat" shows a retaining strap wrapped around the body of the ignition coil, you may or may not be able to obtain the coil's original mounting clip with the coil. One of our two coils was equipped with a clip, and one without. The wrecking yard may include a clip on each coil only if you ask for it, as most dealers assume that such coils are bought as stand-ins for motor vehicles, and that the coils would be mounted in the clip already in the vehicle.

A cable runs from each stool to the central control box. The cable can be made from two lengths of "figure eight" flex, preferably in distinctive colours for ease of identification. The two lengths may be sheathed in 4mm PVC

(Continued on Page 141)

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RSGB Members Probe Atmosphere

Radio amateurs working on the VHF bands can play an important part in extending knowledge of factors affecting propagation. In this article the author, a member of the British Astronomical Association and the Society for Amateur Radio Astronomers, describes some of the experiments which he has been able to perform.

by R. A. HAM

The Earth's atmosphere has been classified into layers, extending out from the Earth's surface, as indicated in figure 1. Generally speaking, the D, E and F regions are ionised by the Sun's rays, and the structure and degree of ionisation will change at any one point as that point moves into the night region, and outside the influence of the Sun.

Approximately 60 miles above the Earth's surface lies the E layer, which is an ionospheric region having considerable influence over VHF radio signals between 30 and 100MHz.

Normally the E layer will form at sunrise and disperse at sunset. However, certain types of solar activity will cause the E layer to form or break up into patchy clouds of dense ionisation, thus earning the name sporadic E.

VHF radio receivers can be used to make useful studies of changes in the E layer and the troposphere. Results obtained in this way can be co-related with the results of solar activity and atmospheric pressure changes.

The accepted range of a radio signal in the 2-, 4- and 6-metre bands under normal atmospheric conditions is between 50 and 100 miles, but under abnormal conditions such as sporadic E, or by tropospheric scatter methods, these signal ranges can be raised by a power of ten.

To observe changes in the Earth's atmosphere by VHF radio simply means that a comparison is made between the propagation of known VHF signals under normal and disturbed conditions.

It is generally accepted that signals between 30MHz and 100MHz are affected by disturbance to the E layer and signals above 100MHz suffer from changes in the troposphere. (Figure 1.)

To carry out regular observation, there must be a permanent low-power signal to look for at any given moment. The Radio Society of Great Britain and a part of its membership have helped to fulfil this need by providing a chain of strategically placed beacon transmitters in the United Kingdom.

With the knowledge of the terrain and the distance between the receiving station and the beacon, the observer can judge the extent of the prevailing atmospheric conditions.

Troposphere conditions can change rapidly, as can be seen hourly on a barometer. The author's records have frequently shown that when the atmospheric pressure is above 30in, and then rises, one can look for a "tropo opening" at the point when the pressure starts to fall.

A typical example of this occurred at the beginning of May 1970. Reference to the barograph (figure 2) will show that the atmospheric pressure rose steadily from 30.05in around noon on April 29 to 30.35in at noon on May 1. By midnight on May 1, a slight fall was showing and by noon on May 2 the pressure was 30.3in remaining steady until 1600 on May 3 when a sharp fall occurred and by 2000hr the barometer was reading 30.2in and falling.

It was fortunate that this critical atmospheric change coincided with a Radio Society of Great Britain (RSGB) 24-hour VHF contest which took place on the two-metre band from 1800 on May 2 to 1800 on May 3. The slight atmospheric pressure drop which started 18 hours before the contest had begun to affect VHF propogation.

During the life of the contest, amateur radio signals were heard from North Wales to Holland and from France to the north of England. Around 1800 on May 3, coinciding with the rapid pressure drop, the two-metre band opened up and a signal from an amateur radio station in Switzerland punched into the south of England.

The writer conducted a tropo experiment between June 1 and August 31, 1969. Throughout the three-month observation a comparison was made three times a day between the barometer reading and the signal strength of the RSGB two-metre beacon at Swansea (GB3GW) 130 miles away.

A graph was made at the conclusion of the experiment and it became obvious that a few hours before the pressure was due to fall, the signal strength of the Swansea beacon increased.

The first tropo example showed that the two-metre band opened up at the point when the high pressure fell, and the second indicated that there was a lift in conditions a few hours before the actual drop in pressure.

A combination of these examples took place in September, 1969. At noon on September 16, the barometer was reading 30.2in. By noon on the 17th, the pressure had risen to 30.35in, to remain there for seven days until noon on the 24th when a rapid fall set in.

Around 1800 on the 22nd, the two-metre

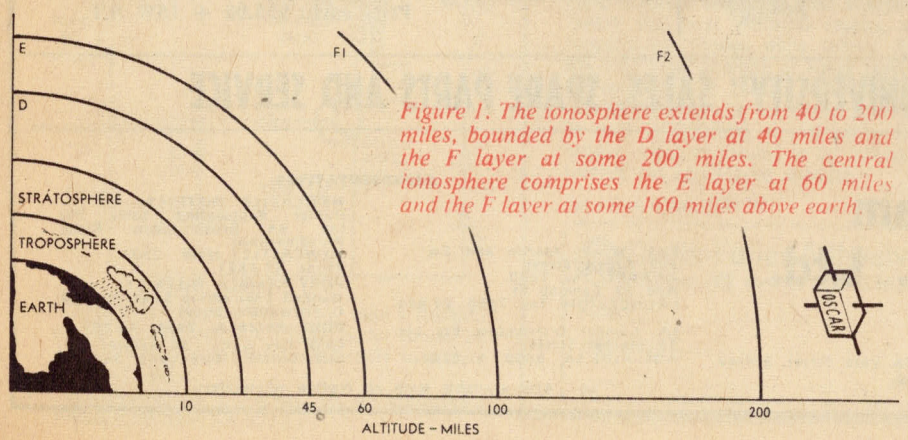


Figure 1. The ionosphere extends from 40 to 200 miles, bounded by the D layer at 40 miles and the F layer at some 200 miles. The central ionosphere comprises the E layer at 60 miles and the F layer at some 160 miles above earth.

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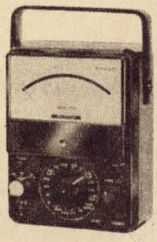
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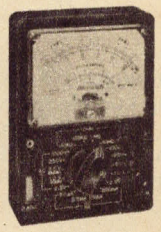
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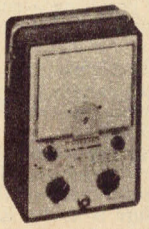


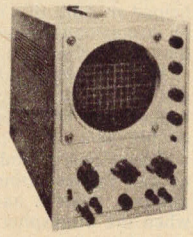
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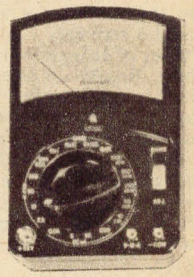


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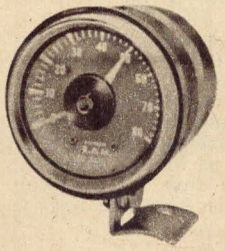


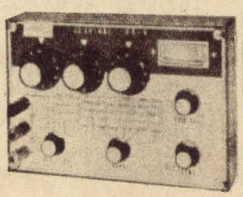
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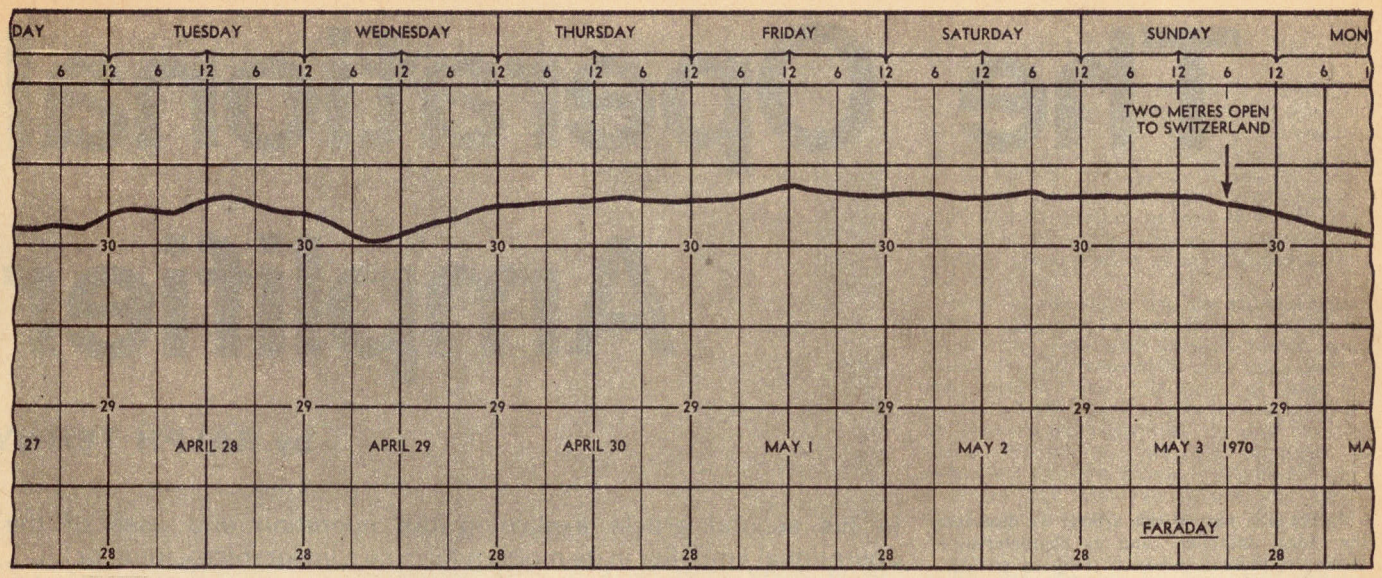


Figure 2. Barometric pressure as recorded over one of the observation periods.

band opened up and remained open until after the pressure fall on the 24th.

During this 50-hour opening, amateur radio stations from Germany, Holland, Belgium, France and the whole of the United Kingdom were heard. The beacon service proved most valuable because at any time throughout the opening a beacon would indicate the extent of VHF propagation.

The writer, in the south of England, could hear the Durham beacon throughout the opening. The late evening of the 22nd found the beacons at Swansea, Angus, and Essen. Early the following morning the beacons at Swansea, Durham, Kiel and Essen were all at good strength, but by mid-afternoon the two German beacons had gone and the beacons at Swansea and Durham were joined by the French beacon at Brest.

This summary will give an insight into the value of the beacon service during a tropospheric opening. The period of enhanced signal conditions was not confined to the two-metre amateur band; the Independent Television stations in band three, and the BBC FM stations in band 2 were suffering interference from broadcast stations operating on similar frequencies hundreds of miles away.

Fortunately, for scientific observation, the amateur radio fraternity in the United Kingdom and Iceland have been allocated 700KHz within the four-metre (70MHz) band. Apart from interstation contacts, the amateurs have provided four beacons, and a radio amateur emergency network channel within their band. A small group of amateur observers use the amateur part of the four-metre band for solar and meteor study.

Although the four-metre amateur band is commercially quiet in the United Kingdom, several Continental countries use this band for their national broadcasting. These European broadcast stations are at such a distance from the UK that their signals can be heard in the UK only via aurora, meteor trail reflection, or sporadic E. This situation means that the four-metre amateur band is a valuable part of the frequency spectrum in which to study three major atmospheric phenomena.

An interesting example of E layer disturbance was observed by the writer on July 6, 1970. At 0700UT, sporadic E was affecting 30MHz to 50MHz, proved by the multitude of Continental RT and RTTY stations that could be heard.

By midday, the E layer had extended its influence to the BBC FM band and at 1430UT the writer counted 14 Continental broadcast stations working between 88 and 98MHz.

A later observation at 1900UT found the bands open from 30MHz to 90MHz, giving rise to the usual crop of electronic bleeps between 30MHz and 50MHz, with interference to the band 1 BBC television service, plus an increase of sync pulses around 50MHz.

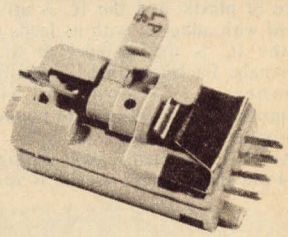
During the period after 1900UT, the four-metre amateur band was impossible to use owing to the strength and bandwidth of the Continental FM broadcast stations. This chaotic situation ended abruptly at 2045UT when the reflecting sporadic E changed and the host of extra radio signals between 30MHz and 90MHz disappeared.

From previous experience of E layer disturbance, the writer turned his four-metre beam from south-east to north-west and for the following hour recorded the signal of the amateur beacon in Iceland (TF3VHF 70.275MHz). The Iceland beacon radiates a mere 2½ watts and during this final part of the E layer disturbance the writer was receiving its signal at 599.

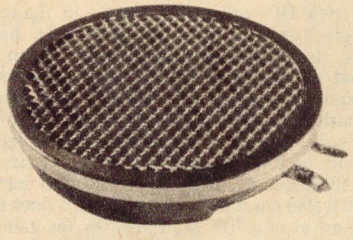
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The Operational Amplifier

PART 2 OF A 2-PART STORY

by RALPH TENNY

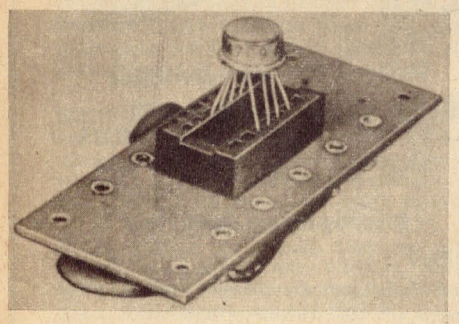
In his second article explaining the operation and uses of the operational amplifier in its modern form as a linear microcircuit or "IC", the author gives details of many useful circuit configurations. He also gives practical advice for the experimenter.

In the first part of this article, we discussed the "ideal amplifier" and its characteristics. However, there is no such thing as an ideal amplifier and we must work with things that exist in the real world. So, how about applications for the real operational amplifier? Figure 1 shows the characteristics of one typical low-cost op amp (Texas Instruments SN72709N), which is a member of the famous 709 family.

This device has an open loop gain of 50,000, an input resistance of 250,000 ohms, an open loop output impedance of 150 ohms, and one microampere input offset current with two millivolts offset voltage at the output. These are typical specifications for most 709 op amps, regardless of manufacturer.

The best way to experiment with an integrated circuit of any kind without damaging it in soldering and desoldering is to make up a breadboard similar to that shown in figure 2. Suitable solder terminals are mounted on a piece of plastic and the IC is attached to the board with adhesive with its leads up. Each pin of the IC is then connected to one of the terminals. Each terminal is identified as to pin number or function, and all external components and circuits are hooked up to the appropriate terminals.

Another approach is shown in figure 3. Here, a 14-pin dual in-line socket is mounted on a board, with a suitable number of terminals around the edge. The circuit can then be built up between the socket leads and the perimeter terminals. Figure 3 also shows how a round TO-99 case can be inserted in the socket, with the pins properly mated.



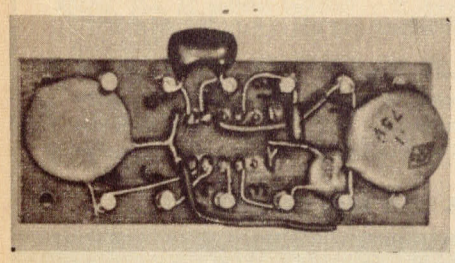


Figure 3: If a dual-in-line socket is mounted on the terminal strip, it can be used for round ICs as well.

Typical Applications. Although only a few circuits will be described here, they are basic to all of the many variations that are found in this and other publications. Note that although some of the circuits shown here do not have compensation, it is always necessary to compensate a 709. This is not true, however, of some other op amps so the specifications should always be checked.

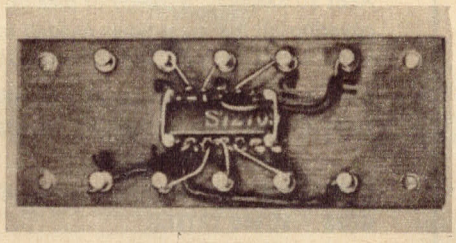


Figure 2: A simple approach when using ICs is to cement them cap down to a terminal strip, and run wires across to the terminal lugs for durability.

The two DC voltmeters shown in figure 4 illustrate some interesting points. In both circuits, the 5000-ohm output resistors can be changed to affect the basic circuit sensitivity. For example, making this resistor 1000 ohms gives both voltmeters full-scale ranges from 0.1 to 100 volts. Circuit A would then have an input sensitivity of 100,000 ohms per volt, but circuit B would retain its original 10-megohm input. Circuit B also has a null balance circuit since the typical offset of a 709, multiplied by the gain of 100, would produce a significant zero offset on the meter.

In this case, with the input shorted, the null offset potentiometer is adjusted to obtain a zero on the meter. Such a voltmeter would be ideal not only for solid-state testing (since it has the necessary low-voltage scale), but also for vacuum-tube circuits where the DC voltage could reach 500.

A very linear AC voltmeter is shown in figure 5. In this circuit, diode nonlinearity is minimized by the high gain of the amplifier. Sensitivity is the same as that of the meter: that is, 1000 ohms per volt for a 1mA meter. A higher input impedance can be attained by using an op amp buffer in front of this circuit.

The current-to-voltage transducer shown in figure 6 makes use of the current sensitivity of the op amp to measure very small currents. As shown, the circuit indicates 1 volt per microampere and is capable of 0.1-microampere sensitivity. Resistance values for R1 can be between 100,000 and 10,000,000 ohms to provide outputs from 10 uA per volt to 0.1 uA per volt.

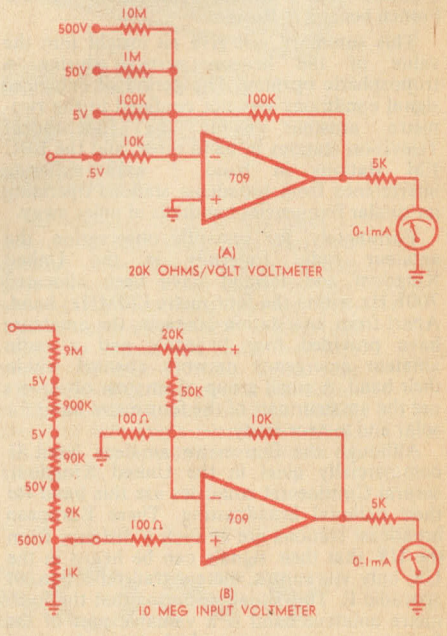


Figure 4: Two approaches to a DC voltmeter using a 709 op amp device.

The circuit shown in figure 7 is an example of just how far you can go in creating an ultra-high input impedance with an op amp. Developed by NASA, the circuit has an input impedance of several hundred megohms with an input capacitance of less than 1 picofarad. The high

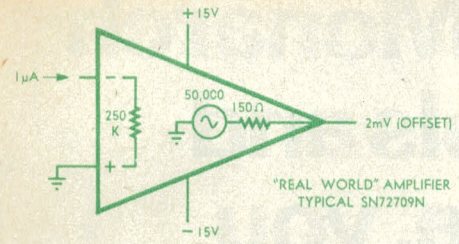


Figure 1: Characteristics of a typical operational amplifier. This one has a gain of 50,000, an input impedance of 250,000 ohms, and a 150 ohm output.

impedance is obtained by positive feedback through C1. The input capacitance plus the capacitance to ground can be cancelled by adding feedback capacitor C2 and properly adjusting R1.

The low-frequency response is determined primarily by C1, for which an electrolytic capacitor may be used. High-frequency response is limited by the op amp. With a square wave applied to the input, potentiometer R1 is adjusted to obtain a square wave on the output (similar to making an oscilloscope attenuator adjustment). The circuit was designed to amplify a 5-uS pulse coupled through a 1-pF

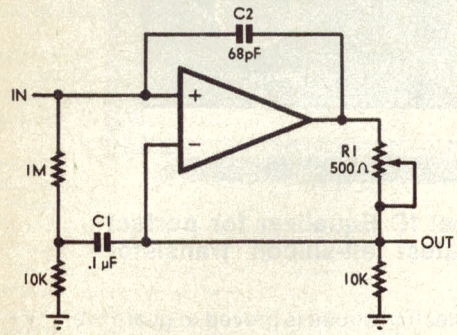


Figure 7: A circuit developed by NASA which has an input impedance of several hundred megohms and less than 1pF.

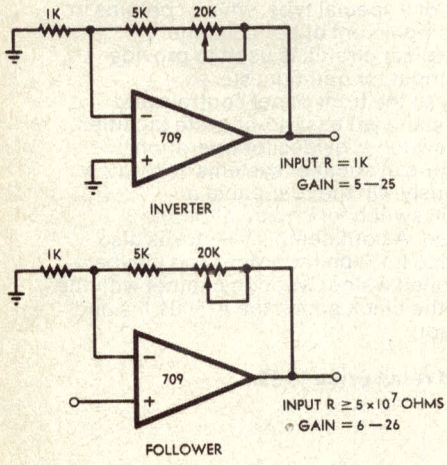


Figure 8: A pair of variable attenuator circuits. The upper one has an input resistance of 1000 ohms, while the lower circuit has a 50 megohm input.

capacitor. The slew rate is approximately 0.5 volt per microsecond.

Two gain-control, or variable-attenuator, stages are shown in figure 8. Note that two different input resistances are shown — one very high, the other low — and that the gain of either stage can be varied by changing the feedback circuit. A word of caution: when the feedback potentiometers are at their minimums, the effective load on the amplifier is 5000 ohms. Be sure that the feedback resistors do not "use up" all the available output current.

An interesting use of the op amp is in frequency-selective networks. With conventional discrete semiconductor circuits, it is usually necessary to use large inductors to perform this operation at low audio frequencies. In the circuit shown in figure 9, a twin-T filter (which has a resonance similar to its LC counterpart), is used in the feedback circuit. Figure 9 shows the method of calculating the element values for any frequency. Unfortunately, the Q of a twin-T filter is rather

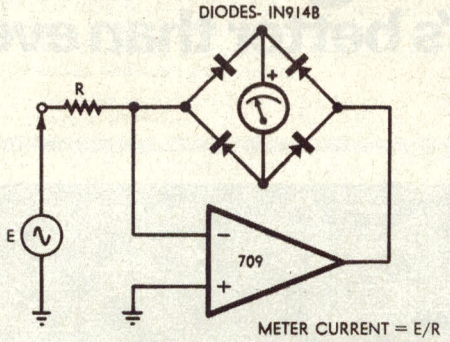


Figure 5: A basic circuit for an AC voltmeter using an op amp. Although the input impedance is only 1000 ohms/volt, this can be raised by adding a preamp.

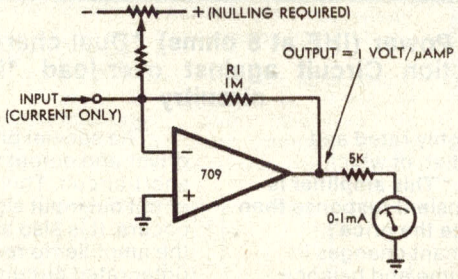


Figure 6: This current-to-voltage circuit indicates 1 volt for every microamp at the input, and is capable of at least 0.1 microamp sensitivity.

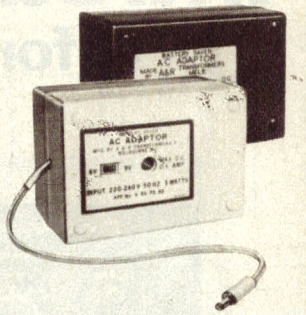
small — in the order of 0.25; but, when combined with the gain of the op amp, the Q is a reasonable value. Using an amplifier with a gain of 10, the Q is 2.5; and with a gain of 40, the Q is 10. Thus an op amp, with a few passive components, can be used to simulate a bulky, expensive inductor; and it has the advantages of a centre frequency and Q that are easily controlled over a wide frequency range.

Another audio filter, this one generating a notch at the selected frequency and having a variable Q, is shown in figure 10. The input to the positive terminal of the op amp is combined with feedback through the bridge-T network. The other input is variable. When the signal levels at both inputs are equal, there is no output from the amplifier. System gain is still R2/R1. By adjusting the "SET" control, a small notch at the filter frequency is obtained. As the "Q

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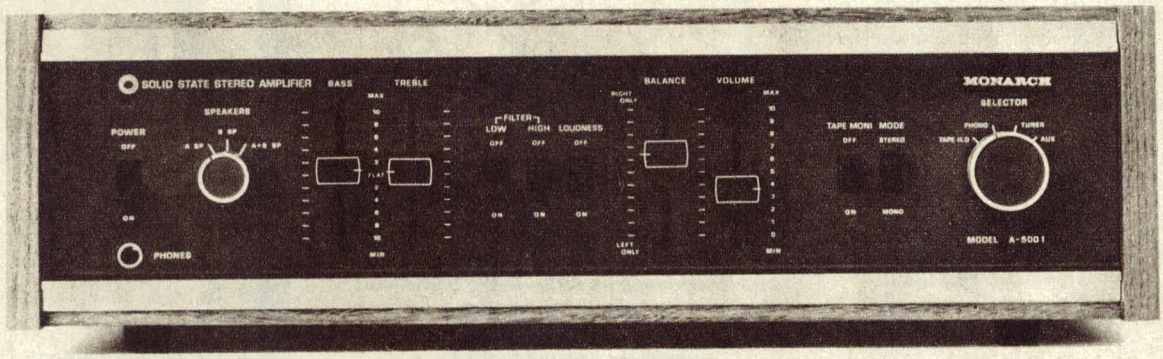
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QLD. Tel-Air Electronics, 187 George Street, Brisbane. 4000

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ADJUST" control is brought near the filter end, the feedback increases, controlling the Q of the circuit. The frequency is determined by the values of the filter capacitors and the setting of the ganged potentiometers.

Performance Limitations. Input limitations are applicable primarily to follower configurations, provided, of course, that input overloads are avoided. The summing junction of an inverter remains at ground except when fast voltage spikes or extremely high voltages are applied. In the first case, feedback is too slow to protect the summing junction; while in the second case, the output stage saturates and is unable to divert the input current.

In followers, the summing junction moves in step with the input voltage so that, in some

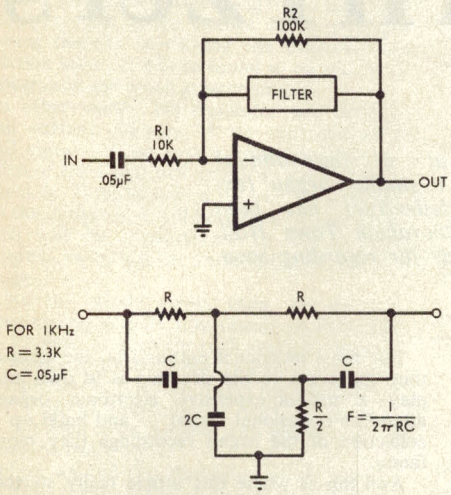


Figure 9: A frequency selective network in the feedback loop of an op amp can simulate an LC circuit having a high Q at audio frequencies. Both Q and centre frequency can be changed easily.

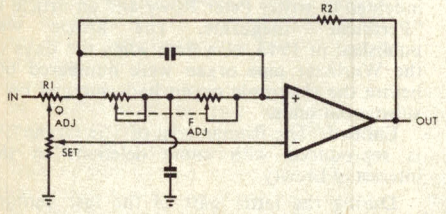


Figure 10: An audio filter which permits continuous adjustments of both Q and centre frequency via a pair of controls.

circuits, the input must be restricted to 15 volts. In figure 4B, for example, the divider restricts the summing junction excursions until the output stage saturates. The amplifier has a gain of 100 (101 if the resistor values are exact), and an input in excess of 0.1 volt would saturate the amplifier at an output over 10 volts. If a 10-volt input were allowed, the summing junction would be driven so high that the input transistors in the op amp would probably be destroyed.

Performance limitations having to do with offset voltage and current are largely inconvenience factors. External null circuits balance out offsets over a small range of ambient temperatures. Offset effects (as well as open loop gain and input resistance) vary with ambient temperature, so circuits that must operate in changing temperatures should be designed around amplifiers with low offset. Op amp circuits with low values R1 and R2 are not

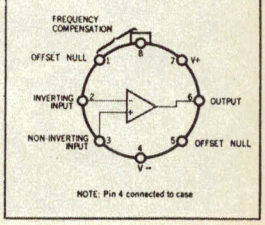
FAIRCHILD LINEAR INTEGRATED CIRCUITS μA748

ELECTRICAL CHARACTERISTICS ($V_S = \pm 15$ V, $T_A = 25°C$ unless otherwise specified)

PARAMETERS	CONDITIONS	MIN.	TYP.	MAX. 709	MAX.	UNITS
Input Offset Voltage	$R_S \leq 10$ kΩ		1.0	5.0	10	mV
Input Offset Current			20	200	750	nA
Input Bias Current			80	500	2,000	nA
Input Resistance		0.3	2.0		.05	MΩ
Input Capacitance			1.4			pF
Large-Signal Voltage Gain	$R_L \geq 2$ kΩ, $V_{out} = \pm 10$ V	50,000	200,000		12,000	
Output Resistance			75		150	Ω
Output Short-Circuit Current			25			mA
Power Consumption			50	85		mW
Transient Response (unity gain)	$V_{in} = 20$ mV, $C_C = 30$ pF, $R_L = 2$ kΩ, $C_L \leq 100$ pF					
Risetime			0.3		0.3	μs
Overshoot			5.0		10	%
Slew Rate	$R_L \geq 2$ kΩ		0.5			V/μs

GENERAL DESCRIPTION — The μA748 is a high performance monolithic operational amplifier constructed on a single silicon chip, using the Fairchild Planar* epitaxial process. It is intended for a wide range of analog applications where tayloring of frequency characteristics is desirable. High common mode voltage range and absence of "latch-up", make the μA748 ideal for use as a voltage follower. The high gain and wide range of operating voltages provide superior performance in integrator, summing amplifier, and general feedback applications. The μA748 is short-circuit protected and has the same pin configuration as the popular μA741 operational amplifier. Unity gain frequency compensation is achieved by means of a single 30 pF capacitor.

CONNECTION DIAGRAM
(TOP VIEW)



ABSOLUTE MAXIMUM RATINGS	709	
Supply Voltage	±18V	±22 V
Internal Power Dissipation (Note 1)		500 mW
Differential Input Voltage	±5V	±30 V
Input Voltage (Note 2)	±10V	±15 V
Storage Temperature Range		−65°C to +150°C
Operating Temperature Range		−55°C to +125°C
Lead Temperature (Soldering, 60 seconds)		300°C
Output Short-Circuit Duration (Note 3)	5 sec.	Indefinite

NOTES:
(1) Rating applies for case temperatures to 125°C, derate linearly at 6.5 mW/°C for ambient temperatures above +75°C.
(2) For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.
(3) Short circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C ambient temperature.

Figure 11: A portion of the specification sheet for the 748 op amp, with the "worst case" parameters underlined. Also shown are 709 specs.

bothered by offset currents, while circuits with low closed loop gain suffer little from offset voltage.

For special applications, where extreme accuracy and/or stability is needed, it is important to consider not only the open loop characteristics of the amplifier, but also the accuracy and temperature stability of the external components.

In choosing an amplifier for a given application, the manufacturer's specification sheets should always be consulted. Unfortunately, these sheets often contain an amazing amount of information — which may be confusing to the uninitiated. Figure 11, for instance, shows part of the information on the Fairchild uA748 op amp. Note the two columns headed "709" which have been added to the illustration for comparison purposes.

Some of the performance figures have been underlined. These are "worst case" conditions and should be used in circuit design. Also note that some specifications are accompanied by "conditions" (such as a specified load resistor). When comparing amplifiers, these conditions must always be identical. All specifications are always for the open loop configuration unless otherwise noted on the sheets.

By now, you should have a pretty good idea what an operational amplifier is and how it is used. The next step is to keep your eyes open as you review the technical literature and be aware of the wide variety of op amp circuits available. Then put them to good use.

(Reprinted from Popular Electronics, September 1971).

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New Lease of Life For the Old Pipe WurliTzers

Tony Fenelon at a four-manual Wurlitzer organ. A similar organ (ex-State Theatre, Melbourne) has been installed in the Moorabbin Town Hall, and should be ready for recording soon.

The "mighty Wurlitzer" pipe organ, little more than a memory to the older generation, is enjoying a new era of popularity around the Western world. Ironically, renewed interest in the old pipe Wurlitzer and its lesser known counterparts is being fostered by the very science that crippled it — by electronics!

The cinema pipe organ reached the pinnacle of its popularity toward the end of the silent film era. A skilled organist, watching the film from a suitably obscured position could provide anything from a stirring march to "Hearts and Flowers", according to the mood of the moment, and produce quite an array of sound effects for good measure.

During the intermission and a featured segment of the program, the curtains would close, the console would rise into full view under the glare of a spotlight and the organist would play the requests and selections for the evening.

It is not always realised that, for the audiences of the day, the big Wurlitzer represented their only encounter with high power, high-fidelity, stereo sound.

It was high power, all right: As much as a pair of ears could take! It was high-fidelity: The real thing, in fact! It was stereo, with sound coming from ranks of pipes on both sides of the proscenium.

It was in vivid contrast to the sound to be heard from horn speakers, cone speakers and the early, rather primitive dynamics.

But, of course, "talkies" took over in the cinema. While the big pipe organs held their own for a while, they were gradually outdone for both spectacle and sound, by what producers could assemble on to a sound film and reproduce through better projectors and vastly improved sound amplifying systems.

Once it became clear that the audience was being satisfied by the spectacle and sound from the screen, theatre managements began to look askance at the very considerable cost of maintaining a complex pipe organ and a highly paid artist to play it.

All over Australia, as elsewhere, the big theatre organs gradually fell into disuse and disrepair and were simply an obstruction when theatres had to be modernised and restyled for wide screen presentation. Organs which had cost many thousands of pounds to buy and install ended up being sold for a few hundred dollars to private organ enthusiasts.

They may well have remained as odd-ball toys for odd-ball enthusiasts had it not been for the emergence of the electronic organ over the past few decades.

Compact, and not unduly expensive, electronic organs are nevertheless capable of simulating a wide range of sound, from that of a traditional pipe organ to a cinema organ, plus a variety of other sounds beyond the scope of either. Rhythm and sound effects have been added and the very latest instruments even incorporate elements from the music synthesiser concept.

For the non-expert musician, an electronic organ offers the facility to produce pleasant sound, even impressive sound, quite out of proportion to the player's skill. This is quite an attraction in itself.

Conversely, however, the number of electronic organs in use and their accessibility has made it possible for a large number of potentially talented musicians to gain experience on organs as a class of instrument. In fact, a whole new generation of organists is very much in evidence who, in the popular field and semi-serious field at least, exhibit all the skills — and more — of the older generation.

It is not surprising that such musicians should seek out and try their skills on the older style acoustic instruments. Nor is it surprising that they, and their audiences, should derive a great deal of pleasure from the sound produced by hundreds of dispersed and carefully voiced pipes.

Far from qualifying as "odd-ball", the person or the group who can own, house, maintain and exploit one of the old-style cinema pipe organs is regarded by many with a good deal of envy.

For most individual enthusiasts, the closest they can come to the situation is to own and play a not-too-expensive electronic organ, attend an occasional recital — and build up a collection of the organ recordings they most fancy.

And this is where this article really started — with the two-record set reviewed on these pages.

But how did the cinema organ come into being?

It would need a much larger volume than this to do justice to the story but, for a brief history of the cinema Wurlitzer, we are indebted to writer Peter Rowe and an article in "Pertinent" magazine. The article was published in 1943, at a time when the days of the Wurlitzer pipe organ were numbered but before the electronic organ had emerged on a substantial scale.

Entitled "The Romanticist of The Organ", it is reproduced with some deletions in the interest of brevity:

During the latter part of the last century arose one of the most interesting figures that the world of music has seen. Inventor, telegraphic engineer, musician, choir master, and revolutionist, Robert Hope Jones left his mark when he died in 1914 as deeply as any great revolutionist who ever organised a complete change.

Hope Jones was not a social reorganiser. His sphere of revolution was in the world of organ building. He applied the science of telegraphy in a modified form, combined with entirely unorthodox tones to the "King of Instruments".

Hope Jones was an Englishman, born and educated in England, but he did not suffer from England's supposedly national complex, conservatism.

His principal tonal laboratory in England was St John's Church, Birkenhead — a handsome example of a good sized parish church, boasting a fine organ of conventional or so-called "classic" design — the only kind of organ then in existence. Such organs graced hundreds of churches in Europe and America in those days.

The influence of what this enterprising romanticist did to that organ shook the world

of organ builders and started a controversy amongst the fraternity, which has never yet been settled.

In all probability organ builders in general will never give their okay to Hope Jones' revolutionary reconstruction of the organ. It had always remained unchangeable in an "odour of sanctity". Hope Jones gave it monkey glands; brought it before the public as an instrument that could express the whole gamut of human emctions.

In doing so, though he failed to receive the support of his fellow organ makers, he did receive the endorsement of the man in the street. Overwhelmingly the public responded to the product of Hope Jones' brain.

What's all this about? Well — it's all quite familiar really; the "Wurlitzer organ", the organ which brought organ music to millions in the world's cinemas.

Robert Hope Jones, after much experiment, applied electricity to the heavy task of playing a large organ.

Originally — and conventionally — the playing keys had to operate air valves which admitted air to the pipes. The player had to provide enough force to operate the valves and to overcome the stiffness and mass of the connecting mechanism. After being rebuilt by Hope Jones the playing keys of the St John's organ merely had to complete low voltage electrical circuits.

These circuits in turn energised small electro magnets which actuated minute air valves, arranged to act as exhausts to air-motors — like bellows. These immediately collapsed, aided by air pressure around them, pulling open the wind-valves of the pipes and causing them to speak promptly as soon as the finger of the player depressed the key.

Hope Jones' successful use of electrical energy brought many advantages to the player. The touch of the keys became as light as that of a fine piano; music could be played much more rapidly than ever before; rattling and noise, inescapble results of wear in the old type of mechanism, disappeared.

Besides this, by a simple arrangement of multiple switches, any family of pipes could be played from any set of keys in the organ allowing a much greater flexibility and the production of new and unusual tonal effects.

The introduction of electrical control in the playing console ultimately allowed ingenious touches to be introduced — tonal changes by merely exerting greater pressure on the keys, and effects resembling the plucking of strings, the notes of a banjo and the tongueing of brass instruments.

Furthermore the organist, who had previously been pinned to a position hard up against the case of his instrument, where he was unable to hear the full effect of his music, could now be situated at a distance, angle and elevation most suited to his convenience. The key desk or console was connected to the organ by a flexible cable.

When Hope Jones received permission to apply his inventions to the St John's organ he made the console, which is really nothing more than a complex switchboard, movable. A photograph still exists of the inventor sitting outside the church in the gravel driveway, playing the organ installed inside.

It was this technique that later made it possible for theatre organists to be raised from a pit as they invoked music from organ chambers situated in the proscenium or ceiling.

Hope Jones also greatly changed the tonal plan of the organ at St John's. But his path, like that of so many revolutionists, was beset by much bitter opposition from musical purists, as indicated by the fact that the St John's organ has since been rebuilt on conservative lines, the electric action removed. It is, however, to be noted that many who tried it were loud in their praises of its ease in playing.

The original Hope Jones' actions are still preserved amongst the archives of St John's and are a monument to the skill and pioneer spirit of the "Romanticist of the Organ".

So great was opposition to the Hope Jones, idea of applying electricity to the organ and to his tonal novelties that he was eventually forced to make his home in America.

There the musical inventor and dreamer (incidentally a hopeless businessman) after sending two small organ builders bankrupt and stranding himself on the rocks, managed to interest "Rudy" Wurlitzer, head of one of America's greatest instrument building houses, in his apparently impossible scheme of marketing an organ which would appeal to the masses; an organ capable of rendering popular songs and dance music.

Wurlitzer, a shrewd businessman, considered, saw possibilities, and entered wholeheartedly into the scheme. He placed at Hope Jones' disposal the necessary capital to develop his ideas on a grand scale, a thing which the

FROM ORGANIST TONY FENELON

Dear Mr Williams,

I have been meaning to write to you for some time now to thank you for the wonderful reviews you have given my recordings in "Electronics Australia". I have subscribed to "Electronics Australia" since it was well back in the years of "Radio and Hobbies" and still find it the best and most comprehensive magazine on electronics available here.

It is gratifying to see from your reviews that you are a pipe organ fan and that so many recordings are reviewed in your columns. Unfortunately here in Melbourne the only recordable instrument at the moment is the Dendy 3/15 Wurlitzer, although the newly installed 4/21 Wurlitzer (ex-State Theatre, Melbourne) in the Moorabbin Town Hall should be ready for recording very soon. It will have a sound very similar to that of Melbourne's Regent Theatre organ.

Incidentally, for your interest, the Dendy recording "Tony" which you reviewed was recorded with a Tandberg Model 62X using two Neumann U87 condenser mikes, two U47s and a stereo mixer based on an "Electronics Australia" design. (That recording session ended at 5 am one morning!)

As you may know, one of our most talented visiting overseas organists was Lyn Larsen. Lyn lives in California, this being probably the hub of all theatre pipe organ activity in the States. During Lyn's last tour of Australia he was fortunately able to record one of his Sunday afternoon concerts at the Dendy Theatre. These concerts were extremely popular in Melbourne and were always packed out.

From the tapes a 2-record set was produced entitled LYN LARSEN "IN CONCERT". Although I am under contract to Festival I had their permission to appear as guest artist on this recording as a pianist. Also on the program was Julie Raines, a most talented harpist and winner of Showcase 69. In all, the "live-in" concert atmosphere has been preserved on disc as a response to many requests here in Melbourne. It is produced on a new label, Concept, which was formed jointly by my wife Kaye and Lyn Larsen during the latter's stay in Australia with the purpose of producing 'live' in-concert theatre recordings.

We are taking the liberty to send you a copy of the recording as we would be very interested in your opinion. These records are available from Concept Records, 6 Carrington Street, North Balwyn, Vic 3104 and the only Sydney outlet is Winton Music Centre, Shop 4, 83 York Street. The price of the recording is $10.95 plus 65c postage.

We hope you enjoy the recording and, once again, thank you for a wonderful magazine.

Yours sincerely,
Tony Fenelon.

THE RECORD REVIEWED

LYN LARSEN IN CONCERT, with Guest Artists Tony Fenelon and Julie Raines. The Dendy Theatre Organ. Stereo, Concept, CRS-3101.

I don't imagine that enthusiasts of the popular organ will need to much convincing to invest in this new two-record set.

Lyn Larsen is a very gifted young American organist, who made this recording while on his second visit to Australia. It is a straightforward concert performance, recorded before a full audience at the Dendy Theatre in Melbourne. The applause and the atmosphere of the audience has been retained, even to the segment on side 3 where Lyn Larsen calls for, and plays, numbers nominated by an enthusiastic group in the gallery.

He gives the full traditional theatre treatment to 15 solo numbers including: Strike Up The Band — San Francisco Medley — She Didn't Say Yes — Fantasy Suite (his own composition) — Cry Me A River — Moon Song — Begin The Beguine — Moonlight And Roses — Blaze Away — Over The Rainbow — Bugler's Holiday — I'll See You Again.

Harpist Julie Raines won Showcase 69, travelled to EXPO with the Australian Youth Orchestra, won the ABC Vocals and Instrumentals Award and qualified for a world trip — which is not a bad performance for a 17-year-old girl! Using more than the usual number of hands (surely) she steals the show with three numbers, backed by organ: At The Fountain — Song In The Night — Harping On A Harp.

Steals the show, that is, until Tony Fenelon at the grand piano teams with Lyn Larsen on organ to do "Ghost Riders In The Sky" and "Theme From The Apartment".

No wonder the audience reacted as if they had really got their money's worth.

Technically, the sound is clean and well balanced, with just a suggestion of system and perhaps organ noise behind the quieter passages. Technically, the outstanding characteristic of the album is the bass content, which can really make the floor throb. It doesn't come much heavier or more fundamental than what Lyn Larsen has coaxed from the Dendy organ. (W.N.W.)



Listening to music in the home

When we listen we become engrossed in the music and, with good equipment, we can often obtain the same satisfaction that we would enjoy in the concert hall. Of course, there are differences between the real and the reproduced. Many of these we recognise as such; we come to terms with them and they do not intrude.

More serious perhaps are the distortions which we do not consciously notice but which are nevertheless continuously producing a contradiction between the actual and the imagined. They produce listening fatigue, a condition detrimental to the true objective. These distortions have little to do with the popular conceptions of HI-FI or LO-FI sound; on the other hand they have much to do with good or bad engineering.

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.....State.....

inventor himself had never been able to achieve previously.

He was allowed to hire the finest workmen, was installed in a factory with his team of experts and supplied with every device necessary to carry out his research work and organ building.

Month after month slipped by as Hope Jones and his men laboured to produce an instrument embodying his unique tonal ideas and mechanical changes; time after time Wurlitzer was approached for his final okay to set the wheels of production going.

World famous organists were called in to try the instrument; day after day they played, noted faults and suggested possible improvements. Time after time the manufacturer refused his okay and further changes and adjustments were made, until at last he was satisfied and the Hope Jones unit orchestra went into production, to be known to the public as the Wurlitzer organ.

Hope Jones never lived to see the full fruition of his schemes, for he died in 1914, when few "Wurlitzers" had come into use. It was not until several years later that the managements of theatre concerns came to realise their value. Then as the great deluxe theatres were built the Hope Jones organs were installed throughout the civised world.

The Wurlitzer-Hope Jones' combination evolved many schemes to improve their organs. All mechanical parts were standardised and are interchangeable, an unheard of breach of organ building etiquette. Each model was also standardised, making mass production possible and making maintenance very simple.

So highly devloped was the design arrived at before marketing began that it has subsequently been altered very little — yet Wurlitzer organs have been notable for their mechanical reliability and ease of playing. Large quantities of sterling silver were used in the electrical contacts to minimise electrical problems.

In fact, most organ builders have since adopted the Hope Jones' method of using electricity to lighten the organist's task and enable him to play every kind of music from a jig to an anthem.

The Wurlitzer design, as has been stated, has stood unaltered for a quarter of a century, yet these organs handle the most extravagant of modern music with the same facility that they rendered the popular tunes of Hope Jones' day.

(EDITORIAL NOTE: This last paragraph and what follows was written in 1943 — as indicated earlier.)

Electronics certainly stands as a possible rival in the "swing" field, but in all other kinds of music is sadly deficient. When a perfect electronic organ is produced there is little doubt that the house of Wurlitzer will be in the lead. Experiments have been carried out, but the time for old man Rudy to give the "okay to run" has not yet come.

Present electronic substitutes have proved no more than a very poor caricature of organ tone. The price of such instruments at present is only a fraction of the smallest Wurlitzer. Wurlitzer prices are high in comparison with the most expensive straight organs, but Wurlitzer offers an instrument which has a very high order of performance and is the acme of convenience to the player, repair man and tuner, built from the best materials the world can offer.

Hope Jones, dreamer of dreams, in revolt against accepted practices, dealer in the unthinkable, as far as the purists views are concerned, was the brains responsible for the production of this successful but controversial instrument.

He split the organ world into two schools. Many builders followed him in part, but to him,



Developed jointly by North American Rockwell and the Allen Organ Company, this new instrument uses a computer and digital coding to construct a wide variety of waveshapes or "voices".

aided by the capital and business ability of Rudy Wurlitzer, goes the honour of having brought romance and all the other human emotions into organ music.

Almost unknown to the public who enjoy the fruits of his genius he missed the glamour which he created, and the pleasure which has thrilled millions of happy picturegoers.

TO 1971 AGAIN

Big pipe organs, classical, popular and "hybird" still provide the standards to be simulated. However, it is no longer valid to dismiss electronic organs as "sadly deficient". Such has been the acceptance of electronic organs for home, church, club and concert use that the Wurlitzer Company now maintains huge manufacturing plants throughout the world to keep pace with the demand.

In so doing, they share the market with many other manufacturers producing a range of instruments from scaled-down utilitarian models to full recital standards.

These latter instruments can simulate with remarkable accuracy the sound of popular or classical pipe organs to a degree where, in certain environments and with certain types of music, it is extremely difficult to pick one from the other by sound alone. But the vital point is that people and organisations that could not possibly aflord or accommodate a pipe instrument can instal and enjoy its electronic counterpart.

However, while designers readily concede that an electronic organ should be able to provide realistic organ-like music, this is by no means a terminal objective. Techniques borrowed from computer technology are making it possible to synthesise sounds and effects outside those obtained by traditional means.

The latest model Wurlitzer, the Orbit Model 111 is a three-manual instrument with conventional organ voices and facilities. But the top manual gives access to a whole array of synthesiser circuitry, allowing the organist to produce sounds and effects of quite unique character.

In fact, it would appear that synthesiser facilities are going to be featured in at least the prestige models in the major brands. Australian Musical Industries recently announced a new Lowrey organ, the "symphoniser", while the Allen Organ Company is apparently investigating the possibility of synthesising both traditional and non-traditional sounds.

FOOTNOTE: The Lyn Larsen 2-record album can be obtained from the address given in the review. NSW readers can alternatively obtain it from Winton Music Centre, 83 York St, Sydney, 2000.

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FORUM

Conducted by Neville Williams

Making Bing Crosby years younger

The above headline has nothing to do with a toupee or with monkey glands. It has everything to do with an un-named recording engineer who, according to a correspondent, has fiddled the speed of a Bing Crosby recording to make the ageing artist sound younger, more "with it". Comes the problem: How can Bing be restored to his former self?

Rejuvenating (and dejuvenating) Bing Crosby is one of the more colourful aspects of a letter to hand from a Tasmanian reader.

He sees as a major problem something that few other people seem to worry their head about: disturbing changes in tempo (and presumably pitch) when music is deliberately or accidentally speeded up or slowed down during the overall record/play process.

He sees the problem as being of such magnitude that all quality disc and tape players should be provided with facilities to vary the speed over a substantial range.

In the process of getting his point across, he raises some interesting side issues.

What do other readers think about his problem? Is it real or is it imaginary?

Dear Sir,

Although I have not been endowed with the sense of perfect musical pitch, I am frequently bothered by incorrect speeds in recording and reproduction.

If you complain to anyone in the business that a recording sounds too fast or too slow, they will reluctantly admit that there is a slight error and that it has apparently been created by the recording engineer for reasons best known to himself.

Back in the days of the wind-up gramophone, recording techniques were so haphazard that even the cheapest gramophone featured speed regulation. Right or wrong, you could set the disc speed to your own taste.

With the advent of motor-driven turntables, everyone stressed constant speed as a desirable feature. At The Audio Fair in London, last October, I could only find two turntables that gave speed control, a Thorens and a Goldring.

The same thing applies to tape. Most tape recorders sold are of the belt-driven variety and you would be struggling to find two that are at the correct speed. If you want constant and correct speed you need a recorder with three motors, plus a special imported gadget to regulate the motor speed. Even this doesn't always give sufficient speed variation and the tape has to be put through at least twice. I have been told that, in Hong Kong it is now possible to buy a SONY recorder which has speed control.

Perhaps I should explain the problem in more specific terms.

Some years ago, Capitol issued a recording of Peggy Lee titled "Latin a la Lee", in which she was accompanied with simple rhythmic arrangements by Billy May's Orchestra.

Some time later, MGM issued a recording of Bing Crosby titled "El Senor Bing" on which he was also accompanied by Billy May using the same type of orchestration. But something was wrong.

The beat was much too fast for any singer and the orchestra sound level dominated the voice level. Apparently the sound engineer had tried to raise Bing's elderly baritone by speeding up the recording and altering the balance between the voice and the orchestra.

With the equipment now available, the recording can be slowed down, which brings the voice forward and slows the rhythmic beat to something like that heard in the Peggy Lee album.

Another instance of speed alteration can be detected on the Capitol album "The Great Country Hits", again by Bing Crosby. This time, the voice sounds as though Bing had a cold and the orchestrations seem slightly slow. But if you listen to the Capitol tape of the same recording, it sounds better because it has been recorded at the correct speed, without any attempt to make Bing sound "country style".

Does anyone complain about the sound when a television station speeds up a film to allow time for the commercials? I have heard that ABC Television does not have this speed-up facility, so if the film happens to be slow it remains so.

(H. H., Burnie, Tas.)

This is one of those letters that one could not possibly read with detachment.

Right at the outset, H.H. says that he lays no claim to a sense of perfect pitch. This is an important statement in view of the remainder of the letter.

Some years ago, there was quite a bit of discussion in these columns about claims that certain people possess "perfect" or "absolute" pitch. The implication usually is that they have inherited some kind of a biological reference which is perfectly attuned to the international standard musical pitch.

If they hear a series of notes or chords played on the piano, they can identify them without difficulty.

They are ill at ease if a piece of music is played above or below standard pitch, no matter how commendable the performance may be in other respects.

Unfortunately for the validity of the "inherited" argument, musical pitch is quite an arbitrary thing and has been the subject of debates and decisions through the years. Presumably people now living and allegedly blessed with "perfect pitch" would have been most miserable in other years, when pitch was as low as A = 424Hz or as high as A = 455.5Hz, as against the current figure A = 440Hz.

To be sure, some people do have an uncanny sense of pitch but it is much more logical to attribute it to aptitude, memory and training than to some mysterious kind of biological resonance.

Most of us have met fitters and carpenters able to judge measurements with uncanny accuracy but I cannot recall this quality ever being attributed to "perfect distance".

However, enough about that in the present context. H.H. says that he does not possess this attribute and is apparently not worried by its implications. Rather would his judgments seem to be based on a highly developed sense of tempo and rhythm.

Developing this theme, he has a lot to say about the speed of certain records, the adjustment facilities that were "featured" on older turntables and the implied benefits that were to be derived from these adjustments.

As a lad, I was reasonably familiar with spring-driven turntables and their traditional governor-type speed control. When I entered the industry a little later, electric motors had taken over but they relied, with very rare exceptions, on the same type of governor mechanism.

At the time, it did not seem that there were any subtle reasons for this. With spring-driven motors, there was really no alternative and, with the substitution of an electric motor, the technique simply carried over.

When setting up or servicing a radiogram of the period, a routine task was to adjust the governor mechanism to produce an exact 78rpm, as indicated by a stroboscope, and to set the lever so that the pointer was at the appropriate place on the speed scale.

There was no thought of removing the lever or of presetting the governor adjustment because it was assumed that the speed would creep (and need adjustment) due to gradual wear of the felt rubbing block.

Service oscilloscopes

Dear Sir,

I refer to the August 1971 issue of "Electronics Australia" and in particular to page 65 under the title "The Serviceman".

Within the text of this article, on page 67, is the following statement: "Granted, one needs a CRO capable of working up to a couple of MHz but this is not nearly the problem today that once it was. Imported units with this order of performance are available for quite reasonable prices. Considering their value in other spheres, such an outlay is not hard to justify".

As the largest manufacturers of quality cathode-ray oscilloscopes in Australia, we applaud you for promoting the sentiment that a low-cost cathode-ray oscilloscope is a need for servicemen today. However, we take very strong exception to the implication that such equipment is available only as an imported item.

I would refer you to our advertisement, which appeared in the same issue on page 44, which shows our model bwd 509A cathode-ray oscilloscope, which would adequately meet the requirements of radio servicemen.

D. R. H. Johnstone, Marketing Manager
BWD Electronics Pty Ltd.

RAUDIVE, COPYRIGHT AND THE W/T ACT

Dear Sir,

I was interested to read the enlightening article "Spook-Easy" in your September issue by my very good friend Tung N. Chique.

I was disappointed, however, that he did not mention the secrecy provisions of the Wireless Telegraphy Act, or how these would apply to the types of messages being considered.

The Act states, in effect, that any operator who intercepts a message not intended for his station must not make use of such a message, reveal its contents or even reveal the existence of the message.

Where does this put Mr Raudive, and others making similar experiments?

It is necessary, of course, to decide whether such messages can be regarded as broadcast transmissions, or whether they are private messages, addressed to individuals or specific groups of individuals.

From the references I have been able to consult it would appear that, apart from an occasional public minded spirit who broadcasts warnings of impending disasters, almost all such transmissions are directed to individuals. Indeed, it is a common procedure for the spirit to call the wanted party by name.

From this it would appear that Mr Raudive and others are transgressing the Wireless Telegraphy Act in a most blatant manner.

On top of that they have recorded the messages without the express permission of the party at the other end of the circuit, or without superimposing the necessary pips every 20 seconds, as required by the regulations.

Which brings us to another point: What about copyright, and the requirements of Actor's Equity?

I don't profess to know a great deal about this aspect of the subject, but I do feel that there is a good chance that they have transgressed here also.

Yours faithfully,
Joe Kerr.

As far as the industry was concerned, the speed adjustment was seen as a mechanical necessity rather than an operator facility.

What about the attitude in those days of rotational speed when cutting master discs? Was the equipment subject to major error? Were recording engineers notably careless? Were they given to manipulating speed to change the character of a performance?

In asking these questions, it is necessary to add that our correspondent is not digging too far back into the past — certainly not into the pre-electric era.

Without having made a specific study of the subject, my impression is that professional recording engineers were highly sensitive to the performance of their turntables — many of them massive, precision, gravity-driven affairs. I doubt that there would have been too much room for error, carelessness or deliberate fiddling.

What is more, with the performance going straight from microphone to disc master, there would have been no scope for error or manipulation in between.

If, in fact, the recordings from at least the early 1930's were spot-on in terms of speed, the basic reason for providing an adjustable governor would have been to keep the replay motor likewise spot-on — not to allow it to be set spot-off!

In fact, talking over the whole subject, I was reminded by a member of the staff that, much earlier than the period we are talking about, the Edison Company had displayed a keen appreciation of the need to set replay speed. I gather that they issued a pitch pipe and a special record containing a reference tone. The idea was to blow the pitch pipe and adjust the speed of the player until the two tones were the same.

But, to read a letter like the one from H.H. is sufficient to generate doubts. Are we assuming too much about the equipment and the engineers who were responsible for its use? Has H.H. picked up something that the rest of us have taken too much for granted?

But the arguments are not without flaws.

H.H. suggests that a Bing Crosby record has been doctored "by speeding up the recording and altering the balance between voice and orchestra".

That certainly could be done if voice and orchestra had been recorded on separate tracks of a tape master.

But then comes the rub:

H.H. says that slowing the record down brings the beat back into line and "brings the voice forward".

Slowing the record will lower the beat and the pitch but it certainly wont change the balance!

Doubts about the correspondent's theories are greatly strengthened by his observations about films played over television.

Australian television has a very precise picture rate of 25 per second. The stations have no option but to present films at this rate rather than at 24 per second, which would be the normal figure.

Having been so discriminating about the replay speed of records, H.H. seems curiously unaware and unconcerned that all films he watches over television are played with a speed error of over 4%

It could be said that he has, in fact, drawn attention to the speeding-up of films on television, but has been mislead as to the reason.

Fair enough, but he obviously entertains the idea that the ABC does not need to speed up films because they don't have to make room for commercials. In fact, he says, "if the film happens to be slow it remains so".

Sorry, H.H. but with currently available projection equipment and within the framework of the television standards, no television station can slow down or speed up the projection rate of a regular film, even if it wanted to do so!

Well then, was the original exposure rate of the films likely to have been subject to variation?

With regular sound films of any reasonable vintage I would be most surprised if they were. The interlocks for picture and sound equipment needed to be so elaborate and extensive that one could hardly imagine engineers arranging all this and then being negligent in the matter of frequency.

But, be that as it may, on the matter of ABC and commercial television stations, H.H. is vague about a speed variation of just over 4%.

Translated into terms of disc records, this would amount to 3.1rpm in 78, 1.8rpm in 45, 1.3rpm in 33.

Is H.H. reacting to speed discrepancies less than this and, if so, why has he been so vague about film speeds?

Or is he reacting to discrepancies greater than those mentioned? If so, are examples

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WRITING TO US? Then please note that we have had to revise some of our Information Service charges. Turn to page 137 for full details.

sufficiently numerous to warrant a whole new approach to turntable design?

Is it really a technical problem at all? Perhaps our correspondent is really reacting to the treatment and tempo adopted for particular performances by the conductor and is trying to "fix" them by juggling the replay speed!

Mention of tape raises a whole new set of circumstances. It is possible that errors could occur in transferring from tape to tape prior to the release recording. It is possible that some deliberate manipulation could take place.

Whether the speed discrepancies in professional equipment could account for the kind of thing that H.H. is complaining about is another matter, as also is the inclination of recording engineers to fiddle the speed deliberately.

With non-professional equipment, the differences between individual recorders would be more noticeable and possibly troublesome in the worst cases.

Our correspondent's cure for the situation is to provide all tape recorders with a variable speed facility, thereby transferring the responsibility for maintaining correct speed to the user.

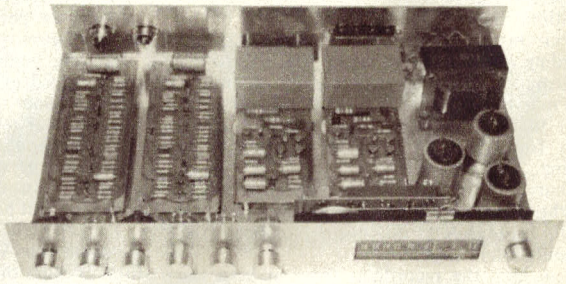
I wonder whether the cure may not in fact turn out to be worse than the complaint.

In rounding this off, let me add a disturbing footnote: Elsewhere in the issue, we mentioned a simple way of varying the speed of a well known brand of cassette player. It's very effective for the purpose for which it was done.

But it also reminds one that an increasing number of recorders are appearing on the market in which the speed is not dependant on the mains and the number of poles in a motor. Rather it is dependant on a control circuit involving components.

Components can drift!

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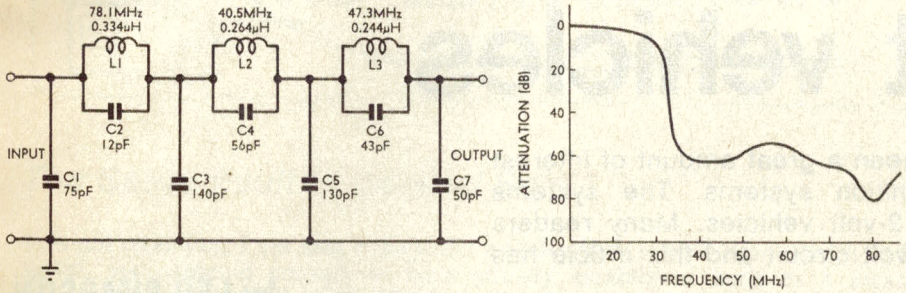
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Easily Adjusted Low-Pass Filter



Of course, not all TVI is the fault of the receivers. There is still an obligation on the part of the amateur to keep harmonic and spurious radiation down, and that usually calls for low-pass filters. While the traditional types, as given in the handbooks, are usually quite effective when correctly set up, they are not always easy to align and check without test equipment. A design which did not perhaps receive sufficient attention at the time it was published ("An Effective Low-Pass Filter", by Glenn R. Walsh, WB6HRM, "QST" January, 1966) is the one shown here. The author claimed that this type of filter, based on the insertion-loss concept rather than the more usual image parameter type offered several advantages: (1) it uses two less coils for equivalent stop-band attenuation; (2) it provides relative freedom in the selection of frequencies of maximum attenuation; and (3) it is easy to tune using only a grid-dip meter. His suggested filter has a 30MHz cut-off with tuned circuits at 78.1, 40.5 and 47.3MHz resulting in the attenuation curve reproduced herewith. Maximum VSWR introduced by the filter was given as 1.3:1 at 29.7MHz.

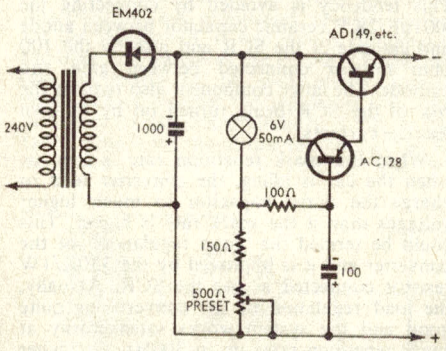
To achieve this performance, the usual filter construction precautions must be taken. Coils were made from 14 gauge enamelled copper wire formed on a ½in diameter mandrel: L1 8 turns; L2, L3 6 turns. When the coils have been formed, the capacitors C2. C4 and C6 are soldered across them and initially tuned to resonance by adjusting the turns spacing until a GDO indicates resonance at the appropriate frequencies. The coil/capacitor assemblies are mounted in the chassis (individually) and again checked for resonance. Finally, the shunt capacitors (C1, C3, C5, C7) are soldered into the filter. The WB6HRM unit was housed in a 5in x 3in x 2in aluminium box, with aluminium shields providing isolation between the three filter sections. Attention was drawn to the need to secure each shield at eight points to ensure good isolation, and he also used angle brackets to reduce leakage from the enclosure, with paint removed from the edges of the cover to ensure good metallic contact between overlapping flanges when the unit is assembled. WB6HRM pointed out that these precautions are important in preventing harmonic currents from reaching the outside surface of the housing and so by-passing the filter.

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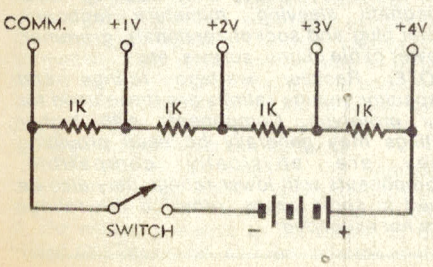
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Five terminals are used for the voltage take-off points. This is possibly the simplest method but a switch could be used if so desired.



(Editorial comment: For the mercury cells, Union Carbide Aust Ltd suggest Eveready type E1 or E640. These retail at $1.10 and 95c, respectively.)

(Submitted by Mr A. D. Fuller, 406 Pennant Hills Road, Pennant Hills, NSW 2120.)

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C-D Ignition Unit for 6-volt vehicles

Over the past few years there has been a great amount of interest concerning capacitor-discharge ignition systems. The systems described to date have been for 12-volt vehicles. Many readers have requested information on a 6-volt circuit and this article has been produced to satisfy requests.

by LEO SIMPSON

Although cars with 6-volt electrical systems are no longer being built, there are many 6-volt vehicles still on the road today. Probably most are pre-1968 Volkswagens, and when it is considered how many of these vehicles alone are still in use, there must be a sizable number of our readers who are interested in such a project.

Some readers may regard the installation of a CDI system on a vehicle such as the VW as a waste of time and money. After all, the engine has very modest performance so that any performance improvements are likely to be minimal. From the point of view of acceleration times from 0 to 60mph, this view is entirely justified. However, the main improvements are noticeably better engine smoothness and flexibility, and easier starting, particularly when the engine is hot. The improvement in petrol economy will be small, especially when compared with a well tuned car with conventional ignition.

Perhaps the biggest advantage of the CDI system is reduction in maintenance of distributor points and spark plugs. Do-it-yourself enthusiasts will tend to belittle this, but for the person whose time is strictly limited, even this reduction is worthwhile.

Design of the unit is straightforward and is based on a circuit published by the Applications Laboratory of Standard Telephones and Cables Ltd. The converter consists of two silicon NPN power transistors in a common-collector transformer coupled oscillator. Self-starting under full load conditions is ensured by the inclusion of the resistor network supplying base current to the transistors. A full discussion of basic converter operation was included in "A Capacitor Discharge Ignition System" published in the August 1970 issue of "Electronics Australia", so we shall not repeat it here.

The square wave voltage impressed across the primary windings by the transistors appears across the secondary winding, multiplied by the turns ratio to around 350 volts, with a 6-volt input. This is rectified by a bridge rectifier to charge the 1uF/600VW "dump" capacitor via the primary of the ignition coil.

A silicon controlled-rectifier (SCR) is used to discharge the dump capacitor back via the coil primary and thus apply the full capacitor voltage to the coil. This is "stepped up" by the secondary winding to fire the spark plugs. The capacitor voltage of around 350 volts is much higher than that developed inductively in the coil primary by a conventional ignition system so that the available "spark energy" is much higher. In addition, the "rise time" of the voltage across the plugs is considerably faster than for conventional ignition so that fouled plugs are easier to fire.

While the dump capacitor is being discharged, the converter stops functioning and does not restart until the SCR reverts to the "blocking" (or non-conducting) state. The 100uF capacitor across the 100 ohm bias resistor improves restarting of the converter to ensure good performance at high spark repetition rates. The charging time of the dump capacitor is approximately 3 milliseconds and the converter frequency around 3KHz.

Since the dump capacitor is charged very rapidly, there is a risk that the SCR will be turned on by the rapid rise time of the voltage across it — this is so-called "dv/dt switching". This tendency is avoided by connecting the .001uF/2KV ceramic capacitor between anode and cathode of the SCR and also by the 100 ohm resistor connected between gate and cathode. The latter component also reduces the risk of the SCR being turned on by its own leakage currents.

When the spark repetition rate is low, ie, when the car is idling, the converter tend to charge the dump capacitor to much higher voltages than if the spark rate is higher. This could be termed the "load regulation" of the converter and it is improved by the 330K/1W resistor connected across the SCR. Actually, the load regulation of the converter is quite good and the system works satisfactorily at spark repetition rates up to 300Hz, far higher than is ever likely to be required on 6-volt vehicles, as 300 sparks per second is equivalent to 9000rpm with a 4-cylinder motor or 6000rpm with a 6-cylinder motor.

With a 6-volt system, variation of the input voltage is far more of a problem than load regulation referred to above. In a typical 6-volt vehicle the input voltage to the converter could vary from as low as 4.5 volts when the battery is almost flat and attempting to crank the motor, to as high as 8 volts when the generator takes over the battery load at high speed. As it is, the converter works reliably with input voltages from 3.5 to 9 volts. It will work with even higher voltages but there is the danger of damaging the SCR.

Positive-going trigger pulses are generated by the distributor points with the aid of a simple network consisting of two resistors, a diode and a capacitor. When the points are closed, current flows through the 27-ohm resistor. When they open, the 0.33uF capacitor is charged up via the 27-ohm resistor and diode and the charging current triggers the SCR. When the points close, the capacitor discharges via the 1.8K resistor.

One of the advantages of solid-state ignition is that the points are relieved of the arduous duty of carrying and "breaking" the heavy coil currents, so that point wear is much reduced. However, if the current is reduced too much, the distributor points become fouled by oxidation and by oil fumes inside the distributor housing. Eventually, triggering of the SCR becomes unreliable. Ideally, the points should carry about 200 to 500mA to maintain a self-cleaning action. The 27-ohm resistor sets this current at around 220mA — a compromise between cleaning action of the points and heat dissipation inside the CDI case.

No steps have been taken to include a "point bounce" suppression circuit. With most of the cars that the unit is likely to be used point bounce should not be a problem since engine speeds are relatively low. Another reason for not including such a feature, is that it is difficult to obtain suitably high amplitude trigger pulses using UJTs with a 6-volt supply, and if transistors were used to do the same job, power transistors would be required. In practice we have found the trigger circuit shown quite satisfactory for Volkswagens.

PARTS LIST

1 Case with mounting brackets (see text)
2 FX2243 ferrite cup cores
1 DT2206 Delrin former
2 2N3055, BDY20 silicon NPN power transistors
4 EM406, BY127/600 silicon power diodes
1 EM401 silicon diode
1 2SF206, BT101/500R silicon controlled-rectifier

CAPACITORS
1 x 1000uF/25VW electrolytic
1 x 50uF/25VW electrolytic
1 x 1uF/600VW paper (Ducon 3S10)
1 x .33uF/100VW polyester
1 x .001uF/2KV ceramic

RESISTORS
1 x 330K/1W, 1 x 1.8/½W, 1 x 100 ohms/1W, 1 x 100 ohms/½W, 1 x 27 ohms/3W, 1 x 15 ohms/½W.

MISCELLANEOUS
Double-tough enamel copper wire (20, 24 and 26 B&S), heavy duty hook-up wire, spaghetti sleeving, miniature tagboard, octal plug and socket (optional), grommet, power cable clamp, screws, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.

back in full working order. The customer picked it up later in the day and was delighted when I was able to demonstrate that those parts of the original tape which she feared had been lost were still intact.

One more happy customer.

And I venture to suggest that she was happy not only because of the final outcome of the episode; as much as anything it was the fact that I had been able to reassure her so quickly. Granted, there was a large element of luck involved here but, by making the most of it, I was able to create a good impression. It is a good idea to take such opportunities when they present themselves; they pay good dividends in customer relations.

And here is a comment from a reader following my remarks in the August issue about the hazards of becoming involved with very old sets.

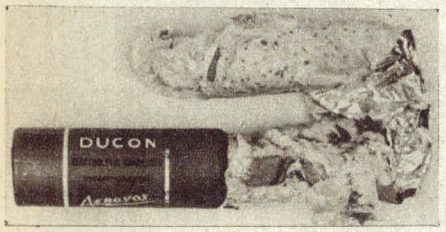
Dear Sir,

I refer to your recent discussion on "Vintage" receivers in the Serviceman section.

Some time after having read this I was presented with a 5-valve set of unknown age which a friend of mine found in the garage of a house he bought.

The only clue to the age of the set is an electro-dynamic speaker, which I believe went out of production in the early 40s.

As a matter of interest I connected the set to the supply and although the speaker did not respond there was a big bang after a few moments. The results of the bang are enclosed



and I do not know what would have happened to me if I did not wear glasses. They changed from being transparent to being translucent.

The positive connection of the condenser is still in the set, which so far has not been reconnected, for fear of further bangs.

Yours Sincerely,
F.M. (Bentliegh Vic.)

I must confess that I hadn't regarded this possibility as a serious hazard. When I wrote about the problem, I was more concerned with the financial hazards, or the hazard to one's reputation if the job turned sour.

Yet it must be admitted that exploding electroytics are an occupational hazard; and that the probability of this occuring must be greater in an old relic.

More to the point, just how great a hazard is it? In the past I have never regarded this phenomena as having anything more than a nuisance value. It could go off with a bang that would scare the living daylights out of anybody in the vicinity. And it could splatter its liquid contents all over the nearby components and chassis, to their ultimate detriment, if not cleaned away quickly.

But I had never thought about copping this lot in the face — or in the eyes, as nearly happened to F.M. It is not a pleasant prospect, if what it can do to chassis etc is any indication of what it might do to the eyes.

So, while I doubt whether I would ever have knocked back a vintage set solely in the basis that the electrolytics might explode in my face, I think I will be just that little bit more careful in future in such situations.

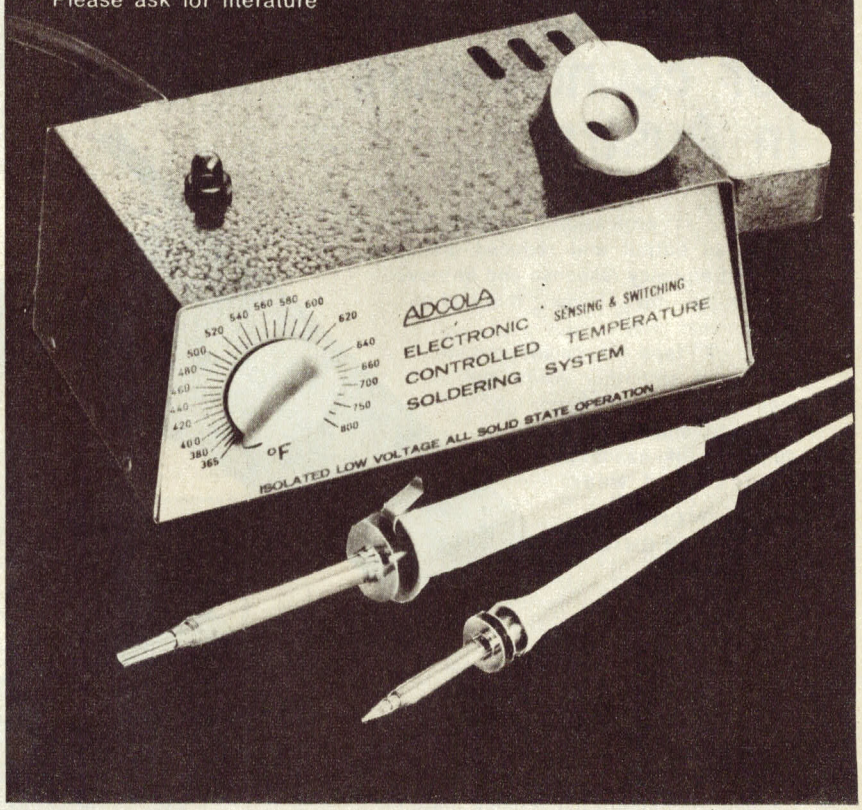
Damaged components can be replaced; eyes are another matter.

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CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome.

Tone Control Amplifier

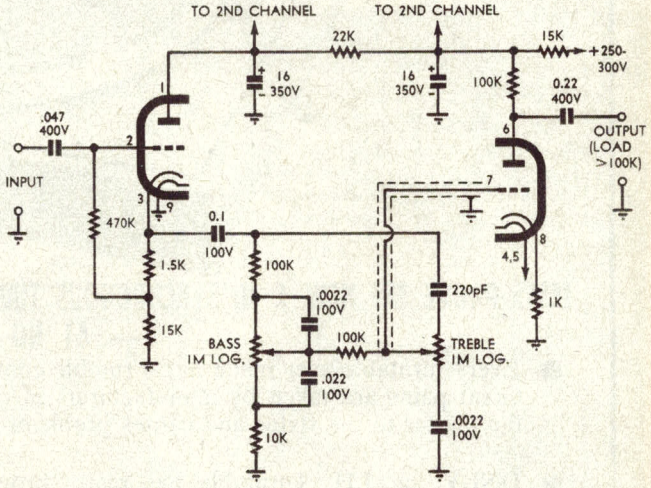
The circuit shown herewith will pep up almost any valve audio amplifier deficient in the treble and bass regions. It may also be used to help overcome the shortcomings of loudspeakers and signal sources lacking in treble and bass frequencies. In short, it may contribute to a poor man's hi-fi system.

This tone control will provide up to 16dB of bass or treble boost or cut, with a small amount of voltage gain. It is designed to be connected into an existing amplifier, immediately prior to the power output stage. As the current drain is small, heater and HT supply may be taken from the main amplifier power supply. For constructors with a reasonably stocked junk box, the cost of this project would be minimal.

Any twin triode such as the 12AU7, 12AX7 or 12AT7, is suitable. Instead of a twin triode, two single triodes such as the 6C4 or 6AV6 could be used. All valve types mentioned have been tried and are satisfactory. With the controls set for flat response, a 12AX7 gives about 3 times voltage gain. A 12 AU7 will give less and a 12AT7 a little more. If the voltage gain is not required, it may be attenuated by introducing a resistive divider between the output and the following stage.

In its simplest form, this tone control can effect a marked improvement when connected to even a mantel radio. I built a stereo version into an EA Basic Stereo Amplifier as described in June, 1966. The existing top cut control in the 6AQ5 grid circuit was replaced by a 470K resistor. The small voltage gain available allowed the use of a lower output medium quality ceramic pickup cartridge. Coupled with low cost 8in wide range speakers, the resulting system rivals many of the more costly systems.

Although only one channel is shown for the Tone Control Amplifier, it can be duplicated for stereo work as indicated.

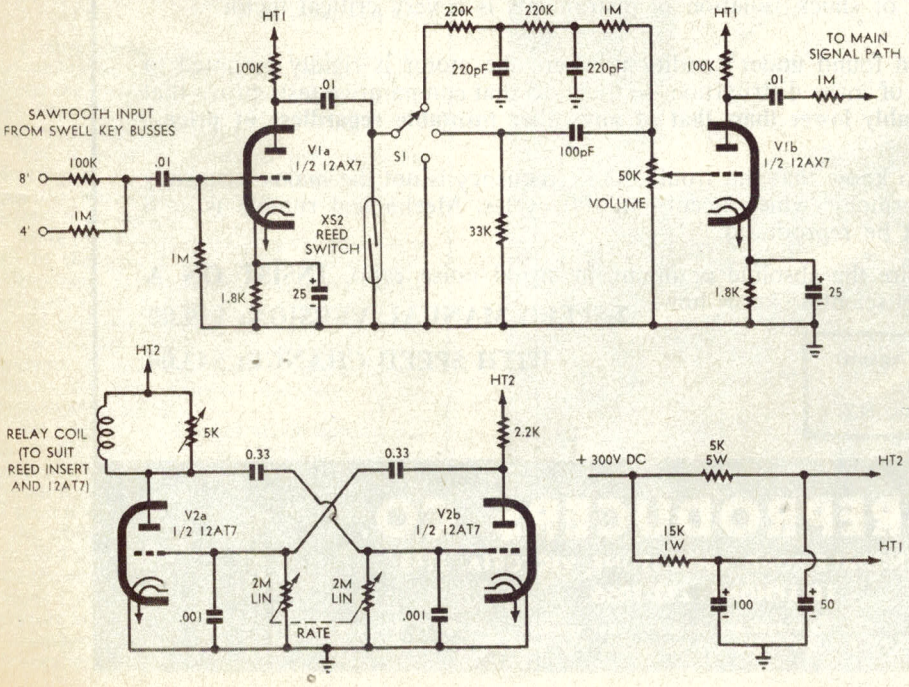


For stereo applications the circuit is duplicated, except for the two electrolytic capacitors and the 15K resistor, which could be reduced to either 8.2K or 6.8K. Both potentiometers will need to be dual gang types.

Component layout is not very critical but care should be taken to avoid earth loops and the unit should be located clear of any AC fields. When the bass boost is used, hum could be a problem if these precautions are not taken.

(By Mr N. W. Giles, 32 Mawby Road, East Bentleigh, Victoria 3165.)

Reiteration for Electronic Organs



Here is a circuit which may be used to add "repeat" or "reiteration" to electronic organs. My organ, being a valve model, meant that it was easier to design the circuit around valves but the same principles could be used where transistors are employed.

Signal is taken from the 8ft and 4ft key busses on the swell manual, mixed and then amplified by V1a. The output of V1a is fed to filters which are selected by S1. Two filters are shown but many more may be added by using a switch with more positions. The output is also regularly interrupted by the reed switch, which is actuated by the relay coil in the plate circuit of V2a. After suitable filtering, V1b gives further amplification and the signal is then mixed with the main signal.

V2a and V2b form a multivibrator circuit to actuate the reed switch. The rate is controlled by the 2M dual ganged potentiometer in the grid circuits. The HT supply requires effective decoupling and this is achieved by using the network shown in the circuit. The .001uF capacitors in the grid circuits are to suppress radiation from the multivibrator and the 5K potentiometer gives some control over the mark-space ratio. The latter is adjusted to give the desired result.

In use, the circuit produces a strumming effect, the rate of which can be varied. It may be used as a solo voice, or in conjunction with the normal stops on the organ. (By Mr J. C. Holliday, 16B Arthur Street, Dalby, Queensland 4405.)

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- The J.H. Turntable has been found under conditions where the motor is rigidly mounted to possess an ideal relationship of mass distribution, so much so that comparative tests prove that **its rumble content is appreciably lower than that of any other turntable regardless of price.**

- (It may interest the reader to know that the troublesome frequency is not the mains frequency of 50 cycles, but the first harmonic which occurs at 100 cycles. Mechanical rumble is at 8 cycles and, of course, cannot be reproduced.

- **CONCLUSION:** If you require the absolute optimum in signal/noise ratio, **INSIST ON A "JH" Turntable** — backed by scientific know-how.

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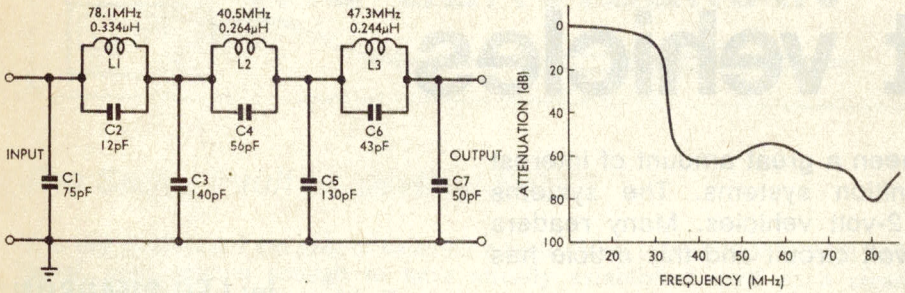
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Easily Adjusted Low-Pass Filter



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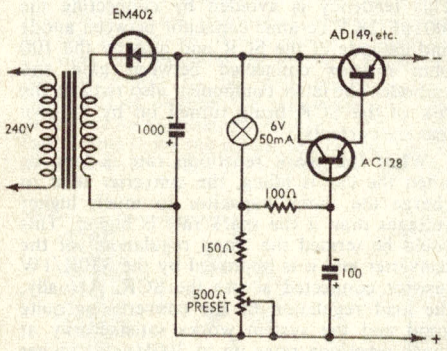
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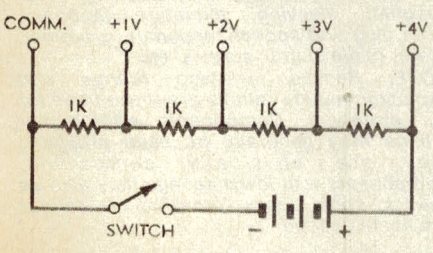
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(Editorial comment: For the mercury cells, Union Carbide Aust Ltd suggest Eveready type E1 or E640. These retail at $1.10 and 95c, respectively.)

(Submitted by Mr A. D. Fuller, 406 Pennant Hills Road, Pennant Hills, NSW 2120.)

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C-D Ignition Unit for 6-volt vehicles

Over the past few years there has been a great amount of interest concerning capacitor-discharge ignition systems. The systems described to date have been for 12-volt vehicles. Many readers have requested information on a 6-volt circuit and this article has been produced to satisfy requests.

by LEO SIMPSON

Although cars with 6-volt electrical systems are no longer being built, there are many 6-volt vehicles still on the road today. Probably most are pre-1968 Volkswagens, and when it is considered how many of these vehicles alone are still in use, there must be a sizable number of our readers who are interested in such a project.

Some readers may regard the installation of a CDI system on a vehicle such as the VW as a waste of time and money. After all, the engine has very modest performance so that any performance improvements are likely to be minimal. From the point of view of acceleration times from 0 to 60mph, this view is entirely justified. However, the main improvements are noticeably better engine smoothness and flexibility, and easier starting, particularly when the engine is hot. The improvement in petrol economy will be small, especially when compared with a well tuned car with conventional ignition.

Perhaps the biggest advantage of the CDI system is reduction in maintenance of distributor points and spark plugs. Do-it-yourself enthusiasts will tend to belittle this, but for the person whose time is strictly limited, even this reduction is worthwhile.

Design of the unit is straightforward and is based on a circuit published by the Applications Laboratory of Standard Telephones and Cables Ltd. The converter consists of two silicon NPN power transistors in a common-collector transformer coupled oscillator. Self-starting under full load conditions is ensured by the inclusion of the resistor network supplying base current to the transistors. A full discussion of basic converter operation was included in "A Capacitor Discharge Ignition System" published in the August 1970 issue of "Electronics Australia", so we shall not repeat it here.

The square wave voltage impressed across the primary windings by the transistors appears across the secondary winding, multiplied by the turns ratio to around 350 volts, with a 6-volt input. This is rectified by a bridge rectifier to charge the 1uF/600VW "dump" capacitor via the primary of the ignition coil.

A silicon controlled-rectifier (SCR) is used to discharge the dump capacitor back via the coil primary and thus apply the full capacitor voltage to the coil. This is "stepped up" by the secondary winding to fire the spark plugs. The capacitor voltage of around 350 volts is much higher than that developed inductively in the coil primary by a conventional ignition system so that the available "spark energy" is much higher. In addition, the "rise time" of the voltage across the plugs is considerably faster than for conventional ignition so that fouled plugs are easier to fire.

While the dump capacitor is being discharged, the converter stops functioning and does not restart until the SCR reverts to the "blocking" (or non-conducting) state. The 100uF capacitor across the 100 ohm bias resistor improves restarting of the converter to ensure good performance at high spark repetition rates. The charging time of the dump capacitor is approximately 3 milliseconds and the converter frequency around 3KHz.

Since the dump capacitor is charged very rapidly, there is a risk that the SCR will be turned on by the rapid rise time of the voltage across it — this is so-called "dv/dt switching". This tendency is avoided by connecting the .001uF/2KV ceramic capacitor between anode and cathode of the SCR and also by the 100 ohm resistor connected between gate and cathode. The latter component also reduces the risk of the SCR being turned on by its own leakage currents.

When the spark repetition rate is low, ie, when the car is idling, the converter tend to charge the dump capacitor to much higher voltages than if the spark rate is higher. This could be termed the "load regulation" of the converter and it is improved by the 330K/1W resistor connected across the SCR. Actually, the load regulation of the converter is quite good and the system works satisfactorily at spark repetition rates up to 300Hz, far higher than is ever likely to be required on 6-volt vehicles, as 300 sparks per second is equivalent to 9000rpm with a 4-cylinder motor or 6000rpm with a 6-cylinder motor.

With a 6-volt system, variation of the input voltage is far more of a problem than load regulation referred to above. In a typical 6-volt vehicle the input voltage to the converter could vary from as low as 4.5 volts when the battery is almost flat and attempting to crank the motor, to as high as 8 volts when the generator takes over the battery load at high speed. As it is, the converter works reliably with input voltages from 3.5 to 9 volts. It will work with even higher voltages but there is the danger of damaging the SCR.

Positive-going trigger pulses are generated by the distributor points with the aid of a simple network consisting of two resistors, a diode and a capacitor. When the points are closed, current flows through the 27-ohm resistor. When they open, the 0.33uF capacitor is charged up via the 27-ohm resistor and diode and the charging current triggers the SCR. When the points close, the capacitor discharges via the 1.8K resistor.

One of the advantages of solid-state ignition is that the points are relieved of the arduous duty of carrying and "breaking" the heavy coil currents, so that point wear is much reduced. However, if the current is reduced too much, the distributor points become fouled by oxidation and by oil fumes inside the distributor housing. Eventually, triggering of the SCR becomes unreliable. Ideally, the points should carry about 200 to 500mA to maintain a self-cleaning action. The 27-ohm resistor sets this current at around 220mA — a compromise between cleaning action of the points and heat dissipation inside the CDI case.

No steps have been taken to include a "point bounce" suppression circuit. With most of the cars that the unit is likely to be used point bounce should not be a problem since engine speeds are relatively low. Another reason for not including such a feature, is that it is difficult to obtain suitably high amplitude trigger pulses using UJTs with a 6-volt supply, and if transistors were used to do the same job, power transistors would be required. In practice we have found the trigger circuit shown quite satisfactory for Volkswagens.

PARTS LIST

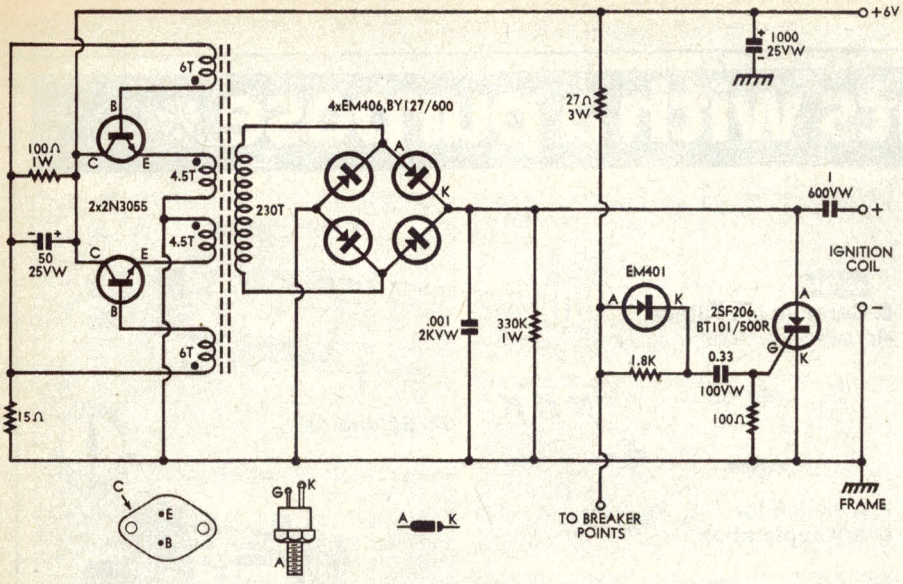
1 Case with mounting brackets (see text)
2 FX2243 ferrite cup cores
1 DT2206 Delrin former
2 2N3055, BDY20 silicon NPN power transistors
4 EM406, BY127/600 silicon power diodes
1 EM401 silicon diode
1 2SF206, BT101/500R silicon controlled-rectifier

CAPACITORS
1 x 1000uF/25VW electrolytic
1 x 50uF/25VW electrolytic
1 x 1uF/600VW paper (Ducon 3S10)
1 x .33uF/100VW polyester
1 x .001uF/2KV ceramic

RESISTORS
1 x 330K/1W, 1 x 1.8/½W, 1 x 100 ohms/1W, 1 x 100 ohms/½W, 1 x 27 ohms/3W, 1 x 15 ohms/½W.

MISCELLANEOUS
Double-tough enamel copper wire (20, 24 and 26 B&S), heavy duty hook-up wire, spaghetti sleeving, miniature tagboard, octal plug and socket (optional), grommet, power cable clamp, screws, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.



EA 6V CDI SYSTEM 3/T1/10

The circuit for the 6V capacitor discharge system. Full winding details for the converter transformer are given in the text.

CONSTRUCTION: The prototype unit was constructed in a cadmium-plated steel box measuring approx 6in x 2½in. However, since this box was specially made and is not available we have not shown photographs. Boxes of a similar type, made by Heating Systems, are available through kitset suppliers. Alternatively, a diecast box measuring 4¾in x 3¾in x 2in made by STC or Eddystone will be suitable. The main requirement for a suitable box is that it should seal out dust and water spray. If a steel box is used, the lid should have a cork gasket.

Construction can logically begin with the winding of the converter transformer. This uses two Elcoma FX 2243 ferrite half-cups and a single section bobbin, type number DT 2206. The secondary is wound on first, 230 turns of 26 B&S double tough enamel (DTE) copper wire. DTE wire is used to allow the secondary to be wound without insulation between layers.

Winding the secondary can be done with the aid of a hand drill clamped in a vyce. Two large flat washers, a long bolt and nut can be used to clamp the bobbin — the bolt is held in the drill chuck. The inner washer should be suitably notched to allow the winding start to lay flat along the chuck during winding.

Begin by soldering the start of the winding wire to a 3in length of 5/.0076 (or similar) PVC hookup wire. Lay this across the width of the bobbin and anchor it with a short length of electrical insulation tape. Wind on 260 turns as evenly as possible. Cover this with two layers of insulation tape and terminate the finish in the same way as the start.

Leads for the primary and feedback windings need not be terminated as for the secondary — just leave the starts and finishes of the windings about six inches long, and cover with spaghetti sleeving. The starts and finishes should be securely anchored on the bobbin with insulation tape. The primary windings are wound over the secondary, and the feedback winding last. Both feedback and primary windings are wound bifilar, ie. both sections of each winding are wound simultaneously, with two wires together wound as one wire. There is no real need to label the windings as each uses a different gauge. The primary winding is 4.5 turns bifilar, 20 B&S. The feedback winding is 6 turns bifilar, 24 B&S.

Place the completed winding in the two cup core halves, ensuring that the faces of the core halves are clean before clamping. If there is dirt on the core faces, the cores may either crack when they are tightened together, or the resultant air gap may prevent proper operation of the converter. Having clamped the cores, the transformer may be impregnated.

The prototype was impregnated using Crown 6084 epoxy insulating varnish. This is an aerosol pack available from Plessey Rola Pty Ltd. Other compounds, such as Estapol, are also satisfactory for the job.

First step in assembling the components inside the case is to install the 2N3055 power transistors on each end of the case, using mica washers and silicone grease to improve heat conduction. Under normal operating conditions the transistors become only moderately warm to the touch and the heatsink area provided by the steel case or diecast box is quite adequate.

The rectifier diodes should have a voltage rating of at least 600 volts, and a high surge current rating since they have to carry the "back-swing" of the dump capacitor discharge current. Diodes recommended are the EM406 or BY127/600.

The recommended SCR is the 2SF206 from STC or the BT101/500R from Elcoma. The 2SF206 has a blocking voltage rating of 600 volts and the BT101/500R a rating of 500 volts. 400 volt SCRs such as the C20D should not be used as the converter output voltage rises above 400 volts with battery voltages above 7 volts.

The SCR does not require a heatsink but is mounted for convenience using a small L-shaped bracket made from a 1½in x ¾in piece of 16 SWG aluminium. The SCR is electrically isolated from the bracket using mica washers supplied at purchase. The bracket is mounted inside the case using two screws, nuts and lockwashers. All screw connections must have lockwashers otherwise everything will vibrate loose within the first 10 miles.

For maximum reliability, an oil-impregnated paper capacitor rated for high discharge currents should be used for the dump capacitor. Peak discharge currents as high as 25 amps are quite typical for this circuit and under these conditions polycarbonate, and in particular, polyester capacitors are a very dubious proposition. Recommended types are the 5S10A with 1000 volt rating and the 3S10 with 600-volt rating. Both types are made by Ducon and available from kitset suppliers. We used the 3S10 in our unit.

All the small components in the circuit were mounted on two small tagboards. Wiring layout is not critical except for the following point. The earth return for the coil primary must not be made via the car body, but must have a separate earth return lead back to the converter. Supply wires to the converter and the coil primary wires must be in heavy duty automotive wire to avoid unnecessary voltage losses.

Presuming that the transformer is the last component to be installed, proceed as follows: A suitable hole is drilled in the case to take the transformer clamping bolt. The bolt is passed through the case, through the transformer core, through a flat washer and lockwasher, and then the nut screwed on. Do not overtighten. otherwise the core will crack, an experience which is both frustrating and costly.

The primary and feedback windings are connected as follows: For the primary winding, connect the start of one section to the finish of the other and connect the junction to the negative supply. Connect the other ends to the transistor emitters. Proceed similarly with the feedback winding, connecting the start of one section to the finish of the other; the junction goes to the junction of the 100 ohm and 15 ohm resistors. The other ends of the windings connect to the transistor bases. If all is well, the converter should emit a whistle when the supply is connected. If not, swap the base connections to the transistors and it should start. Current drain when the unit is operating correctly will range from 400mA when the engine is idling, to around 4 amps at 300 spark rate.

An octal changeover plug was installed in the author's unit to enable easy change

(Continued on page 139)

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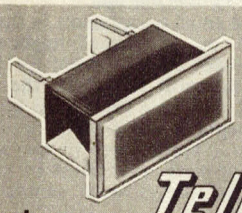
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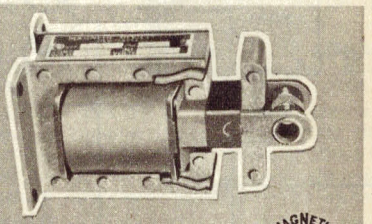
1. Neon Indicator Lamps.

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6. Ceramic I.F. Filters
Actual Size.



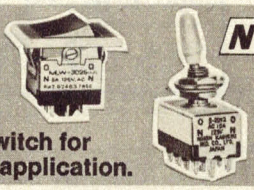
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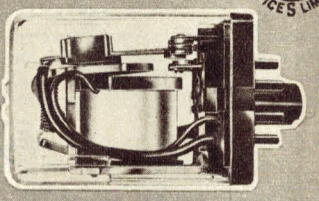
CTS

2. Rotary and Slider Potentiometer Single and Stereo.

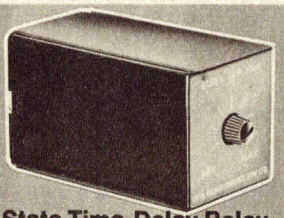


NKK

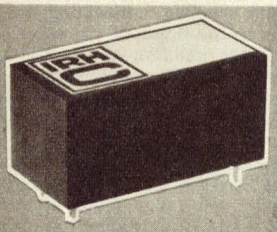
7. A switch for every application.



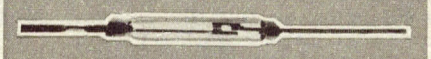
13. Relays A.C. & D.C.



8. Solid State Time Delay Relay.

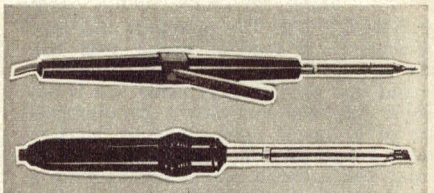


3. Reed Relays.



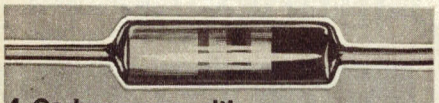
9. Magnetic Reed Switches.

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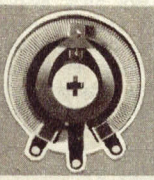


14. Soldering Irons.

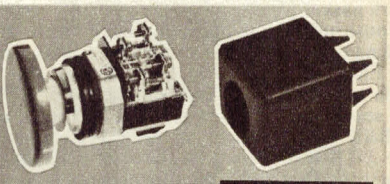
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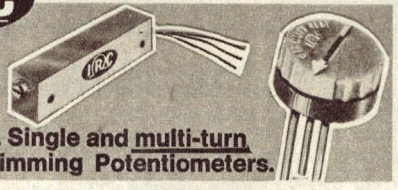
15. Oil Tight Devices.

Yoshida

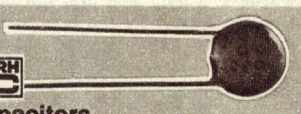
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In the first chapter, we learned of the atomic theory of the structure of matter, and how the atoms of the various chemical elements are composed of differing numbers of electrons, protons and other particles. We saw that all atoms consist of a central nucleus of protons and other particles, around which "orbit" a number of electrons — like a miniature planetary system.

The orbiting electrons of every atom are imagined as being grouped in energy levels or "shells". In atoms of a particular element, the number of electrons in the outermost shell of each atom is of particular interest, since it determines many aspects of the behaviour of the element, both chemically and electrically. It provides the basis, in fact, for the whole discussion which follows.

Considering solid materials in general, an element will generally allow current to flow through it in the form of a passage of electrons **if it has a small number of loosely-bound electrons in its outer shell.**

Elements which exhibit this characteristic are those which we have already defined in chapter 1 as "conductors."

If, on the other hand, an element has an outer shell containing a number of electrons either near or equal to the normal maximum number (usually eight), it is generally much harder to produce a current of electrons through the material. Such elements are the "insulators," another term introduced in chapter 1.

The disinclination of insulators to support current flow may be pictured as being due to an increase in the "binding" of the outer electrons when there are close to the optimum number of them in the outer shell. The more there are, the more force must be exerted, in the form of an applied EMF, before they can be persuaded to move.

It so happens, however, that certain elements, such as germanium and silicon, exhibit electrical properties approximately midway between conductors and insulators, as well as behaving in other interesting ways.

These elements, as one might perhaps expect, have four electrons in their outer shell. They are called **semiconductors,** a name which includes not only elements but also certain chemical compounds having a similar electrical behaviour.

In a lump of a substance, the atoms or molecules of the element or compound comprising it tend to be cohesive rather than to drift apart. There are a number of different ways in which they may be "bound together" but the type of bond which concerns us here is that which occurs in the semiconductors. This type of bond is called "covalent bonding" and is represented diagramatically in figure 1.

Here the loops linking the "Si" symbols represent the outer or "valence" shells of each of 12 atoms of silicon (the inner shells of each are omitted for clarity). Note that each atom shares each of its four valence electrons (the round blobs) with the four neighbouring atoms. Thus any two adjacent atoms are effectively "sharing a pair" of electrons and each atom, in one sense, has eight electrons it its valence shell. This produces a stable bond and a disinclination to pass current.

Silicon or germanium atoms, arranged as in figure 1, in a typical pure crystal, are said to be in a "lattice," as the diagram would suggest.

As already mentioned, pure silicon or germanium having this lattice structure has a rather poor conductivity (high resistance), as all the outer shell electrons are employed in the lattice bonding and are fairly strongly bound.

If heat is applied, the added thermal energy causes the atoms and electrons to become energetic, so that a certain number of electrons are freed and made available for current flow. At low temperatures, however, the conductivity of pure silicon or germanium is poor.

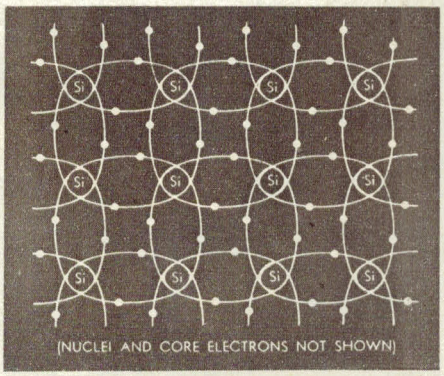


Figure 1: The silicon atoms in a piece of crystal are bound together into a "lattice" by their valence electrons.

Pure silicon and germanium are known as **intrinsic semiconductors,** because of this behaviour. The thing to remember about such intrinsic semiconductors is that they are virtually insulators at low temperatures, and only become conductors if energy is applied to their crystal lattice, for example in the form of heat (thermal energy).

If small amounts of other elements are added to the silicon or germanium as controlled "impurities", their conductivity at normal termperatures may be greatly increased. This may be made to occur in two different ways, by adding one of two groups of impurity element. This process is known as "doping" the semiconductor.

For instance, if a small amount of an element having not four, but five electrons in its outer shell (such as phosphorus, arsenic, or antimony) is added, conditions such as that shown in figure 2 may arise.

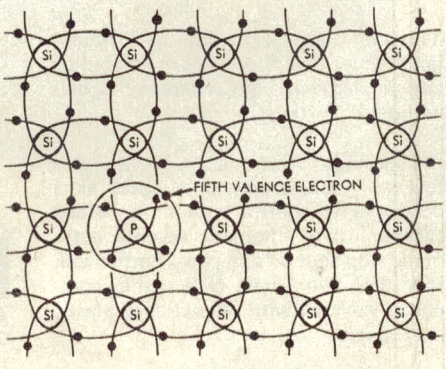
The impurity atom joins in the lattice structure and forms four covalent bonds with the surrounding atoms, but is still left with a "spare" electron. Thus this type of impurity is called "donor" impurity, as its addition results in there being free electrons available for current conduction through the crystal lattice.

Silicon or germanium crystal with a small amount of donor impurity is called **N-type** germanium, the "N" suggesting additional negative charges. Semiconductor materials in general having donor impurity are known as N-type semiconductor.

The other type of impurity which may be added is one which has only three electrons in its outer shell, such as boron, aluminium, gallium or indium. When small quantities of any such element are added to the germanium, conditions such as those shown in figure 3 appear in the lattice.

Here again the impurity atom joins in the lattice structure, but in this case it is only able to enter into covalent bonding with three of the surrounding atoms. There is no fourth electron to share with the remaining atom, so a defect in the form of an electron vacancy or **hole** is set up.

It happens that such holes are able to "travel"



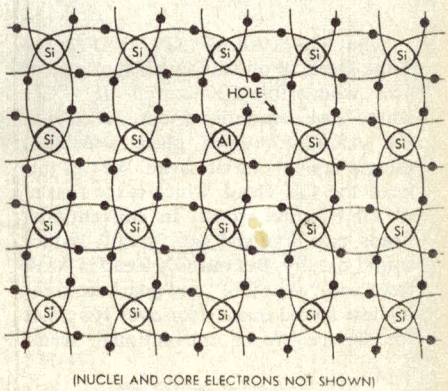
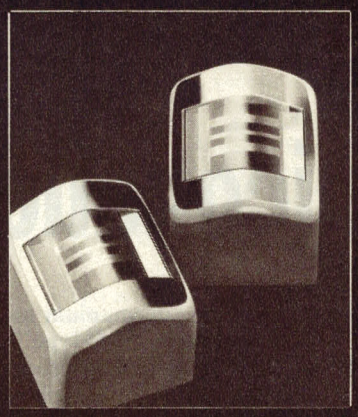


Figure 2 (left), and figure 3 (right): The effects of adding to the crystal "impurities" having either 5 or 3 valence electrons.

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through the lattice from atom to atom, in much the same way as the free electrons do in the N-type material. Thus, under the influence of thermal (heat) energy or light energy or the electric field of an applied EMF, they move around the lattice and effectively constitute a current of positive charges.

The type of impurity which produces holes in the lattice is termed an "acceptor" impurity for, when the hole moves away from the impurity atom, the atom is regarded as having "accepted" a fourth valency electron from the atom which then finds itself with the hole.

A semiconductor material which has been doped with an acceptor impurity is termed **P-type,** to distinguish it from N-type material by indicating that the conduction is by holes rather than electrons. While hole movement may be interpreted as movement in the opposite direction of an electron or electrons, the holes concept is a convenient and simple way of imagining the different types of conduction in N-type and P-type materials.

It is interesting to note that the impurity atoms scattered through the parent material occupy normal positions in the lattice structure, just as if they were atoms on the parent material (ie, atoms of silicon). However, the fact that the valence bond system associates each with one outer electron too few, or one too many, means that the orbiting electrons do not exactly balance the charge of the nucleus.

Thus, although the impurity atoms occupy normal positions in the lattice, they are actually atoms with an electrical charge — **ionised** atoms, in other words, or simply **ions.** Atoms of a donor impurity, having now one less than their normal outer electrons, become positive ions. Atoms of an acceptor impurity, on the other hand, having one more than their proper number of outer electrons, become negative ions.

Thus the two types of impurity semiconductor should be visualised as (1) N-type, having fixed **positively** charged donor ions in the lattice and normally equal number of "free" (for current conduction) negative electrons, and (2) P-type, having fixed **negatively** charged acceptor ions in the lattice and a normally equal number of positive holes able to conduct current by moving through the bonding system of the crystal lattice.

The presence of impurity ions in the lattice structure of, say, silicon, with the attendant "mobile" (movable) electrons or holes, greatly modifies its conductivity.

Now let us see what happens when a crystal is arranged so that an area of P-type and an area of N-type are next to one another. Such a state of affairs is shown in figure 4, which is a diagram representing what we can now call a **P-N junction** — simply a junction between a P-type and an N-type lattice. As we shall see, such a junction behaves in a very similar way to the thermionic diode valve which we examined in the last chapter, and thus is used as the basis of the semiconductor **junction diode.**

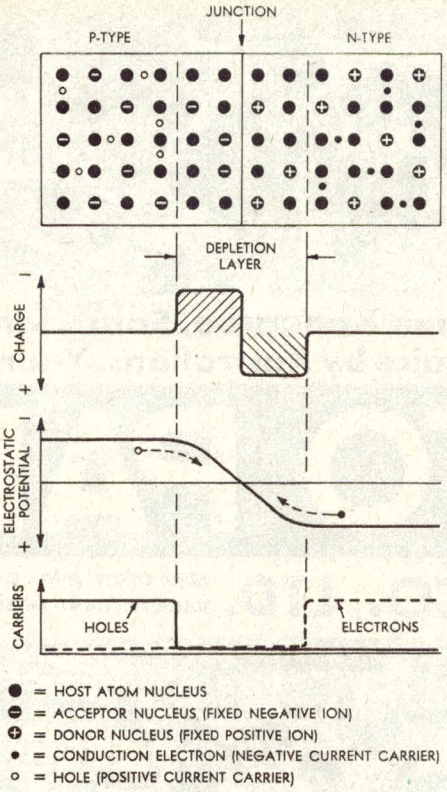


Figure 4: When P-type and N-type regions are formed adjacent to one another in a crystal, a "depletion layer" is formed.

At normal temperatures, due to thermal energy, the current carriers — electrons in the N-type, holes in the P-type — wander freely throughout the lattice. Some may wander across the junction in the course of their travels.

If a current carrier from one side wanders across the junction, there is a good chance that it will meet a carrier of the other type, each neutralising the other. For instance, if a conduction electron from the N-type side wanders into the P-type, it may easily meet a hole and "fill" it, the lattice in that immediate region reverting to normal. Similarly, when a hole appears in the N-type region, there is a very good chance that it will meet a conduction electron and the two will cancel one another as before.

Due to this mutually neutralising action, at normal temperatures there is a section of the crystal immediately surrounding the junction which has virtually no carriers. This is called the **depletion layer,** signifying that it is effectively a "no-man's land" as far as free current carriers are concerned.

In the P-type section of the depletion layer there are no free holes present, and there is thus a net negative charge — due to the fixed acceptor impurity ions. Similarly, the depletion layer in the N-type region acquires a net positive charge, due to the fixed donor impurity ions and the lack of free electrons.

As the small graph in figure 4 labelled "charge" shows, this means that the section of the crystal occupied by the depletion layer differs from the rest of the crystal in having nett charge "humps," one each side of the junction. There is a negative charge "hump" on the P-type side, and a positive charge "hump" on the N-type side (this is shown as a "dip" because it is of the opposite polarity).

Because of this setting-up of opposite charge concentrations, each side of the junction, the P-type and N-type sections are effectively shifted in potential with respect to one another. For instance, the P-type region is effectively negatively-charged with respect to the N-type, because electrons in the N-type are prevented from passing to the P-type region due to the "hump" of negative charge on the far side of the depletion layer. (remember, like charges repel one another.)

The same is true of holes in the P-type region, which are discouraged from passing to the N-type region by the net positive charge N-type part of the depletion layer.

As the second curve of figure 4 shows, we can represent the potential difference which is set up by the depletion layer by showing a gradient or slope in the depletion region, with the P-type negative with respect to the N-type. Or the N-type positive with respect to the P-type, whichever you prefer.

Looking at this potential diagram one can see the potential "hill" that carriers would have to surmount if they were to cross the depletion layer and reach the other region. Right-way-up, the hill for electrons may be seen, travelling from right to left; inverting the page will show the hill seen by the holes.

It is the potential "hills" set up at the junction as part of the formation of the depletion layer which under normal conditions cause the layer to remain at a certain constant width, and with a certain potential difference between the P-type and N-type sections of the crystal. For a given amount of thermal energy, electrons and holes cross the junction only until they set up the depletion layer and its potential hills to an extent which discourages any further movement. A balance or **equilibrium** is thus reached, with the width of the depletion layer and the potential difference between the two sections determined at least partly by the amount of thermal energy present.

With us so far? If you're not too sure, it would be a good idea to read some of the foregoing material again, as the concepts involved are quite important.

Now if we try to pass a current through a germanium junction diode or "crystal" having a P-N-junction, by applying an EMF across its end, we find that interesting things happen. And it all depends upon the way we connect our EMF, for different things happen for each of the

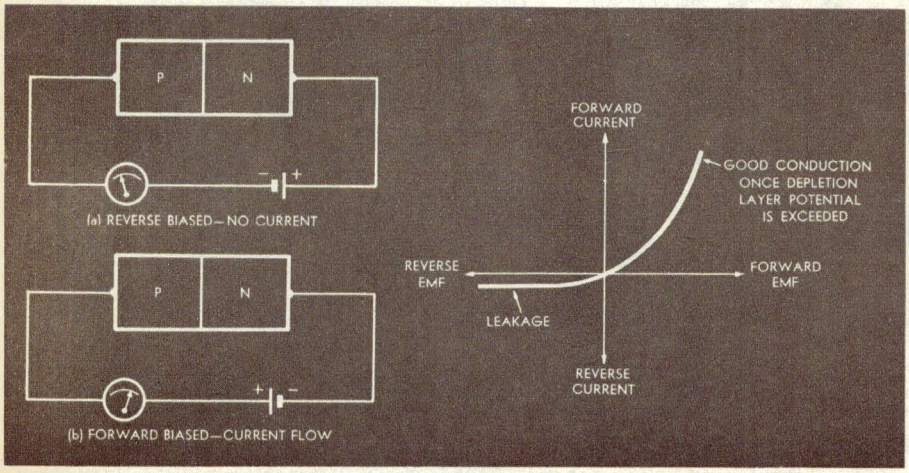
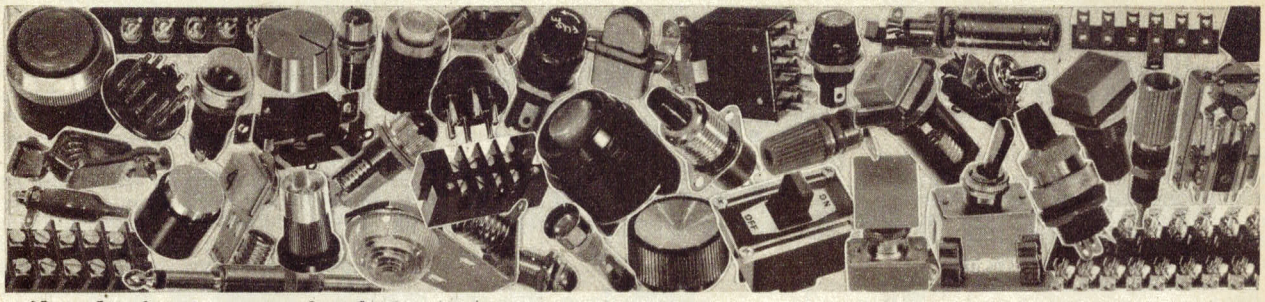


Figure 5 (left), figure 6 (right): Because of the behaviour of the depletion layer, a P-N junction acts as a "one-way" conductor.

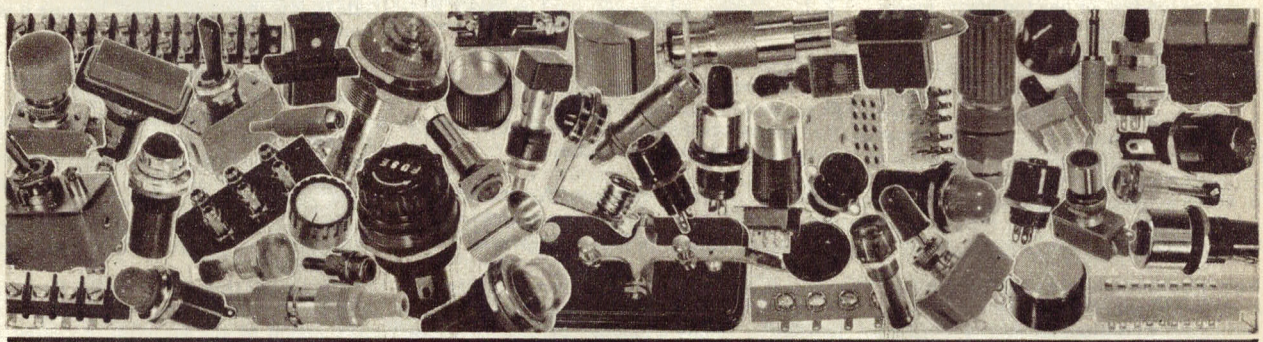


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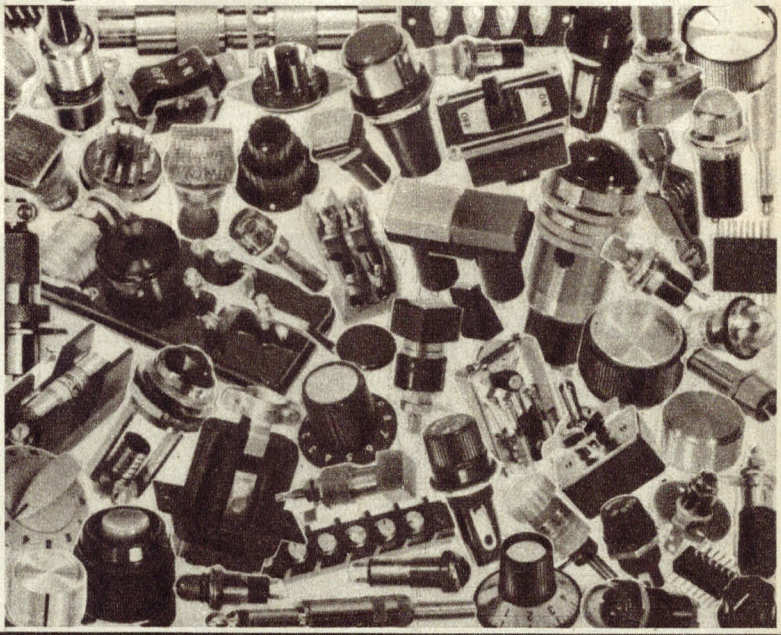
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two possible connection polarities.

If we connect an EMF so that its positive polarity connects to the N-type region and its negative polarity to the P-type region, as in figure 5(a), we are simply increasing the potential difference which the depletion layer has already set up between the two regions. What happens is that we simply increase the width of the depletion layer (and increase the steepness of its potential difference gradient) by causing more carriers in the crystal structure to cancel.

After a very brief and tiny flow of these carriers no current flows apart from a leakage current which is due to various lattice imperfections and effects which need not worry us just at present. The initial flow amounts to a capacitive charging current, just as if the junction was a capacitor — which, in fact, it is.

In this condition, which is called **reverse biasing,** the junction may thus be regarded as an open circuit. Or more exactly, as a low value capacitor with a small leakage current.

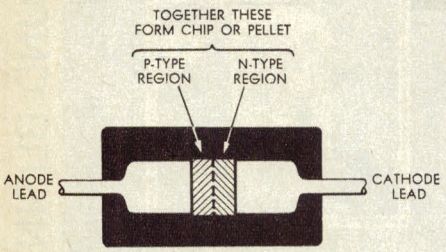


Figure 7 (above): The construction of a modern silicon rectifier diode. Figure 8 (right): The construction of a low-power glass package germanium detector diode.

If on the other hand we connect an EMF to the crystal so that its positive and negative polarities connect to the P-type and N-type regions respectively, as in figure 5(b), the situation is quite different. In this case the external EMF opposes that set up by the depletion layer, rather than assists it.

If the external EMF is greater than that of the depletion layer (which is in practice only a few hundred millivolts) there will thus be a net EMF acting in the direction of the external EMF, and the potential "hills" of the junction will be compensated by larger "downhill" sections. Current is thus able to flow, in terms of both electrons and holes within the crystal and electrons alone in the external circuit.

A junction in this condition is said to be **forward biased.** Forward biasing thus results in high conductivity (low resistance) and easy current flow.

Figure 6 shows a typical current-voltage curve for a semiconductor junction — note the low current with reverse biasing (due to leakage) and the sharp rise in current with forward biasing as the depletion layer potential is exceeded.

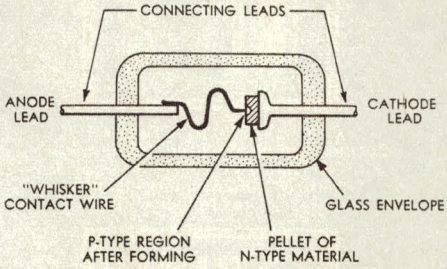
As this curve shows, the semiconductor junction is thus very similar to the diode valve which we examined in the last chapter — it is effectively a "one-way" path for conduction.

Sealed in a small glass shell or plastic or metal package for moisture protection, and fitted with two connection leads, it is the familiar junction diode which is used in "crystal" sets, in radio and TV receivers for detection and other jobs, and in power supplies for rectifying AC into DC. We see some of these uses in later chapters.

Many modern silicon diodes are made with the P-type and N-type regions formed together in the same tiny "chip" of crystal, rather like the structure of figure 4. The regions are formed as part of the same crystal structure either by a controlled doping process when the crystal is being grown, or by growing a crystal which is uniformly doped with one type of impurity, and then changing certain areas into the other type of material by "diffusing" atoms of the opposite type of impurity into them from a surrounding vapour at high temperatures. The structure of a modern silicon diode of this type is shown in figure 7. Note that the P-type and N-type regions of the chip are merely two electrically different regions within the same physical piece of material.

In figure 8 is shown a diagram of the construction of a typical small germanium junction diode, whose construction is a little different. During construction the piece of N-type germanium is soldered to the cathode lead, and the fine wire "cat's whisker" contact welded to the anode lead so that it is in contact with the surface of the germanium. When assembly is complete, a short but heavy pulse of current is fed through the device, whereupon a small amount of the wire material melts and dissolves in the germanium near the contact.

The composition of the wire and the techniques used are such that this produces a very small area of P-type germanium in the immediate vicinity of the wire contact, to which



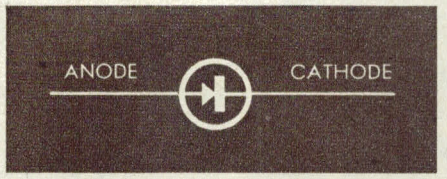


Figure 9 (above): The usual schematic circuit symbol for a diode.

the wire is firmly welded. Thus a P-N junction is formed which is small in area — and thus low in capacitance, which is desirable for many applications — yet quite robust.

The usual schematic symbol for a junction diode is shown in figure 9.

Having discussed the junction diode we can now progress to the bipolar transistor. This is simply the junction diode carried one step further — a semiconductor crystal having not one but two P-N junctions. They are near one another and, as we shall see, they interact in a way which makes the transistor able to amplify small signals. The bipolar transistor is thus the semiconductor version of the triode valve, in the same way that the junction diode corresponds to the diode valve.

There are two different types of bipolar transistor, as there are two different ways in which one can arrange two P-N junctions to be side by side. One type is the PNP type, where, as the letters suggest, the two junctions share a common N-type region and have separate P-type regions; the other is the NPN type, where the two junctions share a common P-type region.

Both types are quite practical and, in fact, they are often used side by side in circuits — one type being best suited for some jobs, the other type for different jobs.

Figure 10 shows a diagram of an elementary PNP transistor. The common N-type region in the centre is thin, and is called the **base** region. The left-hand P-type region which is called the **emitter** is normally forward-biased with respect to the base by means of the battery E1, so that the base-emitter junction conducts freely.

The right-hand P-type region, termed the **collector,** is biased in the opposite direction by battery E2, so that the base-collector junction is reverse-biased and would normally be considered to be a high resistance. However things are not the same as they would be with single junction.

As we mentioned before, the base region is made quite thin. It is also made weakly N-type by only doping it with small quantities of donor impurity, whereas the emitter region is made quite strongly P-type by strongly doping it with acceptor impurity.

This "differential" or unbalanced doping has one major effect: it makes holes play the major part in the current conduction of the emitter-base junction. In other words, most of the current passed by the junction is in the form of holes passing from emitter to base, rather than in the form of electrons passing in the reverse direction.

Because the base is thin, the base region part of the reverse-biased collector-base junction depletion layer extends almost to the emitter-base junction. This would not normally have much effect on the base, as the normal base carriers are electrons and would not be inclined to "climb" the potential "hill" to the negatively-charged collector. But it has quite an effect on the holes which reach the base from the emitter.

To these, the "hill" is not an uphill grade but

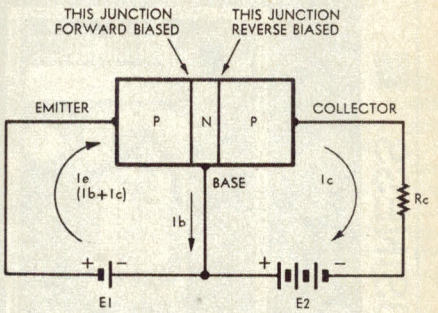


Figure 10: An elementary bipolar transistor, whose operation relies upon the interaction between two P-N junctions.

an inviting downward slope. Thus, unless they are met and cancelled by one of the free electrons in the base as soon as they arrive, there is a good chance that they will "roll down" the potential hill into the collector region.

Confused? Then consider it from another viewpoint. The base-collector junction is reverse-biased, meaning that carriers would normally not pass from one side to the other because of the fixed-ion concentrations and potential "hill" of the junction depletion layer. But the "hill" is only an upward grade for the particular carriers normally present on each side.

What the emitter-base junction does, because of its forward bias, is to **inject** the "wrong sort" of carriers into the base region. Not the usual electrons, which see an upward grade to the collector region, but holes — which see the potential gradient as a downward grade, and may therefore pass straight through.

The holes "haven't been told" that the collector junction is meant to be an open circuit, as it were, and they accordingly have no objection to crossing over!

Not all of the holes which cross the emitter-

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base junction pass through into the collector. A few are cancelled by electrons before they can do so, and the base region accordingly receives a corresponding number of electrons from the external base connection — in other words, a small amount of the original emitter current flows "out" via the base lead, although most of it passes through to the collector.

The currents in the transistor can be visualised in terms of the base lead current Ib and the collector lead current Ic. In figure 10, Ib can be imagined as flowing in the small left-hand circuit loop, while Ic flows around the large outside loop. Ie may be considered as simply the sum of the two, as they both flow through the emitter lead.

Due to the action of the transistor, there will be a definite ratio between Ib and Ic, the collector current normally being many times Ib. It happens that if we change Ib by a small amount thereby modifying the base-emitter depletion layer, Ic will be found to change by a proportional and much greater amount.

In other words, the transistor will amplify small current changes. If we superimpose a small signal on the base current Ib, a larger replica of the signal will appear in the collector current Ic. If we include a resistor Rc in series with the collector, it will develop a voltage drop which will be proportional to the current changes, to produce an amplified output voltage.

Like the triode valve, then, the bipolar transistor can amplify tiny signals so that they may be used to perform such tasks as operate earphones, loudspeakers, television picture tubes and so on. It is thus a very useful device in many fields of electronics — particularly as it does not need to be supplied with heater current as does the triode valve.

Before we end this discussion of the bipolar transistor, there are one or two points which we should look at. The first is the matter of the amount of amplification obtained.

It should be fairly obvious from the foregoing discussion of the operation of the transistor that the amplification or gain will be governed by the number of holes which pass straight through the base from emitter to collector. The fewer the number of holes which are intercepted by electrons in the base to produce Ib, the higher will be the gain.

In manufacturing the transistor the gain can thus be manipulated by two methods: (1) making the doping ratio between the emitter and the base high so that the current is mostly holes going from emitter to base, and (2) making the base thin so that there is less opportunity for the holes to meet electrons before crossing to the collector. There are also a number of other techniques which need not concern us at present.

There are a number of ways of expressing the gain of a transistor, but many need not concern us here. For the present, it is probably sufficient to know that there are two common terms used, both expressing gain in terms of current ratios.

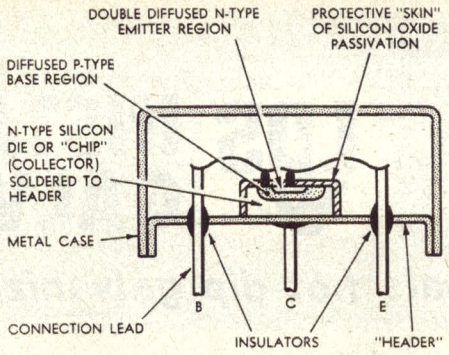


Figure 11 (above): The construction of a modern silicon planar transistor. The size of the chip has been exaggerated to show its various regions more clearly.

The first is **alpha** (α), which expresses the gain in terms of the ratio between the collector and emitter currents:

$$\alpha = Ic/Ie \quad (1)$$

Since the Ic is always less than Ie, α is always smaller than one. It is very close to one for high gain transistors, and lower for low gain transistors.

The other current gain ratio is **beta** (β), which expresses gain in terms of the ratio between collector and base currents:

$$\beta = Ic/Ib \quad (2)$$

Beta is almost always more than one, and generally much higher. Most modern transistors have a beta of between 50 and 500, although some may go as low as 20, or as high as 10,000.

Since alpha and beta are merely different expressions of the same basic effect within the transistor, knowing one always allows the other to be calculated.

$$\beta = \alpha/(1-\alpha) \quad (3)$$

and conversely

$$\alpha = \beta/(1+\beta) \quad (4)$$

It should be realised that due to thermal energy at normal ambient temperatures, some electrons and holes are generated in small quantities in all types of semiconductor — intrinsic, N-type and P-type. Thus, in the bipolar transistor, **even when an internal input current is not applied,** there are small currents flowing because thermally generated carriers "of the wrong sort" are present in small numbers and are able to cross the various junctions.

For instance, due to heat energy, there will be some holes present in the N-type base region even in the absence of holes being injected from the emitter, and these will be able to "roll down the hill" into the collector.

These thermally generated "minority carriers," as they are called, are the major reason for the small **leakage** currents which are observed to flow in the transistor even when no input is applied. As the number of minority carriers generated depends upon the temperature, the leakage currents are likewise proportional to temperature, both externally applied and internally generated. This is one of the things which tends to complicate transistor circuits.

Although in the foregoing description of bipolar transistor operation we have considered only the PNP type, the operation of the NPN type is very similar, except that the operating potentials and currents are reversed. The main

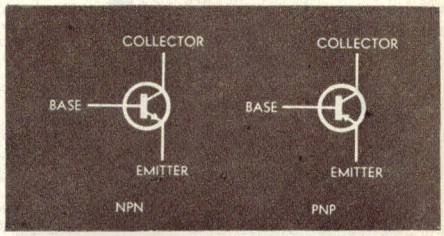


Figure 12: The usual schematic circuit symbols for bipolar transistors.

difference is that the principal conduction carriers are electrons, rather than holes. The reader might find it worthwhile to trace the operation of an NPN transistor out for himself, by working through the description again and substituting electrons in place of holes.

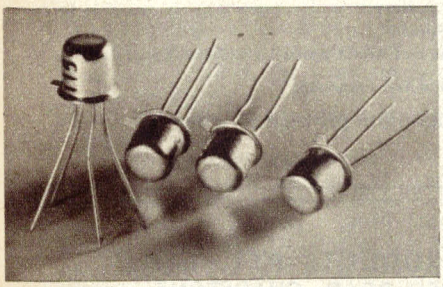
Figure 11 shows the construction of a modern silicon planar bipolar transistor, illustrating the form taken by a practical device. The collector, base and emitter regions of the transistor are formed within a single tiny chip of silicon, by the impurity diffusion process mentioned earlier.

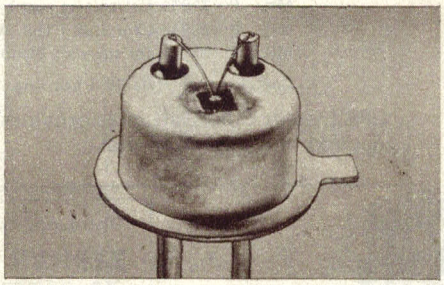
Figure 12 shows the usual schematic symbols used to represent NPN and PNP bipolar transistors in circuits.

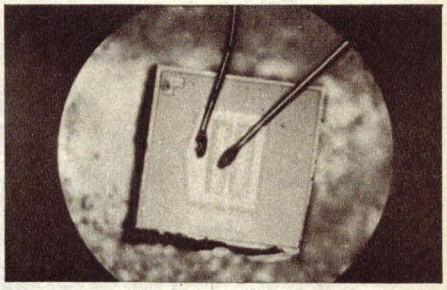
Although the bipolar transistor may be regarded as the semiconductor equivalent to the triode valve, there is one vital difference. The valve controls output (plate) current by input voltage (grid bias), and has a very high resistance input. It draws microscopic input current, if any at all. On the other hand, the bipolar transistor for its very operation must draw at least some base input current — and may hence present an input resistance as low as a few hundred ohms.

Using suitable circuit configurations it is possible to arrange for a bipolar transistor to present an effective input resistance as high as several megohms; however, in order to obtain higher figures, it is generally necessary to employ a different type of device.

Such a device is the **field-effect transistor or FET,** which consists basically of a thin "channel" region of one type of semiconductor







Three pictures which further illustrate the construction of a silicon planar transistor. At left are completed devices; in the centre, a device without its metal can; and at right, a close-up of a chip with its connection wires.

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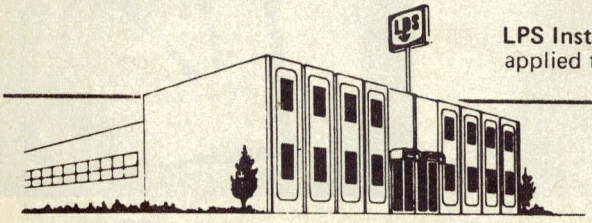
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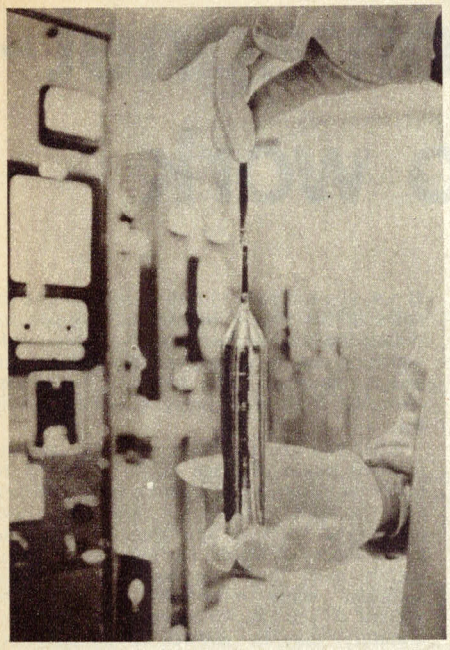
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First step in the manufacture of most semiconductor devices is to grow large single crystals of pure silicon or germanium. This picture shows a single crystal of pure silicon, from which many tens of thousands of devices will be made.

material surrounded on both sides by regions of the opposite type.

Like the bipolar transistor, the FET may be made in two possible versions. It may be made in a P-channel version, consisting of a thin channel of P-type material surrounded on both sides by N-type regions; or alternatively in an N-channel version, in which the channel is of N-type material and the surrounding regions are P-type material.

The construction of an N-channel FET is shown in figure 3. It may be seen that the channel is a U-shaped region of N-type material formed into a chip of primarily P-type material. The P-type regions on each side of the channel are connected together to form the "gate" electrode of the device, while connections made to each end of the channel region form the "drain" and "source" electrodes.

The operation of the FET depends upon the fact that, as we saw earlier in this chapter, electrons and holes wandering across a P-N junction tend to neutralise one another and cause a carrier-free depletion layer to be set up on either side of the junction. Because this depletion layer region is exhausted of current carriers, it is virtually an insulating region unable to conduct current.

The P-N junctions forming the sides of the channel of a FET will have such depletion layer regions, and the depletion layers will extend into the channel. Because they are virtually insulating regions, they therefore tend to make the effective electrical width of the channel somewhat narrower than its physical width. And if an external voltage is applied between the gate and channel regions so as to reverse bias the junctions, the depletion layers will expand further into the channel to make it narrower still.

The effect of this narrowing of the channel is to reduce its ability to conduct current between the source and drain electrodes connected to its ends. In fact, if the reverse bias connected between gate and channel is increased sufficiently, the depletion layers will extend

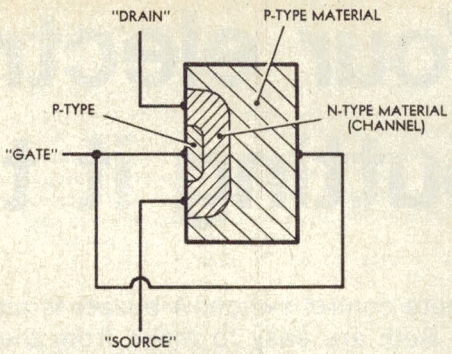


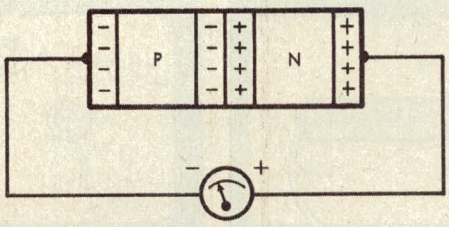
Figure 13: The basic structure of a field-effect transistor or FET, whose operation is rather like that of the triode valve.

right into the centre of the channel and meet, virtually turning the whole channel into an insulator. Naturally this effectively "blocks off" the channel as a conducting path as far as the source and drain are concerned.

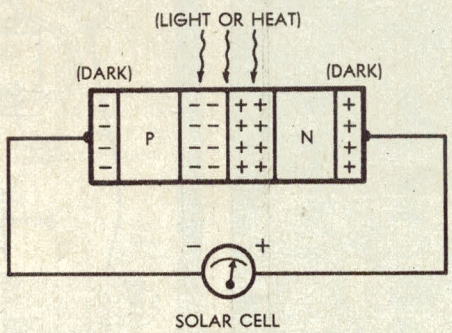
If a potential is connected across the length of the channel by means of an EMF applied between drain and source, it is found that the width of the gate-channel depletion layers may be used to control the resulting current. The drain-source current may be varied simply by adjusting the reverse bias applied to the gate-channel junctions, and a relatively small change in gate bias can produce a relatively large change in drain-source current.

The FET is thus capable of amplifying small signals, in much the same way as a triode valve. In fact it is a much closer equivalent to the triode valve than the bipolar transistor, because like the valve its input control electrode — the gate — does not draw significant current. Thus the gate of the FET corresponds to the grid of the valve, while the source and drain correspond to the cathode and anode or plate respectively. This may be seen by comparing figure 14 with figure 6 in chapter 6.

Like the thermionic valve, the amplification of a FET is expressed in terms of **transconductance,** and measured in milliamps/volt. The usual schematic circuit symbols for FET devices are shown in figure 15.



NORMAL DIODE — NO CURRENT



SOLAR CELL

Figure 16: Diagrams used to explain the operation of the solar cell.

In passing it should perhaps be noted that the type of FET we have just described is only one of a variety of practical types. Another type which the reader may meet is the MOSFET, in which the gate and channel are insulated from one another by a thin layer of oxide.

There are many other types of semiconductor device besides those which we have looked at in this chapter, but unfortunately space does not permit dealing with these here. Happily the reader will find that the junction diode, bipolar transistor and FET devices are those which he will tend to meet most often, so that the basic grounding provided in the foregoing should be found very useful. More information on semiconductor devices in general may be found in our companion handbook, "Fundamentals of Solid State".

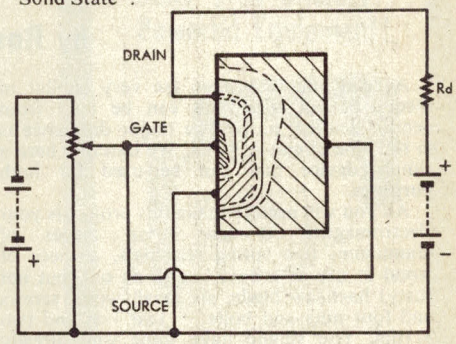


Figure 14: Because a small negative bias on the gate of a FET controls the channel current, the device can amplify.

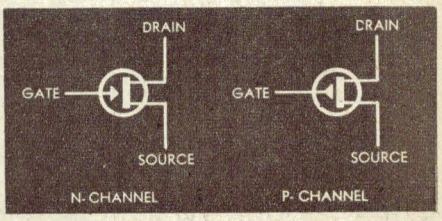


Figure 15: The usual schematic circuit symbols used for FET devices.

A final note before we leave the topic of semiconductor fundamentals. In reading the section earlier discussing a P-N junction "depletion" layer, it might have seemed that one should be able to measure the depletion layer potential of a junction using a sensitive voltmeter. This is not the case, however, because as soon as an external circuit of any description, such as a measuring circuit is connected to such a diode, another depletion "layer" forms. It forms in two parts, one at each end of the crystal where the wires connect (see figure 16), and the two "half depletion layer" potentials equal and exactly cancel that of the central junction. With no net circuit voltage, the meter will show nothing.

While we cannot measure the depletion layer voltage of a normal diode, we can measure a voltage across a special type of diode known as a "solar cell." In this type of diode, the "main" P-N junction is made to that it can be exposed to light or heat radiation while the rest of the diode remains unexposed.

Because greater radiation energy is given to the carriers near the exposed junction, the depletion layer which is set up has a greater voltage than that at the connections, which are "dark" and at ambient temperature only. Thus there is a net voltage produced, which can be used to operate small radio receivers or other devices.

Elementary Electronics

Your electromagnet - putting it to work

A relay is an electromagnetic remote control switch. A buzzer is an electromagnetic noise generator. Both are easy to make from the electromagnet we described last month.

by Ross Tester

A relay and a buzzer are very similar in theory of operation and can be built from nearly identical parts. The major difference is in how the circuit is wired. We describe here a simple device that can be used for both purposes.

All you will need to make this project is your electromagnet, a few scrap pieces of aluminium, two spring terminals, a piece of wood to use as a base board, an old (but not rusty) hacksaw blade, six small wood screws and four nuts and bolts — two ⅛in and two 3/16in. You should have some wire already attached to your electromagnet. (If you don't have a ⅛in Whitworth tap, you will need an extra two ⅛in nuts. We will explain this later.)

Start by drilling and cutting out the four pieces of aluminium from the patterns given. The holes and slots are best drilled before you cut out the pieces — it is much easier to hold a larger piece of aluminium! Where slots are shown, simply drill two or three holes close together and form them into a slot using a fine file.

Next, make some holes in the base board for the woodscrews, using the pattern shown. You can do this with a small drill, or by hammering in a small nail and removing it.

The holes in the vertical sections of the "U" bracket may be ordinary ⅛in, or preferably, tapped ⅛in Whit. If the hole is tapped, only one fastening nut is necessary, but if it is not, two nuts, one each side of the bracket, will be required to hold the contact screw steady.

The screws mentioned in the last paragraph should be pointed. This may be done by first winding a nut on to the screw, then filing the end to a point with a fine file. Once the point has been made, the nut can be wound off to rethread the screw.

The reason for pointing the screw is that we want to make good electrical contact between the screw and the blade and a point has a much better chance of making contact than a flat end. You will have to polish the blade as well, at the point where the screw makes contact. We use a piece of hacksaw blade rather than an ordinary piece of steel, because the "armature" (which the blade becomes) relies on a springing action for its operation.

If you use the end of a hacksaw blade there will be one 3/16in dia hole already drilled in it. If not, you will have to drill two holes. Use the holes in the largest bracket as a guide for drilling the holes in the blade. The holes should match up exactly, as mechanical rigidity at this end is important if the buzzer is to operate correctly. Both these holes should be 3/16in dia.

After you drill the holes, you can snap the required length of blade off. It is easiest to fasten the required length into a vyce, and then snap the blade by bending it close to the jaws of the vyce. You need approximately three and a half inches of blade. Do not worry if it is slightly more than this, but don't use less. Sufficient blade movement may not be realised if you do. Once cut, the blade (or armature) may be screwed to its mounting bracket.

All brackets may now be screwed to the base board. The screws holding the armature bracket are not completely tightened, to allow it to be moved around to get the optimum position for operation.

Attach the spring terminals in the positions shown. You can screw the terminals directly into the wood by making holes for them slightly smaller than the screwthread, and screwing them in under pressure. Although the thread is not intended to be used as a woodscrew, it works quite satisfactorily.

Place the electromagnet in its mounting brackets, and tighten it with the nut on the "head" end. There should be a short length (approx 1/16in) protruding at the shaft end.

Figure 1. Electromagnet connected for use as a relay. The circuit which lights the lamp is separate from the one which operates the electromagnet — except that in this case we have used the same battery to energise both circuits.

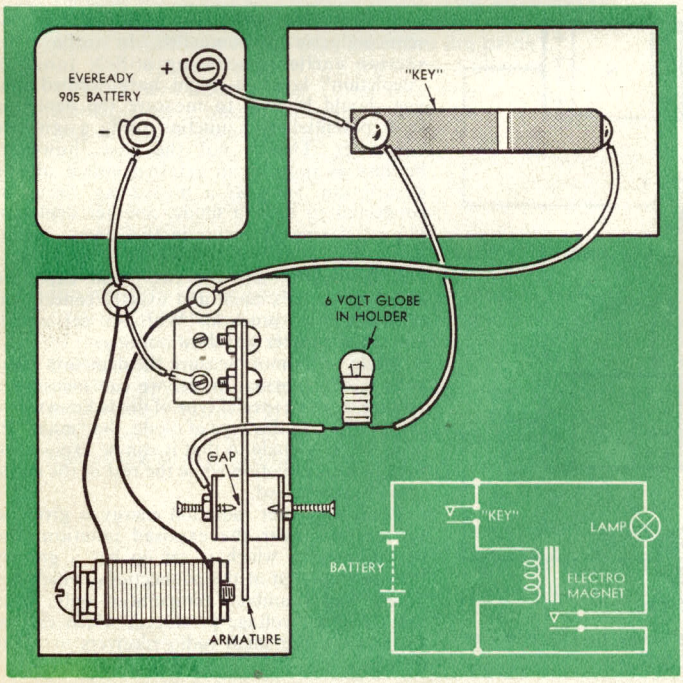
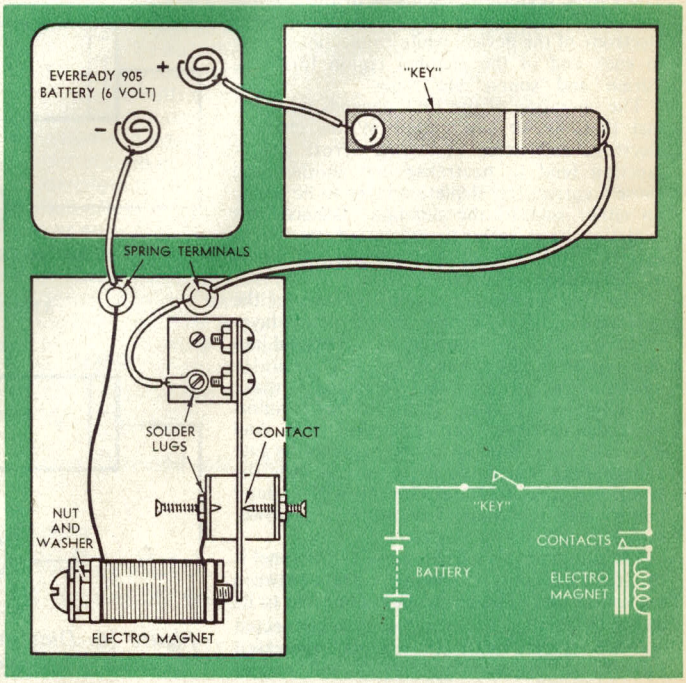


Figure 2. Electromagnet connected for use as a buzzer. Wired in this way the electromagnet turns itself on and off hundreds of times per second, thus producing an audible tone.



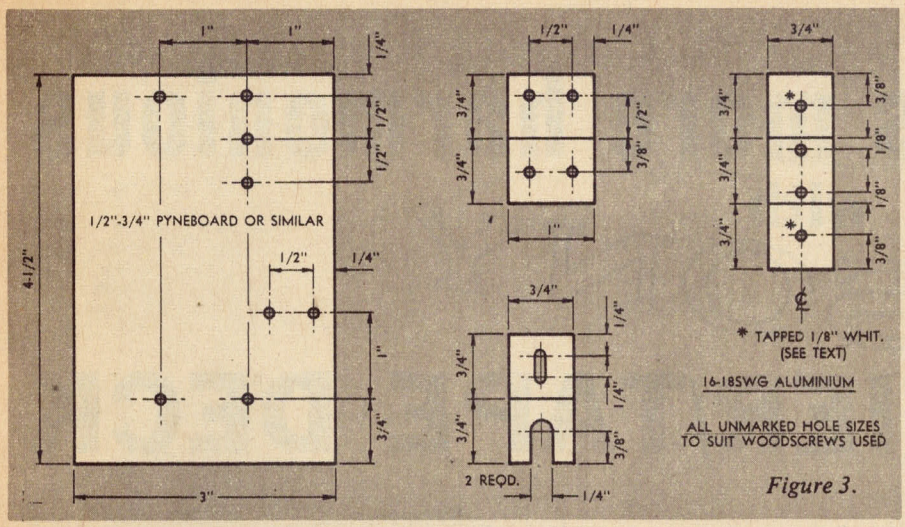


Figure 3.

This may be seen from the accompanying drawings. The flat of the hacksaw blade should be another 1/32in away from the end of the bolt. Once you have all the pieces in the correct position, tighten up all screws.

Now take the two pointed contacts, and insert nuts all the way on to them. Place a solder lug under one of them, and put them into the holes in the "U" bracket. If you do not have tapped holes, put another nut on the contact to hold it in position. Screw the outer contact into the hole until it just touches the blade when it is at rest. Hold the contact in this position, and tighten the nut(s) hard against the bracket. Repeat for the other contact, but this time hold the blade against the electromagnet, and adjust the screw until it just touches the blade in this position. Then tighten the nut(s).

Now all you have to do is wire the components together, and this will depend on whether you want to make a relay or a buzzer — or both!

The relay is probably the most simple, so we will explain it first. By wiring the electromagnet directly into a source of current (a battery), the coil is energised and the bolt becomes a magnet. This attracts any ferromagnetic material in close proximity — in this case, the blade. By making the blade part of another circuit, we can control the other circuit without actually touching any of the components in it.

In practice, a relay is usually used for the control of a high voltage or high current circuit by means of a low power circuit. In an automobile, for example, horns and starters are operated by relays to avoid having to route heavy wiring carrying high current to the inside of the car.

To make the relay work, you must loosen the outside nut and remove the screw far enough to make sure that it will not touch the blade in any way. Then connect the circuit up as shown in figure 1. When you are sure that everything is correct, connect the battery.

If the circuit is correct, the lamp should be out. If it is on, check to see that the screw you just loosened is not touching the blade. If this is not the case, something is wrong with your wiring.

When you get it operating correctly, examine the circuit diagram and note that the circuit which lights the lamp is completely separate from the electromagnet circuit except for the battery connections. We use the same battery for convenience, but the lamp could be connected to another battery of a different voltage or to another power source without affecting the operation of the electromagnet-and-key circuit.

Now we will show how the electromagnet can be used as a buzzer. All you need do is replace the screw you loosened before, and loosen the other screw you were using as the relay contact. Connect the circuit as shown in figure 2. It will help if you have some kind of key between the battery and the coil. Besides saving the battery, you will be able to experiment with Morse code. If you haven't got a proper key, you can fashion one from tinplate by following the simple diagram in figure 4.

However, we must point out that using such a key will certainly be detrimental if you seriously try to learn Morse code. A proper hand action must be developed, and this can only be learnt by much practice, on a proper key. Good keys are available quite reasonably from disposals sources. Such a key is a "must" if you are to develop good Morse technique.

First, let's see how a buzzer works. As in the relay, the electromagnet is operated by connecting it to a battery via a switch. When the switch is turned on, current flows through

(Continued on Page 141)

WARNING: On no account should this simple relay be used to control anything other than a few volts from a battery. DO NOT attempt to use this as a control for mains voltage. Stick to batteries — they are much safer.

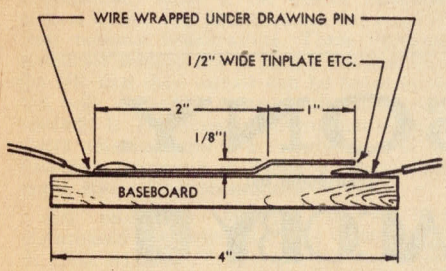


Figure 4. A simple key for experimenting with Morse code can be made from a strip of tinplate and two drawing pins as shown above.

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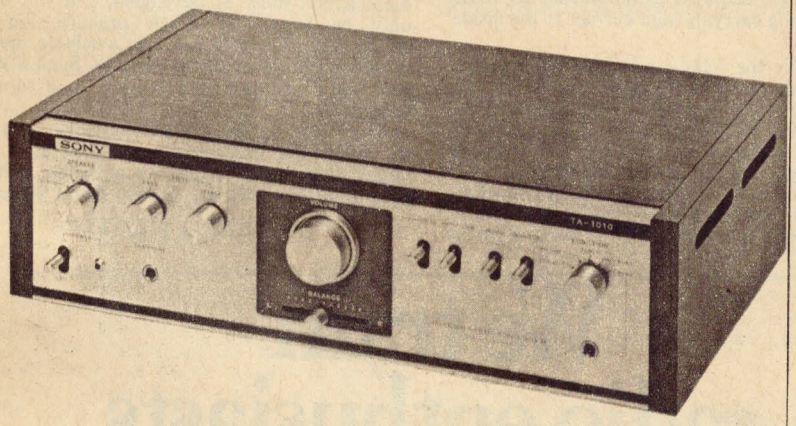
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Elementary Electronics: Ideas Worth Trying

WARBLER

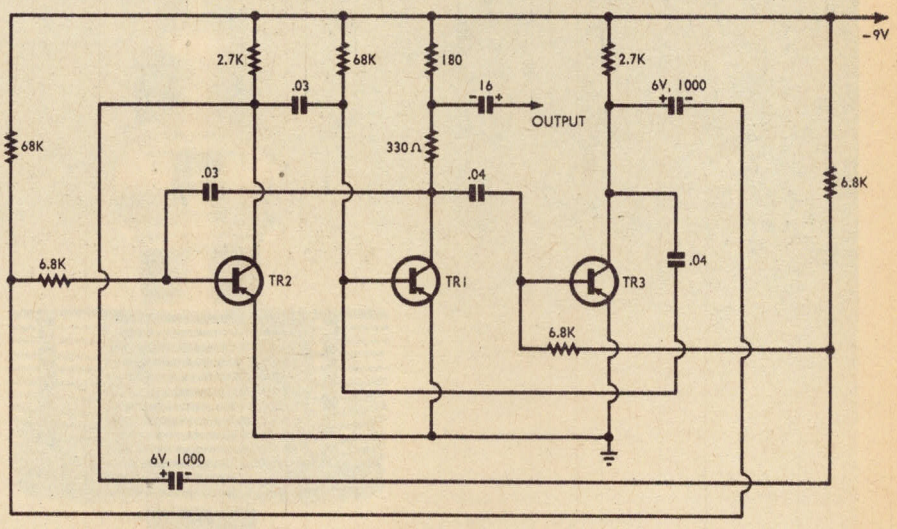
If you want a noise that really attracts attention, it's hard to beat warbling sirens such as those now being used by many emergency vehicles.

This warble-tone generator (see diagram) has three transistors, each of which is coupled to the other two to form a free-running multivibrator.

With the values shown, TR1 and TR2 oscillate at about 700Hz; TR1 and TR3 oscillate at about 500Hz; and TR2 and TR3 loaf along at about 1.5Hz. A square wave pattern at the collector of TR1 alternates between the two higher tones at about 1.5 times per second.

When TR2 is off, multivibrator TR1-TR3 oscillates at 500Hz, and when TR3 is off, multivibrator TR1-TR2 oscillates at 700Hz. The output is taken off through a 16uF capacitor from a tap on TR1's collector load.

The output can be connected to any general-purpose audio amplifier to drive a loudspeaker.



NOTE: TR1, TR2, TR3 ARE GENERAL-PURPOSE AUDIO TRANSISTORS WITH β 30-50

(From "Radio-Electronics"; originally described by A. B. Blackwell-Jones in "Wireless World".)

SIMPLE TIMER

This simple one-transistor timer was originally designed for use in a model submarine, but could be used for a variety of non-critical timing jobs.

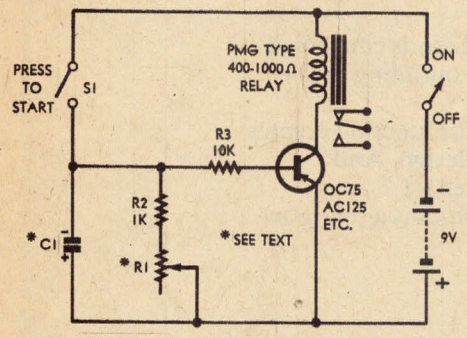
The circuit has proved very reliable in service, although large changes in temperature will affect the time duration.

Time duration is adjusted by varying potentiometer R1, within a range chosen by selecting the values of C1 and R1. Typical ranges are:

2-8sec ——— 100uF and 50K
5-30sec ——1000uF and 50K
30-3600sec ——— 100uF and 2M

Depressing S1, which is a momentary contact switch, charges C1 to 9 volts. The transistor conducts, causing the relay to close. When S1 is released, the timing period is started and the charge begins to bleed off, mainly through R1 and R2, with some current drawn by the transistor through R3.

As the bias on the transistor decreases, its collector current is lowered to the point where the magnetic attraction of the coil in the relay is overcome by the relay spring and the contacts open. This completes the timing period.



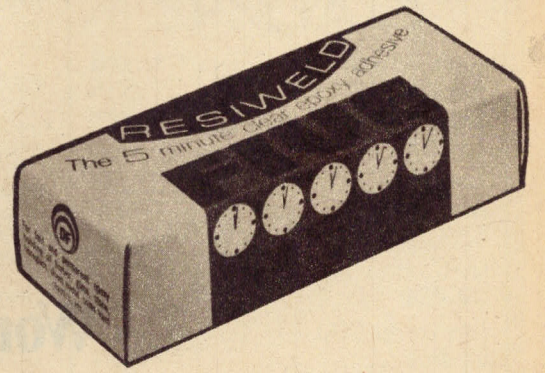
Users should note that it will take a fraction of a second to charge C1 fully, so S1 should be pressed firmly and held down briefly to ensure accurate timing.

(Submitted by J. Parker, 16, 63 Holbrooks Road, Inderdale, SA 5032.)

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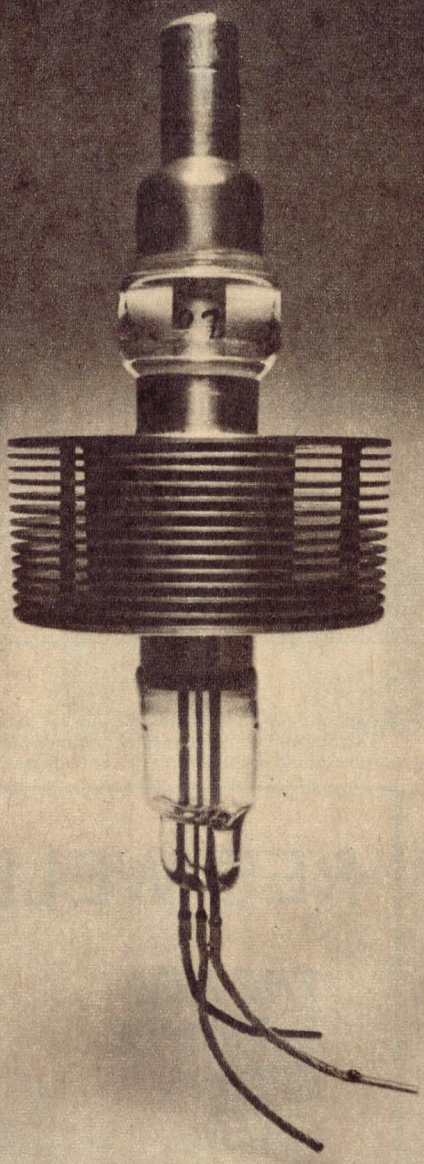
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BIAS – You dont need it... Your tape recorder does!

No tape recorder will record and reproduce signals with acceptable fidelity unless it is provided internally with some form of recording bias — usually a high frequency or supersonic field. It is an extraordinarily difficult matter to explain, but the following note should be helpful until you are ready to tackle the heavy theory!

by W. N. Williams

In transforming sound waves into magnetic patterns on a wire or a tape, engineers encountered a problem which is a fundamental one and which had to be solved before magnetic recording could be considered as a really satisfactory method.

It was found that, when a magnetising force is applied to ferrous material, the degree of magnetisation produced and retained is not strictly proportional to the applied magnetising force. Beginning from zero, the amount of magnetisation first tends to rise very slowly, then rises more rapidly, then tapers off again as the ferrous material becomes magnetically saturated.

This occurs for magnetisation in either direction, so that the overall curve of induced magnetic flux (B,-B) plotted against magnetising force (H,-H) is as shown in figure 1.

The diagram also illustrates what happens to a signal which is passed through such a recording system without any bias.

For clarity, the input is shown as a pure sine wave. When transformed into a magnetic pattern, then recovered for subsequent amplification, the kink in the centre of the magnetisation curve is found to have produced a kink in the signal waveform.

The end result is very severe distortion in the reproduced sound.

To overcome this effect, it is necessary to apply a magnetic "bias" to the tape so that the signal does not, as it were, centre on the kinked part of the magnetisation curve.

The earliest system of magnetic bias involved placing a magnet near the recording gap, or passing a direct current through the recording head. This produced a fixed magnetic field which (hopefully) caused the signal to centre on one of the straight portions of the curve.

While a relatively simple method, "DC" or "permanent magnet" bias tended to produce a recording with undue background noise. This was due largely to the fact that each discrete particle on the tape was magnetised in the same direction, so that the tiny pulses they produced were all additive and were heard as noise on playback.

Nowadays, all but the most elementary recorders use a system of high frequency bias. A special oscillator in the recorder produces a signal well above the limit of hearing. During recording, this supersonic or high frequency bias signal is fed in to the recording head, along with the input signal.

Because the bias signal is at a very much higher frequency than the sound signal, the head is responding to a powerful magnetising force, even during instants when the sound signal waveform is passing through zero. This modifies fundamentally the way in which the particles on the tape respond to the sound signal.

In fact, as far as the recording head is concerned, the input signal is a composite waveform as illustrated in figure 2. As it passes across the gap in the record head, each particle is subjected to one or more complete cycles of high frequency energy, displaced bodily somewhere along its magnetising (or BH) curve by the simultaneous presence of the audio waveform.

What each particle retains in the way of remanent flux would take far more space to explain than is available here. For those who want to follow it up, however, the key thought is that the bias signal swings the particles through a series of magnetic cycles known as hysteresis loops. As the particles move to and beyond the edge of the recording gap, the loops collapse towards the B,-B axis but not as a direct transfer from the basic non-linear transfer curve.

The action of these loops, collapsing into the space between the BH curve and the B,-B axis makes the system behave as if it had a magnetisation curve quite different from the curve shown and without a kink in the centre.

The end result, when the tape is played back, is an output waveform which is substantially free from non-linear distortion, as in figure 2.

Because the particles are not all uniformly magnetised in one direction, as with DC bias, they do not tend to generate additive noise pulses as they pass across the replay head. The background noise with high frequency bias

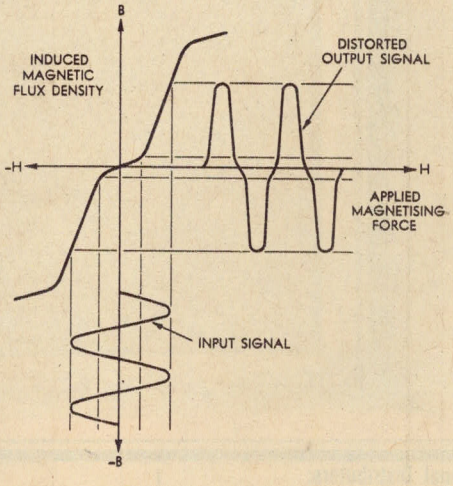


Figure 1: If the induced magnetic flux is plotted against magnetising force, the resulting curve is kinked near the centre. Recorded on this basis, an input signal would be distorted as shown.

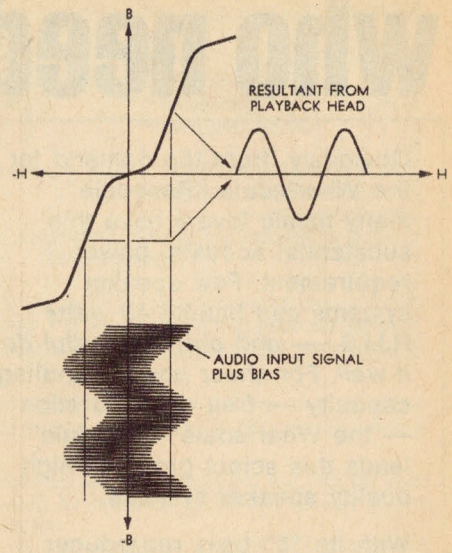


Figure 2: When a high frequency bias signal is present along with the audio signal to be recorded, the tape particles are subjected to a complex magnetising signal so that remanent flux is no longer dependant on the basic magnetisation curve. The tape exhibits a much more linear transfer characteristic.

therefore tends to be much lower than with DC bias.

It is not surprising to find that the magnitude and the frequency of the high frequency bias current through the record head is important.

The magnitude of the bias current affects the slope and the linearity of the apparent magnetisation curve, referred to earlier. It therefore has a direct bearing on the distortion content of the reproduced signal, the level of signal that can be impressed on the tape and the level of the recovered signal.

By inference it must have a bearing also on the noise level, since the larger the signal than can be impressed on the tape without distortion occurring, the better will be the signal/noise ratio.

As far as bias frequency is concerned, it is in the interest of overall recording quality to use a quite high figure — 100KHz or more. However, designers commonly have to settle for a figure nearer 50KHz for the sake of design economy.

In most tape recorders, the high frequency oscillator incorporated to provide the bias is actually made to serve double duty.

In a normal tape recorder the threading is arranged so that the tape passes over an "erase" head just before it reaches the record/play head. During replay, the erase head is inert — just a thing across which the tape happens to pass.

When a recording is being made, however, a strong signal from the high frequency oscillator is fed into the erase head, creating an intense high frequency magnetic field across the gap in its exposed surface.

The amplitude of this erase signal is made such that it magnetically saturates the particles on the tape in both directions as they pass across the erase gap. As they move out of the gap the magnetic cycling diminishes to zero and the particles are left with zero magnetisation.

In other words erasure eliminates any previous recording and (hopefully) noise content, so that the tape passes to the record head magnetically "clean".

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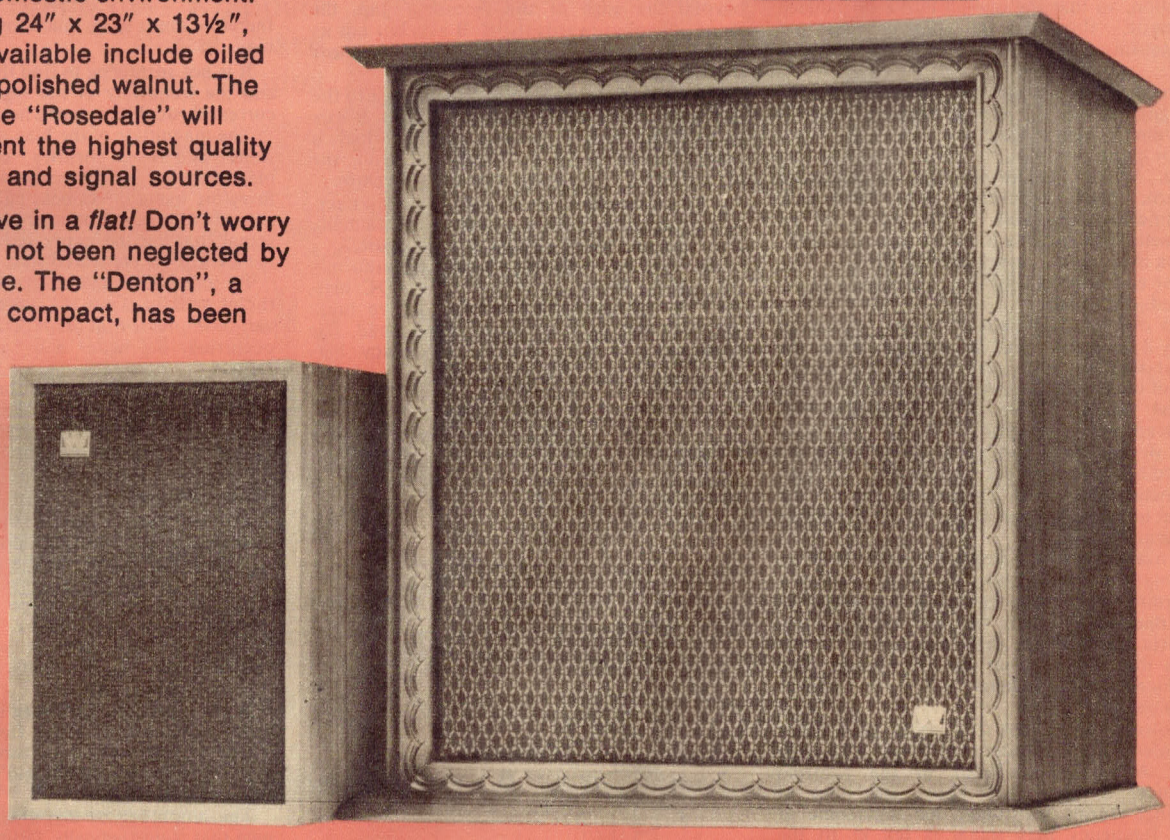
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CLASSICAL RECORDINGS

Reviewed by Julian Russell

Cassettes add to classical repertoire

The fast growing acceptance of musicassettes as a convenient method of recording music, and ever-increasing sales have made it necessary to devote the bulk of this month's space to reviewing recent issues. Nowadays three major companies, Philips, Deutsche Grammaphon and the World Record Club (World Cassette Club) add monthly to the classical repertoire.

A few years ago most cassettes were made from early LP and stereo recordings. Now some cassettes are being released simultaneously with the disc version of the same performance. Moreover, the titles which follow indicate they are aimed at more sophisticated buyers than the earlier examples.

The new cassettes show a definite improvement in regard to background noise and a good cassette recording will often come close to a disc version in the matter of fidelity. Another contemporary development is the production of extra long playing cassettes, each side running as long as two sides of an LP disc.

★ ★ ★

HOLST — The Planets. Suite for Orchestra. Boston Symphony Orchestra and the New England Conservatory Chorus conducted by William Steinberg. DGG Stereo No 3300-106.

The disc version of this performance was issued in England as recently as July this year. The suite was finished in 1917 and received a rapturous first performance the same year. Its popularity has never waned. Holst was always interested in astrology and he uses the planets as astrological symbols. Mars, for instance, is the bringer of war, Venus, the bringer of peace, Jupiter, the bringer of jollity, and so on. In the first item, Mars, the heavy bass is a little fuzzy, but after that the recording is very good indeed. Steinberg takes it at a brisker than usual tempo but retains the heavy accenting that gives the piece its juggernaut-like character. The Boston brass put up a magnificent show. If the fast tempo removes some of the piece's sinister weight, there always remains the convincing picture of crushing armour making ruthless, irresistable progress.

In Venus, the opening notes on the horn in a fairly high tessitura come off splendidly. This, too, though taken rather faster than is usual by English conductors, is most beautifully played — and excellently recorded. If it misses a little in serenity and langour, it never fails to introduce passion when that is needed.

Item three, Mercury, the Winged Messenger, slips by fleetly with brilliantly executed fast woodwind and celeste passages. A truly mercurial performance. Jupiter, the bringer of jollity, is really jovial. It is rumbustious music, unmistakeably English in character with, in the middle section, a broad, open-air tune reminiscent of Elgar and worthy of carrying one of that composer's favourite markings "nobilmente". The sound in this is particularly good.

The second side opens with Neptune, the Bringer of Old Age. Here the wan, widely spaced woodwind chords against deep bass strings are superbly effective. There follows a slow march, a spectre-like theme that could represent a procession of departed spirits. There is about the whole of this movement an atmosphere of tragic resignation that, despite claims to the contrary, is experienced by most very old people. A moving piece of mood painting.

Uranus is used as a symbol of the Magician. It is made up for the most part of a quite remarkable, lop-sided four note phrase reminiscent of the cry of the Queensland butcher bird which persists throughout the whole movement. It is interrupted by a spirited "alla marcia" tune in which Holst introduces all manner of orchestral legerdemain and virtuoso showmanship which the Boston players use with stunning expertise.

Neptune, the Mystic, is the most distant of the major planets — Holst doesn't use Pluto, I think because, at the time he composed the suite, it had still not been securely confirmed as a real planet. But on this point I may be wrong since I am no astronomer. In this suite Neptune is used as a symbol of mysticism. The music is as cold as interstellar space with a quite wonderful theme on the bass flute in the opening bars. A wraith-like, wordless women's chorus later enters so softly that it might be coming from light years away. For my part it could have been made to sound even fainter, but it still does very nicely as it is.

★ ★ ★

SCHUMANN — Piano Concerto.
FRANCK — Symphonic Variations for Piano and Orchestra. Moura Lympany (piano) and the Royal Philharmonic Orchestra conducted by Constantin Silvestri. World Record Cassette No 0098.

The Schumann Concerto has always been a favourite work of mine. It is full of beautiful melodies, its form is delightfully simple yet shapely, and the scoring is rewardingly transparent. Miss Lympany's style is well suited to the work — a limpid but firm touch, a nice range of dynamics, and graceful phrasing. Both she and the orchestra push the first movement along without any sentimental hesitations. The more romantically inclined might find it a thought too businesslike. I didn't. The original recording dates from 1959 and some later disc versions have slightly more tonal refinement. Despite this it makes a most enjoyable experience through which one can relax in complete security.

The Franck Variations were coupled with the Schumann on the original disc. And, despite the nowadays fashionable disparagement of the composer's works, it still remains another of my favourites. It is beautifully put together, giving both soloist and orchestra plenty of material with which to display their skill, and in this performance, impeccable taste. My earliest memory of the concerto was a live performance by the famous French pianist, Alfred Cortot. Miss Lympany uses much the same approach with one important bonus — Cortot occasionally played a wrong note while Miss Lympany's performance is note perfect. Here is a product that I can recommend to all but the most hypercritical.

★ ★ ★

IBERT — Divertissement.
BIZET — Jeux d'Enfants.
SAINT-SAENS — Danse Macabre. Le Rouet d'Omphale. World Cassette Club No TC-S-4886. Paris Conservatoire Orchestra conducted by Jean Martinon. World Cassette Club Stereo No TC-S-4886.

The items on this cassette would probably have been called by the late Sir Thomas Beecham musical "lollipops". The Paris Conservatoire Orchestra, heard after the others I have noticed above, sounds rather on the thin side but its members play the Ibert pieces with considerable spirit.

Those familiar with the suite will already know how witty is its send-up of hackneyed music. For instance, in the second piece, Cortege, there is a hilarious burlesque of Mendelssohn's Wedding March from his "Midsummer Night's Dream" music, and Parade has true music hall boisterousness. The Valse is played in the spirit of true Gallic mockery but, as a contrast, the Nocturne is a delicious bit of tone painting most sensitively delivered.

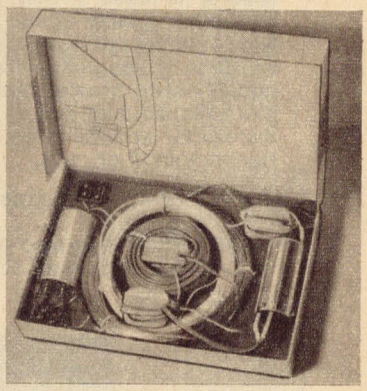
The solo pianist in the final item, Galop, is not named but he splashes around exhilaratingly in the first bars producing a sound as if he were playing the instrument with his elbows. This concluding piece goes at a terrific bat in the good old circus grand finale tradition.

The Bizet suite, which used to accompany a very picturesque little ballet that seems nowadays to have been dropped from most ballet companies repertoires, opens with a little March full of precise, rhythmic playing. In the

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second piece, Cradle Song, the strings are muted and sound very much more refined in tone than they do elsewhere in the recital. It is most delicately scored and a real charmer to listen to frequently. In Impromptu you will hear more playing of delicious rhythmic accuracy, always sensitively inflected. The following Duo offers a graceful sugary melody, luxuriously harmonised, but which I never find cloying. The merry bustle of the final Galop goes at a furious pace without any hint of a stumble.

Danse Macabre should be well-known to most readers of this column. But I wonder how many remember the curious old 78 disc of the music to which the singer Vladimir Rosing added the odd-sounding words "zig-z-zig-z-zig"? The solo violinist's tone is much to harsh for my liking in his opening tritone phrase. Later on I found a fairly hefty bass boost improved the reproduction without in any way imparing the clarity of the sound, which is almost clinical. The slow middle section is played — deliberately I think — very sentimentally. But the clarity of the sound I mentioned above tends to rob the little symphonic poem of its midnight, graveyard atmosphere.

Le Rouet d'Omphale (Omphale's Spinning-wheel) aims at describing Hercules, enslaved by Queen Omphale and made to wear women's clothes to work a spinning-wheel. The music may not tell you much about Hercules but it again reveals the composer's elegant workmanship and his effective, if not very profound, melodic invention. The only theme to hint at Hercules, restrained heftiness is the fine second subject which never loses its attraction for me.

★ ★ ★

BARTOK — Music for Strings, Percussion, and Celesta.
KODALY — Harry Janos Suite. Concertgebouw Orchestra of Amsterdam conducted by Bernard Haitink. Philips Stereo No 7300 017.

Bartok took considerable trouble to indicate in his original score of this work just how he wanted the musicians to be seated. There are two string orchestras and these must be placed on either side of the percussion, a very large group which includes tuned-xylophone, piano and so on — and the usual timpani and other metal and wooden objects. This recording faithfully follows Bartok's instructions and, played on stereo equipment, delivers the antiphonal effects the composer had in mind. I could write columns on this miracle of a score though if it is new to you you might have to repeat it several times for all its wonders to be appreciated. I can, however, briefly add that, if you are in sympathy with Bartok, each repetition will reveal fresh wonders — and beauty.

The Dutch orchestra plays the difficult music with superb confidence and style. The string tone is luscious, the percussion consistently accurate and balanced to perfection. Although the opening fugal passage might seem a trifle on the slow side it follows the composer's markings scrupulously. The only movement in which I felt the slightest disappointment — and this only minor — was the second which might have profited by slightly more humourous, or even disrespectful treatment. The third, an adagio, is one of the finest examples of Bartok's now famous "night" music with its tiny insect-like sounds against a dark background. It is played to perfection, a ravishing experience.

Then you have the exciting finale with the percussion as busy as one-armed paperhangers with the itch, the whole leading up to an overwhelmingly passionate conclusion. Solti's version is perhaps a little showier, a shade more unbuttoned; Haitink's the more refined. Your own taste must guide your choice between two magnificent performances. Moreover, so far as I know, the Solti (Decca) has not yet been transferred to cassette.

Haitink's Jary Janos is perhaps not quite so brilliant as the Kertesz disc performance, also for Decca, but again I know of no cassette account of this one either. But please don't think that I mean you will find the Concertgebouw's reading dull. On the contrary it is full of humour and the kind of accenting that is so characteristic of this type of Hungarian music. And here again your own preference must guide you, if you can find a cassette version of the suite.

As to the recording, though both works are excellently engineered by cassette standards both respond a little better to disc reproduction. In the cassette account of the Bartok a very small amount of the detail doesn't get through as clearly as on disc. But the production remains very impressive for all that.

★ ★ ★

BRAHMS — A German Requiem. Gundula Janowitz (soprano), Eberhard Waechter (baritone), the Vienna Singverein and the Berlin Philharmonic Orchestra conducted by Herbert von Karajan. DGG Stereo No 3581-002.

This is one of the extra long playing cassettes I mentioned in the introduction to these reviews. The makers claim that they have the same content as two LP discs and they retail at $12.50. $14.50 would be the price of two separate cassettes. Side 1 runs for 37 minutes plus a few seconds; Side 2 for 37 minutes 55 seconds. The disc version of the Requiem took only three sides. The fourth side was devoted to Brahms' St Anthony Variations. A text in both English and German accompanies the cassette. The voices of the chorus sound very remote in the opening bars but soon move into comfortable audio range.

Under Karajan the performance is a very romantic one — so romantic in fact that the chorus seems more intent on this aspect of the work than on their diction which, even to one fairly familiar with the German language, is often impossible to make out. This same preoccupation with emotion seems also to effect the performance of the solo baritone, Waechter, who often imposes an unwanted vibrato on the otherwise splendid quality of his voice.

But this is emphatically not the case with Janowitz' very beautiful account of a ferociously difficult solo. Her opening high pianissimo phrases are so very lovely that they reminded me of Schwarzkopf at her very best, and I can think of no higher praise. The orchestral playing is magnificent, lustrous in tone during most of the work and blazing into climaxes that are never coarse.

★ ★ ★

BEETHOVEN — Piano Concerto No 3 in C Minor. Emil Gilels (piano) with the Cleveland Orchestra conducted by George Szell. World Cassette Stereo No TC-S-4887.

A slight bass boost will help the otherwise good recording of this performance. Both conductor and soloist take the first movement rather coolly in what I can only describe as an unremarkable account of the music. There is

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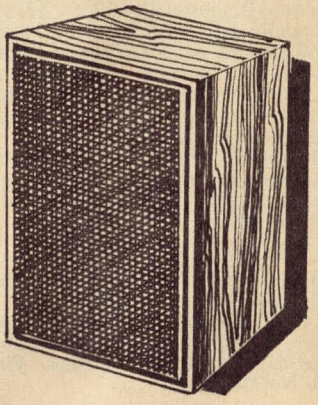
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some slightly exaggerated accenting in both the orchestral and piano parts. And both sound as if they were playing no better than dutifully. However even this movement has its delights — Gilels' pearly touch at the beginning of the cadenza, and its change later to rhythmic assertion. Then there is the very lovely sound when the orchestra re-enters. Quite entrancing, these bars.

Gilels' playing of the quiet, unaccompanied opening bars to the largo is sensuously poetic and both soloist and orchestra sound more rapt throughout this movement. Unfortunately on my cassette there is a slight pitch waver in the last bars. All the performers make the final rondo an occasion for much rustic good humour, rather than the skipping treatment awarded it by some other artists. It is fine if you go along with this unusual interpretation. And even if you don't, there is always the impeccable technique of all concerned and a truly exciting coda.

On disc . . .

BIZET — Carmen. Complete opera recorded from the original score. Anna Moffo (Carmen); Franco Corelli (Don Jose); Piero Cappuccilli (Escamillo); Helen Donath (Micaela) and others with the Choir of the German Opera, Berlin, the Schoneberger Boys' Choir, and the Orchestra of the German Opera, Berlin conducted by Lorin Maazel. Eurodisc Stereo 80 487 XR.

It is a pity I can award only brief space to this impressive set of three records very handsomely boxed in white and red and accompanied by an English/French/German libretto and a second brochure telling of the recovery of Bizet's original score. It is another impressive example of an original score being better than the debased version which has, over the years, displaced it.

The first thing to strike one is the unusual amount of spoken dialogue instead of the mediocre accompanied recitative to which one had become accustomed. The result is a series of dramatic points of repose between scenes of breathless expectancy. The orchestration, too, shows differences that are always superior to their replacements. The score has been scrubbed as clean as was the Paris of the composer, when, in the 1960s, property owners were given a year to have their buildings steam-cleaned.

Maazel enters vigorously into the spirit of the thing seeking no prettification but presenting, instead of a rather sentimental Spanish operetta, an earthy tragedy, the roles characterised in depth, the music ruthlessly expressive of every change of mood of a dark-natured people. Except for Anna Moffo's superb performance in the title role the singing is fair average with a special word of praise for Miss Donath's youthful sounding Micaela.

But it is in the orchestral playing and the concerted numbers that the score flares into unexpected life. I have known the opera in the form you have probably heard it ever since I was a small boy but, despite some not very extraordinary singing, no performance has ever moved me like this one under review. One example — I never thought I would live long enough to again get the thrill I did out of the all-too-hackneyed Toreador's Song. I can only urge you to acquire a set as soon as you can.

★ ★ ★

HOLST — Complete Works for Military and Brass Band. Central Band of the Royal Air Force and the BMC (Oxford) Band. Conductors Imogen Holst and Wing Commander J. L. Wallace. World Record Club Stereo S/4893.

Most classical music lovers are, if not absolutely supercilous, at least very reserved in their acceptance of music composed for brass and military bands. This always interesting disc should go a long way towards changing this attitude for here is music, for the most part of symphonic quality, with playing of corresponding seriousness. There are four pieces on the disc, the first, "A Moorside Suite" for brass band, the other three, "Suite No 1 in E Flat", "Suite No 2 in F Major", and "Hammersmith" (A Prelude and Scherzo) are for military band. The first three are conducted by the composer's daughter, Imogen, the last by Wing Commander Wallace who uses the Central Band of the Royal Air Force; this same band plays the two military band suites, and the BMC (Oxford) brass band the first item.

Most of the brass soloists produce a rather wide vibrato in their tone but this is — or rather was — currently acceptable at the time the pieces were written and the sort of timbre Holst must have had in mind. While on the subject of changes in the style of timbre, it must be remembered that the vibrato tone now cultivated by almost all string players is a comparatively recent development. When one remembers that Holst had an exceptionally keen ear for instrumental timbre I am afraid this tone production must be accepted however odd it sounds to modern ears. The four works are of varying quality and I prefer Imogen's Holst's conducting — despite some occasional untidiness in accenting — to that of the Wing Commander. Whether you like this unusual disc enough to buy it — and I advise you to listen to it first, if possible — I think you will agree that it is the best record of "serious" music for band ever made.

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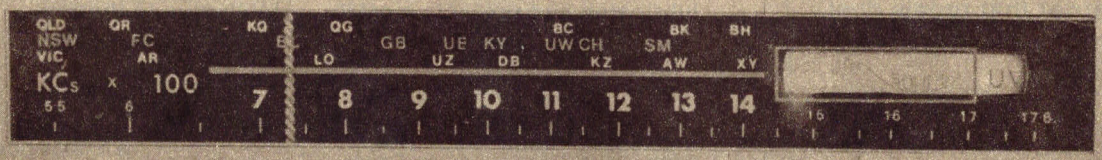
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VARIETY FARE

REVIEWS OF OTHER RECORDINGS

Devotional Recordings

GREAT CHORUSES FROM HANDEL'S MESSIAH. The Ambrosian Singers, English Chamber Orchestra conducted by Charles Mackerras. Stereo, HMV HQS-1244.

In his notes on "The Messiah", Charles Mackerras reminds the reader that Handel's original score left much for the performers to fill in, according to the musical conventions of the day. For this performance he has selected a score edited by Basil Lam as representing a scholarly approximation of the intentions of the composer.

The choruses in order are: And The Glory Of the Lord — And He Shall Purify — For Unto Us A Child Is Born — Glory To God — His Yoke Is Easy — Behold The Lamb Of God — Surely He Hath Born Our Griefs — And With His Stripes — All We Like Sheep — He Trusted In God — Lift Up Your Heads — Hallelujah — Since By Man Came Death — But Thanks Be Unto God — Worthy Is The Lamb — Amen.

The Ambrosian Singers and the English Chamber Orchestra provide a sound which is disciplined without being mechanical; full bodied without being ponderous. The quality is good, the stereo spread is excellent and there is virtually no background noise.

If you do not already have an adequate recording of the "Messiah" choruses, this one can be purchased with every confidence. (W.N.W.)

★ ★ ★

HOW GREAT THOU ART. Burl Ives. Arranged and conducted by Kurt Kaiser. Stereo, Word WST-8537-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

Paralleling his career in films and as America's pre-eminent folk singer, Burl Ives also devoted a great deal of time to Gospel music. In this latest album, the sincerity and personality of the artist are evident but the voice betrays the passage of time. The first track "How Great Thou Art" is largely recitative and, in the next two or three, most of the work is done by the supporting chorus.

On side 2 the soloist is much more to the fore, causing me to wonder whether the tracks were indeed all recorded at the same time.

Other than track 1, the hymns are those which Burl Ives knew and sang in his younger days: Are Ye Able? — A New Name In Glory — Will The Circle Be Unbroken? — Beyond The Sunset — Victory In Jesus — Stepping In The Light — On Jordan's Stormy Banks — Since Jesus Came Into My Heart — Only Believe.

It is an album that will appeal mainly to those with a soft spot for Burl Ives, particularly as the imported double-fold jacket carries three characteristic portraits in full colour. (W.N.W.)

★ ★ ★

ONCE IN ROYAL DAVID'S CITY. City of the Cathedral Church of St John The Divine. Alec Wyton, Organist and Master of Choristers. Stereo, Word WST-9021-LP. (Sacred Productions Aust, 181 Clarence st, Sydney and other capitals.)

The sound and atmosphere of this Christmas record is distinctly that of an English Abbey. Perhaps this is explained in part by the fact that Alec Wyton was born in London and educated at the Royal Academy of Music, London, and at Oxford University.

Much of the recording is taken up with the choir of 40 boys and 18 men singing unaccompanied in what constitutes a service of Christmas music.

Side 1 contains "The Prophecy" (12th century plainsong), "I Know A Flower It Springeth" (German carol), "The Annunciation" (Basque carol), "Once In Royal David's City", and "Away In A Manger". For the most part, the sound on this side is distant, at rather a low level, and with background noise apparent.

A more spontaneous "congregational" atmosphere emerges on side 2, with all too brief stanzas from the magnificent organ: "O Come All Ye Faithful", "We Three Kings Of The Orient Are" and "The First Noell". Some will like this record but it is not one that will appeal to everybody. To get an idea of the range in content, listen to the start of side 1, then the start of side 2. (W.N.W.)

★ ★ ★

AMAZING GRACE. George Beverly Shea, arranged and conducted by Bill Walker. Compatible Stereo, RCA LSP-4512.

As with all his more recent albums, this new one by Bev Shea has been arranged and recorded in the RCA studios at Nashville, Tennessee. Backing is provided by a polished but unnamed instrumental group and by a chorus "The Nashville Sounds". In charge of the operation is Bill Walker, a man referred to in Jesse Burt's jacket notes as the "amazing Australian".

Aimed directly at the public which has supported his earlier albums, this one is built on a background of harmony and gentle rhythm with Bev Shea doing the solo work. Beginning with John Newton's "Amazing Grace" the album contains: Wings Of A Dove — In The Garden — Do Lord — Good Night Sweet Jesus — Ezekiel's Wheel — I Will Pray — Reach Out To Jesus — One Day Nearer Home — Tender Farewell.

The sound is well balanced but my sample pressing exhibited surface faults which produced distortion here and there, becoming quite bad on both inside tracks. Check these two tracks before you buy. (W.N.W.)

Instrumental, Vocal and Humour . . .

THE AGE OF ELEGANCE. Favourite Airs and Dances. The Philadelphia Orchestra, conducted by Eugene Ormandy. CBS (Australian Record Company) stereo SBR 235435.

Elegance there is indeed in this collection of well known melodies. This adjective can be successfully applied to the music, the conducting and the performance of the superb Philadelphia Orchestra. And nowhere is it more appropriate than in the last item on side 2, Gluck's "Dance Of The Blessed Spirits" from the opera "Orpheus". How tenderly Ormandy phrases this sublime music, and how exquisitely the flautist plays his solo in the middle section.

What can be more elegant than Boccherini's famous "Minuet" which begins the program. Then follows Fur Elise (Beethoven) — Largo (Handel) — Minuet from "Don Giovanni" (Mozart) — Air and Hornpipe from "The Water Music" (Handel) — Trumpet Voluntary (Clarke) — Minuet in G (Beethoven) — Serenade (Haydn) — Gavotte from "Iphigenia In Aulis" (Gluck) — Musette from "Armide" (Gluck). The only departure from true elegance in the program is the unnecessarily fussy arrangement of "Fur Elise". If the flute and plucked cellos had been allowed to carry the melody all through, instead of being shouldered aside by other instruments, this would have been much more successful. The recording suffers from some distortion in string passages, but is otherwise satisfactory. (H.A.T.)

AND GOD CREATED WHALES (Hovhaness) and other orchestral works. Andre Kostelanetz and His Orchestra. CBS (Australian Record Company) stereo SBR 235433.

"And God Created Great Whales" was composed by the contemporary American musician Alan Hovhaness at the request of Kostelanetz to accompany the "songs" of whales which somebody had recorded in various oceans. I fear that in his search for

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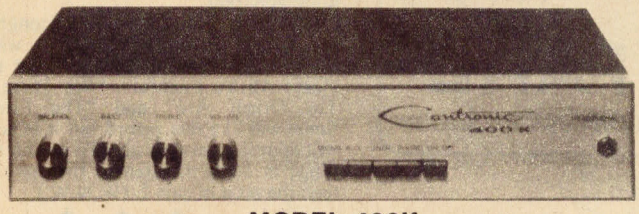
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Reviews in this section are by Neville Williams, Harry Tyrer, Gil Wahlquist, Leo Simpson, George Hughes.

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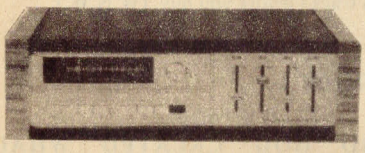
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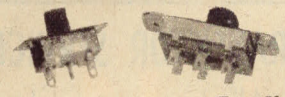
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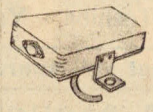


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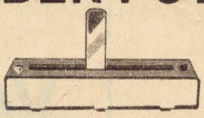
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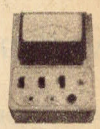
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novelty Kostelanetz has gone too far this time. It is most disconcerting after listening to some very well written modern orchestral passages to suddenly have the grunts and squeals of whales emerging from your loudspeakers. I find the effect quite grotesque. The sleeve proudly announces that this is a world premiere recording, and I suspect that it is the last one as well. It has certainly had the first and last visit to my turntable.

Side 1 is completed by three short items from the incidental music composed by Sibelius for Shakespeare's "The Tempest". These are The Mermaids — Miranda — Caliban's Song. More modern music begins side 2, Three Greek Dances by Nikos Skalkottas — colourful and attractive music with a definite Balkan flavour. Back then to more familiar ground with "Mack The Knife" from Kurt Weill's The Threepenny Opera; and finally Glinka's brilliant Spanish orchestral fantasy "Jota Aragonesa". Throughout, the Kostelanetz orchestra present their usual polished and disciplined performance. I cannot help reflecting that an orchestra as good as this one deserves a better title. The name suggests a dance orchestra, but they are of symphonic status. (H.A.T.)

★ ★ ★

TRUMPETISSIMO. Marcel Andre, trumpet, with supporting artists. World Record Club stereo.

When I first looked at it, I had my doubts about the success of this disc. Tender melodies such as Bach's "Air on a G String" and "Greensleeves" are not usually associated with the brassiness of the trumpet, and it seems a far from ideal combination. However, Marcel Andre plays a very sweet-toned instrument, and his renderings of the slower paced numbers such as those mentioned above make surprisingly pleasant listening; and in the faster pieces he displays a fine technique in presenting a brilliant exhibition of trumpet pyrotechnics.

He is assisted by Wolfgang Karius on the grand organ, and the performance as a whole is given a modern touch by double bass played by Guy Pedersen, and drums played by Gus Waller.

Most of side 1 is devoted to Bach, and includes the popular "Sleepers Awake" chorale, four items from the Suites, and the "G String" melody already mentioned. The side ends with the Largo from Vivaldi's "Four Seasons". Side 2 has folk tunes, mostly French, but including "Greensleeves" and "Silent Night". The disc, from the Erato catalogue, has very clean sound. A disc with perhaps rather specialised appeal, but excellent of its type. (H.A.T.)

★ ★ ★

MANDOLINS OF NAPLES. The Mandolins of Gino del Vescovo. Camden (RCA) stereo OCS 7131.

Mandolins and Neapolitan songs! Was there ever a more pleasant musical combination? If you feel the same way as I do about this kind of music, don't miss this $2.65 disc. Recorded, presumably in Italy, by a combination called the Mandolins of Gino del Vescovo, it includes all the normal favourites, such as O Sole Mio — Come Back To Sorrento — Santa Lucia — Funiculi, Funicula — Core 'ngrato — Maria Mari, as well as some not so well known outside Italy, 16 tracks in all. Without being over-sentimentalised, the performance has all the soul of the Neapolitan musician expressed in its yearning melodies. This is easily the best performance of this type I have heard for many years, and at its low price it is a fine bargain. The sound quality is slightly below the best, but acceptably clean. (H.A.T.)

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MIRAGE. Manuel and the Music of the Mountains. Columbia (EMI) stereo SDEX 9696, Series 259.

It is most frustrating to come across a record as badly matched in ratings as this one. It is an excellent performance of some fine music, but the enjoyment of it is ruined by what must be one of the worst quality modern recordings I've heard for a long time. It starts off well enough, but by the third track distortion starts to creep in, and it becomes progressively worse as the inner tracks are reached. By the time the stylus reaches the inside grooves, the sound to my, admittedly rather critical, ears became almost intolerable.

Musically the performance is a delight. Manuel's intriguing arrangements give the performance a piquant Balkan flavour, and the numbers are beautifully executed by the Music of the Mountains orchestra. His treatment of "The Shadow Of Your Smile" is most delicate and refined. Other excellent tracks are: So Nice — Man Of La Mancha — Sway — Strange Oasis — La Cumparsita — Love Is A Stranger — Meditation — And You Were There — Frenesi — Mirage — Hora Staccato.

To sum up, a beautiful performance marred by a bad recording. (J.P.P.)

★ ★ ★

WILL GLAHE. Accordeon Hit Parade No 2. Will Glahe and His Orchestra. Decca Stereo SKLA 7678.

German melodies, accordeons and long medleys! If this is your taste, then here's the disc for you. Willy Glahe does not attempt anything very dramatic in his treatment of the numbers, but he is a very sound performer and maintains a rhythm and stability of tempo which makes his music excellent for dancing.

I noticed some inner groove distortion, which, I might add, is not typical of Decca recordings. Whether this was due to mastering or from some other cause I cannot tell. I have not listed the titles, as there are so many included in the medleys. They are all in German anyway, and probably meaningless to most readers. The disc is pleasant listening, but nothing to rave about. (G.F.H.)

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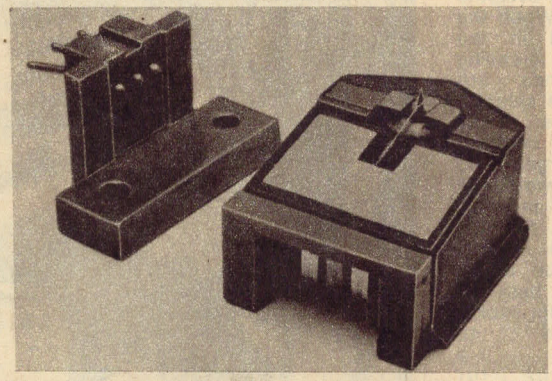
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Left: Mounting Bracket. Right: Pick-up Head.

The Decca Mark 5 story

Five years ago Decca laboratories started a research programme, the objectives being to reduce the physical weight of the existing ffss design and improve the hum problem.

When the ffss system was first invented the signal was generated at the stylus itself and any hum present in the vicinity of the pick-up was "read" as a genuine signal since it could not differentiate between this and the magnetic field created by the stylus movement. The advantage of direct coupling between stylus and search coils was obvious but in the interests of obtaining the best signal from the record, hum produced by turntable motors, mains leads, switches and transformers had to be tackled if progress was to be achieved in sound reproduction. In the following ten years people were satisfied by reproduction from moving magnet or induced magnet systems, although losses occur in the interpretation of the signal, sometimes known as cantilever haze, cantilever translation losses and so on.

With the improved quality obtained by the DECCA "POSITIVE SCANNING" system, the consumer became aware one must accept a degree of hum or select a turntable motor which did not generate an external magnetic field.

In the meantime DECCA continued on the seemingly impossible task of producing a hum free pick-up still having the "POSITIVE SCANNING" system.

The major breakthrough has come with the production of a new magnetic material. Although very small yet extremely powerful, with the tight magnetic circuit a significant reduction in hum has been achieved, and the cartridge mass is reduced from 14 grams to less than 4 grams. The external magnetic field which made the previous ffss cartridges unacceptable with steel turntables is now virtually removed. One final bonus is an increase in output which gives 1¼mVs/cm/sec., some 50% increase on the average top quality magnetics now available.

While this work was going on another line of research has been pursued in conjunction with a leading British university specialising in metallurgy. Decca laboratories in experiments with something like 2,000 samples tested and analysed, evolved a new method of tempering the cantilever using liquid nitrogen—"super cooled" at minus 196°C.

The new DECCA Mk. 5 cartridge has the following advantages over previous models:—

1. NEW MAGNETIC CIRCUIT resulting in
   (a) hum reduction by as much as 15 dbs
   (b) high output (7¼mVs for 5 cms.)
   (c) reduction in stray magnetic field enabling steel turntables to be used
   (d) lower physical mass.
2. SUPER COOLED ARMATURES FOR GREATER STABILITY.
3. Suitable for standard ½" centre mounting and DECCA arms.

Brief Specifications

Frequency range: 20 Hz to 20 KHz
Vertical tracking angle: 15°
Stereo balance: Within 1 db
Stylus tip mass: Less than 1 milligram
RECOMMENDED RETAIL PRICE $42.00

Sole Australian Agent: British Merchandising Pty. Ltd., 49-51 York Street, Sydney, N.S.W. Telephone 29-1571.

BALLET FANTASTIQUE. The Philadelphia Orchestra conducted by Eugene Ormandy. CBS stereo SBR235431.

There are not many people prepared to sit through complete ballet scores but many find pleasure in the arranged suites, presenting most of the best tunes from the complete works. Fot these people, this program of suites from La Boutique Fantasque (Rossini-Resphghi), Les Patineurs (Meyerbeer) and Giselle (Adam), played by the Philadelphia Orchestra under Eugene Ormandy should meet all requirements. Few, if any, other orchestras can approach the Philadelphia/Ormandy combination in the presentation of light classical music such as this, so if the music is to your liking, you will not be disappointed by the performance. If you have high quality equipment you may have cause to complain about the slight edge on the string tone which seems to be a feature of far too many records nowadays, but otherwise the sound is satisfactory. (H.A.T)

★ ★ ★

ENGLISH GUITAR MUSIC. Siegfried Behrend, guitar. DGG 2530 079.

Some time ago I commented on the skilful and sensitive playing of guitarist Siegfried Behrend when he was playing with a small group in a program of popular music. I had not realised that he is also an accomplished performer in the classical music field until I received this disc. However, he proves in full measure that he is just that in this interesting recital of medieval English lute music and modern guitar music.

The lute music has, of course, been arranged for guitar performance — such items as Greensleeves and Galliard (Cutting) — Monsiers Almaine (Batchelor) — Merry Melancholie and Galliard (T. Robinson). The famous lutenist Dowland is represented by his Lachrimae Antiquae, The King of Denmark's Galliard, Melancholie Galliard, Captain Digori Piper's Galliard, and Queen Elizabeth — Her Galliard.

From the 19th century we have a Sonatine For Two Guitars by Camidge, a lightweight item which is interesting but not very profound; while from this century we have the English Suite, opus 31, by Duarte, a tuneful work very easy on the ear; Canto For Guitar by McCabe, an English composer who is well established on the contemporary music scene — his piece here being an excellent example of modern guitar writing; and finally an interesting experiment entitled Soliloquy 1 for guitar and pre-recorded tape by the English woman composer Thea Musgrave. This is an imaginative piece, using the currently fashionable technique of layers of sound, each layer complete in itself yet contributing to the effect of the others. If you would like to know what the more sensitive modern composers are doing as a contrast to the senseless noise making of those calling themselves composers but without the ability to express themselves in musical terms, you should try to hear this example by Miss Musgrave. The high quality recording is quite in line with the modern DGG product. (H.A.T.)

★ ★ ★

THE VERY BEST OF THE GUNTER KALLMANN CHOIR. Polydor (Phonogram Recordings Pty Ltd) stereo 2371 072.

The Gunter Kallmann Choir is probably one of the best choirs of its type in the world. Of particular note is the clear enunciation of the singers and their fine sense of rhythm. And when backed up by the high recording standards of Polydor, you can be sure of a fine disc.

Most of the tracks are sung in a lively up-tempo style with a driving instrumental backing that soon has listeners foot-tapping.

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Two of the tracks are sung in German: "Edelweiss" and "La Mer". The remaining 10 titles are sung in English: My Cherie Amour — Good Morning Starshine — just A Dream — Its Getting Better — Daydream — The More I See You — Feeling Groovy — Somewhere My Love — Half As Nice — Goodbye.

All this adds up to just on 40 minutes of very fine singing. The recording quality is faultless throughout the disc and the stereo spread is wide. (L.D.S.)

★ ★ ★

THE PEOPLE NEXT DOOR. Original sound track. Avco Embassy, stereo SAVL-933981. Released through Festival Records Pty Ltd.

The People Next Door — (a movie which looks at every cornerstone of our society, "the family unit", it probes at the inner core of our social mores and values, says the sleeve note). So much for the background to the film. The rock group The Bead Game opens up the album with "Sweet Medusa". This is followed by "Mama, Don't You Wait Up For Me" by the pop group The Glass Bottle. The same tune is also used, however, as the film's theme which is why it reappears now and again either right in the middle of a different number or at the tail end of it. Lyrics throughout are interesting and at times amusing. One of the most interesting soundtracks I've heard for a while I'd say. (J.P.P.)

★ ★ ★

COCKER HAPPY. Joe Cocker. Interfusion, stereo SITFL-934,121. Released through Festival Records Pty Ltd.

Success seldom comes overnight. And so it has been with Joe Cocker. Born in Sheffield in 1944, the first 15 years of his life were fairly uneventful. By 1963 he had formed a band which called itself "Vance Arnold And The Avengers". Shortly after the group toured American military bases in France.

It was not until 1967-8 that he received any form of recognition. This came with the release of "Marjorie" which won him and his newly formed backing outfit, called Joe Cocker's Big Blues Band, some performing engagements in London.

The rest of his climb to success is probably well-known. After the breakthrough hit "With A Little Help From My Friends" he recorded his first album, named after the single. This was followed by a second album and finally this his latest release.

The tracks include some of the numbers of his previous albums just mentioned: among these are "With A Little Help From My Friends" and "She Came In Through The Bathroom Window". The others are: Delta Lady — Darling — Do I Still Figure In Your Life — Feeling Alright — Something's Coming On — The Letter — Hitchcock Railway — Marjorine — She's So Good To Me — Hello, Little Friend.

The performance throughout is reasonably varied; backing and voice modulation interesting. Quality is surprisingly good considering that this record falls in the "pop" category. The only exception to this is the track "The Letter" which, besides being mono or "non-stereo" as the label reads, is also distorted, sounding like a re-dub. Other than this, all is fine and sure to please his many fans. (J.P.P.)

★ ★ ★

ON PARADE. The Band of the Blues and Royals. RCA stereo OCS-7130.

The band featured on this disc resulted from the amalgamation of the two regiments — the 1st Dragoons (Royals), and the Royal Horse

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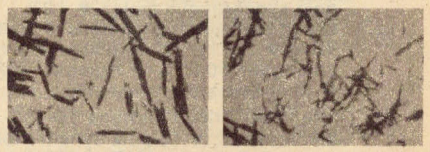
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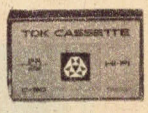
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Ordinary magnetic particles, magnified (left) SD-tape microfine particles, also magnified (right).



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Examine Thorens specifications closely and critically. The new Model TD-125 features: ● Transistor governed 16-pole synchronous motor ● ±2% speed control on all speeds ● Belt drive ● 7½ lb. 12" turntable ● Wow and flutter ±0.08% ● Rumble —68dB. ● Fine Swiss craftsmanship.

The lower priced Thorens TD-150 Mk. II offers: ● 16-pole synchronous motor ● Belt drive ● 7 lb. 12" diameter turntable ● Two speeds — 33⅓ and 45 rpm ● Wow and flutter ±0.09% ● Rumble —65 dB.

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After many years research, Ortofon have designed a new stereo cartridge which maintains the proud traditions of the Ortofon name. Featuring new principles, the high performance standards which have made Ortofon world famous have been preserved in the new Series M15 and MF15. Over 80% of professional users such as the radio and television stations (and recording studios) specify Ortofon equipment.

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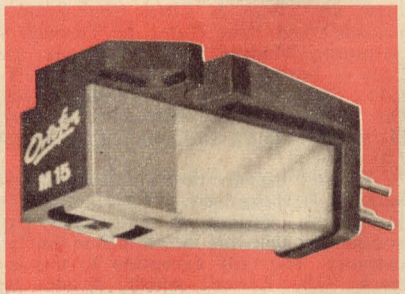
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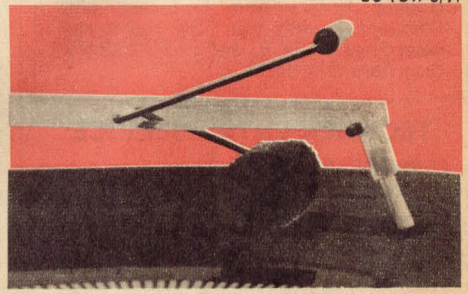
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Festival budget-priced double albums

TJB. Herb Alpert and the Tijuana Brass. A&M (Festival) double album, stereo SAML-135/6

This double album, retailing for $7.95, provides 24 of the most popular Tijuana Brass tracks selected from earlier releases. Included is the group's first big hit, "The Lonely Bull", as well as such established favourites as A Taste of Honey — Tijuana Taxi — Green Leaves of Summer — South of the Border — The Great Manolete — Spanish Flea — Zorba the Greek and so on. If you missed out the first time round, or have played the music off the grooves of earlier issues, this bargain package provides the opportunity to retrieve the situation at minimum cost. The discs have the characteristically clean sound of the A&M/Festival combination, with good stereo spread.

Apart from the above titles, the following are included: I Will Wait for You — Hello Dolly — Let It Be — Mame — Never On Sunday — Bittersweet Mamba — More — What Now My Love — Third Man Theme — The Work Song — Carmen — The Shadow of Your Smile — A Banda — The Girl from Ipanema — Mexican Road Race. Excellent value. (H.A.T.)

★ ★ ★

SERGIO MENDES AND BRASIL '77. A&M (Festival) double album (stereo) SAML — 141-4.

Those who favour the bossa nova of Sergio Mendes rather than the mariachi of Herb Alpert will find this double album from Festival to their liking. Like the Tijuana Brass set, this one has 24 tracks selected from previous issues, including the very original "Crystal Illusions" with which the group apparently tried to create a new bossa nova sound. Again, the technical quality cannot be faulted, so this also can be rated a bargain at $7.95. The following are included in the 24 tracks: Mais Que Nada — Daytripper — Night and Day — The Joker — The Look of Love — Scarborough Fair — Fool on the Hill — Constant Rain — Laia Ladaia — Masquerade — Agua de Beber — Wichita Linesman — Norwegian Wood. The musicianship of the group is superb. (H.A.T.)

★ ★ ★

A&M SOUND. Various artists. A&M (Festival) double album stereo SML-133/4.

If four sides of mariachi or bossa nova is too much for you, you will have nothing to complain about of the variety provided in this double album, again with 24 tracks, at $7.95. Look at this line up of talent from the A&M catalogue! Sergio Mendes and Brasil '66 — Claudine Longet — The Tijuana Brass — Burt Bacharach — Bossa Rio — The Sandpipers — Chris Montez — Nick de Caro — The Baja Marimba Band.

The Tijuana Brass and Brasil '66 tracks are also included in the double sets reviewed above, so presumably you will not want both. The other artists perform as follows: Claudine Longet, Love is Blue — Scarborough Fair — Both Sides Now; Burt Bacharach, The Look of Love — Any Day Now — Reach Out for Me; Bossa Rio, Do You Know the Way to San Jose? — Day by Day — Up, Up and Away; The Sandpipers, Guantanamera — Cuando Sali de Cuba — The Windmills of Your Mind — Chris Montez, Nothing to Hide — I'll Wait for You; Nick de Caro, Hey, Jude — Ob-La-Di, Ob-La-Da; Baja Marimba Band, Eleanor Rigby — Sound of Silence. Again, the sound quality is consistently very good, so if you like the contents you can buy with confidence. (H.A.T.)

Guards (The Blues). Each had its own first-class band.

The band's performance can only be described as impeccable in music which varies from strict tempo marches to an almost orchestral sound. Their performance of the "Radetsky March" and "Sons of the Brave" is exceptional, with the focus on phasing and interchange between trumpet and trombone groups.

Practically all of the marches and choruses are well known, and those familiar with the scores of the following titles will need no introduction: Radetsky March — The Soldier's Chorus — Marche Militaire — Grand March from "Tannhausser" — Entry of the Boyards — March from Suiite No 1 for Military Band — Sons of the Brave — With Sword and Lance — The Medallion — Voice of the Guns — The Champions — Prince of Wales March. Recommended. (G.F.H.)

★ ★ ★

BEAUTIFUL PEOPLE. The New Seekers. Philips (Phonogram) stereo 6308055.

The New Seekers have little resemblance to the old Seekers, whose characteristic sound was dominated by the strong vocals of Judy Durham. The new group has a much more unified sound, resulting from the equal contribution made by each member. It is perhaps not so strongly individualistic, but it is still distinct and colourful enough to be recognised as their very own.

Each member of the group (comprising Lyn Paul, Eve Graham, Peter Doyle, Martin Kristin and Paul Layton) displays ample talent, either as vocalist, or as instrumentalist, or as both. The songs have a wide range of variety, both in styling and arrangement. "Beautiful People", the title track, is perhaps an outstanding example of this, and if you are sampling, be sure to try this one. Others, equally refreshing, are: One — Never Ending Song of Love — Look What You've Done — When There's No Love Left — There's a Light — Blackberry Bay — Cincinatti — Eighteen Carat Friend — Ain't Love Easy — Your Song — I'll Be Home. (J.P.P.)

★ ★ ★

12 GREAT SONGS FROM DOWN UNDER. M7 Records (distributed by Music for Pleasure). Various Australian artists. Stereo LW3322.

M7 Records have dedicated themselves to the task of fostering Australian talent in all fields of music. This disc, distributed for M7 by Music for Pleasure, carries 10 tracks depicting Australiana in a selection of new and traditional songs.

Each song is pleasant to listen to and hard to fault — either in terms of musical arrangement or of recorded quality.

To ensure a virgin copy, each disc is sealed in a plastic sleeve. The glossy cover incorporates a fold-over leaf which can be torn off along a serrated edge. The tear-off is a print of a painting by Bryan Mansell in Central Australian earth colours, "The Golden Dawn", which is eminently suitable for framing.

Titles are: Waltzing Matilda — Oh! The Springtime it brings on the Shearing — Botany Bay — While the Billy Boils — Brisbane Ladies — My Country — Down Under — Along the Road to Gundagai — Click! Go the Shears — Wild Rover No More — The Dying Stockman — The Girls Of Broome. Good value. (G.F.H.)

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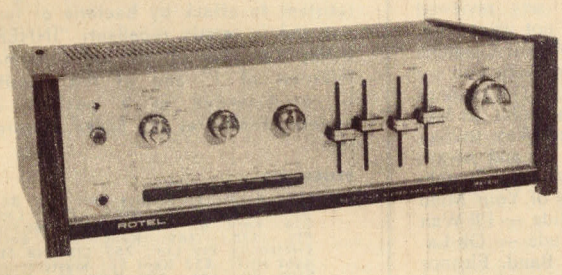
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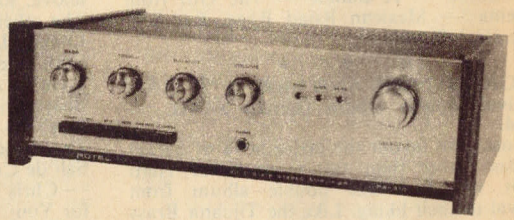
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In an "Electronics Australia" review of RA 610, these comments were included:

- Harmonic distortion was less than 0.1 percent at 25 watts into 8-ohm loads.
- No crossover distortion is evident.
- Frequency response was exceptional, with minus 3dB points at 6Hz and 200Hz.
- Square wave response was excellent and stability with capacitative loads was also good.

TECHNICALLY:

RA 310 comes with 60 watt power output (IHF) (17 / 17 watts RMS 8 ohm), all silicon transistors, signal source indicator lamps, tape monitor and mode push-button switches, loudness contour push button switch, 2 pairs of back panel speaker terminals, 2 front panel speaker selector switches, 1 magnetic phono and 1 ceramic phono inputs, front panel headphone jack.

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ON THE CONTINENT. Reginald Dixon plays the Magic Organ. Stereo, Columbia SCXO-6426.

The jacket is singularly uninformative about the how, when and why of this album. Apart from the credits and the track details, there is literally no other information. The "Magic" organ is a modern electronic sharply but pleasantly voiced and with lots of sustain and reverb. Reginald Dixon plays it as he would a big Wurlitzer but, despite his facility at the console, my tip is that most of his fans will be wishing that he hadn't swapped pipes for loudspeakers.

The title "On The Continent" comes from the track themes. France, on track 1, is represented by "I Love Paris", "Mademoiselle de Paris" and "C'est Paris". Luxembourg is represented by Lehar's "The Count Of Luxembourg" Overture, done with full vibrato. In turn we visit Portugal, Spain, Italy, Russia, Austria, Germany, Scandinavia and Holland.

The quality is clean, the balance is good and it will stand lots of level, if you want it that way. I liked it best turned down, background style. (W.N.W.)

★ ★ ★

THE MISTY MR WISTY. Peter Cook, comedian. Decca (EMI) mono LKA 7677.

Peter Cook is now widely known for his television appearances with Dudley Moore, but here he presents a series of sketches in his role as Mr E. L. Wisty, a character he apparently created for a radio series in the UK. Mr Wisty is a slightly pixillated character with all kinds of improbable ideas — for example, in one excerpt he represents himself as a tadpole expert, and dwells on the endearing habits of his small charges, but complains that they have a nasty habit of turning into toads and frogs. He tells how he won the war (1939-45) by explaining to Winston Churchill in a letter that it was only necessary to beat the "Boche" and finish off Hitler, then complains that his advice was disregarded for nearly six years — and to cap it all, he was given no credit for thinking of the solution in the first instance.

There is lots more of this kind; in fact, the playing time is extremely generous, and could well run over the hour with the 14 tracks included. In general, it is all good clean fun, suitable for family listening, except that the occasional appearance of "bloody" may cause a few parental frowns.

The tracks have been selected from radio soundtracks, and in general the mono only sound is acceptably clean. However, there is an irritating high pitched whistle present in some tracks which I was unable to explain. However, I did satisfy myself that it is in the recording, and did not arise from amplifier or mains noises. (H.A.T.)

★ ★ ★

THE GUITAR AND I. Written and narrated by Andres Segovia, plus exercises for developing techniques and 12 studies. MCA (Astor Records) stereo MAC/S 3965.

Students of the guitar should find this disc interesting, since it contains demonstrations by Segovia of exercises he has developed to improve technique as well as his performance of some basic studies by Coste, Sor and Giuliani. All fine for students, but not exactly fascinating listening for those who just like to listen to guitar performances.

About three quarters of the playing time on side 1 is taken up by Segovia's reminiscences of his childhood and early youth in Spain. The sleeve information says this is the first in a series in which Segovia will narrate his experiences, so presumably the next disc will take up the theme from there.

For the record, here is the list of studies included: By Coste; G minor — A minor — A major. By Sor; C major, Op 31, No 1 — A minor, Op 35, No 3 — E major, Op 32, No 2 — B minor — A major, Op 35, No 9 — D minor, Op 35, No 11. By Giuliani; G major, Op 111, No 3 — A major, Op 1a, No 11 — A minor, Op 1a, No 3. (H.A.T.)

Jazz and Rock . . .

LOBBY LOYDE PLAYS WITH GEORGE GUITAR. Infinity stereo SINL 934256.

Lobby, who played lead guitar with Billy Thorpe for two years is bursting with excellent melodic ideas.

He throws them at you on this loud, ebullient recording. Lobby's vigor is something which we haven't encountered in the Australian rock scene for many years.

Many performers hide behind their amps. Lobby uses his to beef out his exciting improvisations. He has written all of the the tunes on the disc and they are excellent. He doesn't follow anybody. The nearest parallel to his style is that of the early Rolling Stones. "Everybody Come Together" and "Dream" are two of the best tracks and the most typical of Lobby. The LP is a tour de force for an original spirit in Australian rock. (G.W.)

★ ★ ★

SOUTHERN CONTEMPORARY ROCK ASSEMBLY. M7 stereo LW 3312.

Peter Martin's formation of a big band of talented musicians to play rock and roll in Australia has proved to be a great success. This is a 10-piece straight-on group after the "Chicago" pattern, playing originals with the exception of "C C Rider" which has become a theme tune for the group.

Micky Leyton, the male lead singer and Sheryl Black are outstanding individual talents and a great strength to the group. Use of trumpet, trombone and reeds in addition to guitars gives the assembly a big and exciting sound on tunes like "Sydney Born Man", "Traveller" and "Bush Sunrise". (G.W.)

★ ★ ★

WES MONTGOMERY, A&M stereo SAML 137/8.

This two-album set was recorded near the end of the life of the most outstanding jazz guitarist of modern times. Montgomery was blues oriented and distilled the melodic essentials from any tune before building an exciting new melody from it.

An hour spent with this album will explain more about fundamentals of jazz composition than one thousand textbooks.

The setting is comfortable — strings and things.

Montgomery starts the album with Lennon/McCartney's "Eleanor Rigby". It's what happens after that which is so interesting. "Scarborough Fair", "I Say a Little Prayer for You", "When a Man Loves a Woman" and "A Day in the Life" are some of the songs.

By approaching improvisation through something utterly familiar the newcomer is in a better position to share the creative experience with the performer. (G.W.)

★ ★ ★

BLOOD SWEAT AND TEARS FOUR. CBS stereo SBP 233982.

With their fourth LP, Blood Sweat and Tears are getting better results from their approach to symphonic jazz. The use of individual instruments in solo passages is acquiring more polish.

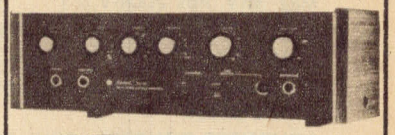
"Cowboys and Indians" sung by David Clayton-Thomas is the outstanding original composition on the album. I've always felt that the Clayton-Thomas voice has escaped the microphone in the past, coming out as a hoarse distortion. There is a more satisfying texture on this LP. (G.W.)



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2. Junior Executive II, $219

"Monarch" SA 400 solid-state Stereo Amplifier with 28 watts of clear music power. Has loudness control, scratch filter and tape monitor. Is fed into a pair of Matched Hi-Compliance Speakers in a two-way walnut cabinet. BRS auto or manual Turntable. Deposit $23 and two years to pay.

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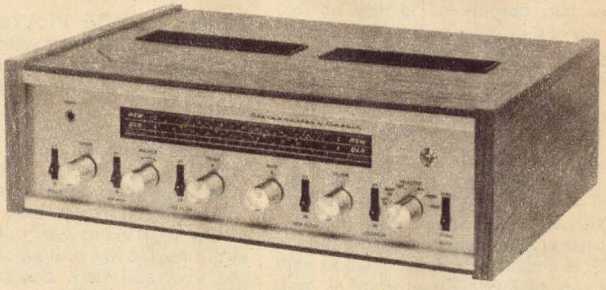
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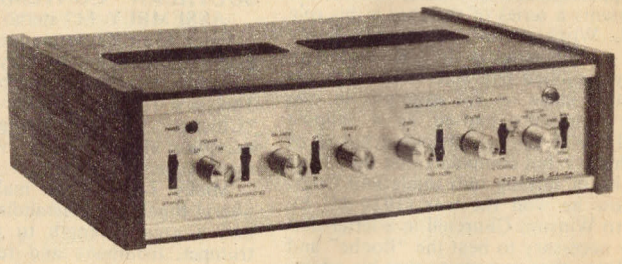
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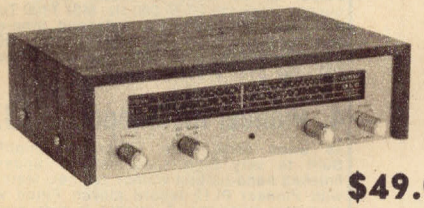
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AUSTRALIA AND ALL THAT JAZZ. Johnny Sangster and group. Cherry Pie. Stereo CPS 1008.

Sangster wrote (or should we say created) the two sides of this LP as the soundtracks for two natural history films made by the Australian museum.

With the reassuring backing of a series of Australian images, the jazz group has created a distinctly Australian sound.

Errol Buddle, Don Burrows, Graeme Lyall, George Golla, Ed Gaston and Derek Fairbrass make up the group with Sangster. All of these performers have been dedicated over the years to producing something original in our environment. They have each had their individual successes. This disc, with Sangster is an astounding joint effort.

Buddle's bassoon, for instance, is wonderfully evocative of Australia. Tony Buchanan's bass clarinet, Lyall's soaring tenor saxophone and of course Sangster's vibraphone playing put jazz in a suitable setting.

Sangster has always been an innovator and on this LP he uses actual bird noises. I think this is the first time this has been done on an Australian jazz disc although many South American bossa nova groups use exotic instruments which imitate animal and bird cries. The recording engineers, Warren Mills and Max Harding, have produced a recording of excellent quality, quite up to the standard of the best overseas recordings. (G.W.)

Editor's Note: A sample copy of this recording was also received in our editorial office. We feel it appropriate to comment on the folder type sleeve in which the disc is supplied. This is beautifully prepared, printed in full colour with wild life pictures and Australian landscapes, and has a four-page printed insert containing informative notes and pictures of the artists. As an all-Australian effort, this is highly recommended.

DADDY WHO? Daddy Cool. Sparmac stereo SPL001.

This is a one-track LP and the track is "Eagle Rock" a brilliantly conceived re-creation of rock and roll from twenty years ago. Robie Porter, the former Rob E. G. appeared on the track, playing Chicago style piano, and the members of the Daddy Cool group hammed it up in a stylish manner.

Daddy Cool are the most successful of our rock revival groups, recalling the fun and abandon of the years when rock and roll was in its crew-cut days. Yet with "School Days", "Blind Date" "Come Back Again" and their other numbers they are little more than a series of musical attitudes.

They don't really shape up against overseas groups like Sha Na Na and Beach Boys yet on listening to their musical ability, there is no reason why they shouldn't.

Perhaps they are too cool. The recording was made by Roger Savage at the Armstrong studios, Melbourne. (G.W.)

★ ★ ★

CHAIN: Toward the Blues. Infinity stereo SINL-934295.

This Melbourne blues/rock group has seen several personnel changes but it still manages to perform exceptional basic blues. The outstanding guitarist Phil Manning must be one of the world's best blues pickers. Mat Taylor, vocalist and mouth-organ player, makes the harp move in the best country blues style.

They start with the "Thirty Two Twenty Blues" by Robert Johnson whose works have recently been resurrected by scholars in the US.

Johnson was more poetic than the usual blues performer. The darker shading of his lyrics obviously appeal to Chain. They play four of their own numbers "Boogie", "Booze is Bad News Blues", "Albert Goose's Gonna Turn the Blueses Looses" and "Black and Blue". The last of these is outstanding. Technical quality is good. The recording was made at T.C.G. Sound, Melbourne with engineer John Sayers. (G.W.)

★ ★ ★

DUKE ELLINGTON. Concert of Sacred Music. Liberty stereo SLYL-131/2.

This is the second recording made of the Duke's famous suite. He fills two LPs this time with a performance which spreads itself more than the original made for RCA. Soloists are Cootie Williams, Johnny Hodges, Paul Gonsalves, Cat Anderson and Lawrence Brown. Lead singers are Alice Babs and Tony Watkins.

Duke explains in the liner notes that he isn't out to convert anybody. He wants to remind people, through jazz, of the things they already know to be true. This is as much a jazz quality as a religious quality.

The opening up of the mind that is possible when Hodges takes a solo on alto saxophone, for instance, is extraordinary. Even the two drummers Sam Woodyard and Steve Little are able to extend understanding with their unusual performance of "The Biggest and Busiest Intersection". Recording quality is excellent. (G.W.)

★ ★ ★

ATOMIC ROOSTER. Interfusion stereo SITFL-934192.

This is a brash, noisy English rock trio which makes a big sound and enjoys doing it.

Vincent Crane, the organist, uses special devices to beef up his Hammond. John Cann is a masterful guitar soloist and the drummer, Paul Hammond, gives the group a desirable lift, performing a crowd-pleasing drum solo on "Gershatzer".

Crane wrote the Arthur Brown hit "Fire" and his composition "Death Walks Behind You" which opens the LP is in a similar vein. The sound quality is good, lifting the group off the record. It reflects the great improvement in the recording of blues groups in recent times. The muddiness of many early recordings is thankfully not regarded as being good enough any more. (G.W.)

★ ★ ★

THEY CALL ME MUDDY WATERS. Chess Stereo CHLS 276.

"I sold myself to the devil when I started loving you" sings Muddy Waters on this exceptional recording of tracks taken from a 20-year period.

It was Muddy Waters' use of slide guitar, interacting with a second guitar rhythm, which changed the whole style of popular music. Muddy's beat has been the rock on which the Rolling Stones have built, with many other groups including Quicksilver Messenger Service, following.

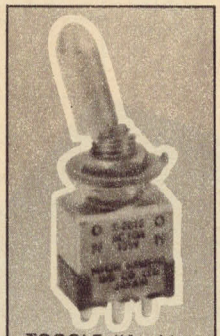
Muddy was probably the first of the Chicago blues men to use an electrified harmonica and to demonstrate the power of the electric blues.

There are two keynote performances on the disc — "They Call Me Muddy Waters" which defined the beat in 1951 and "Country Jail Blues" which comes from the electric era.

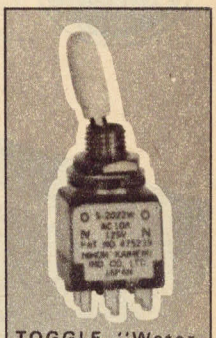
Quality is variable but adequate for a record of such interest. (G.W.)

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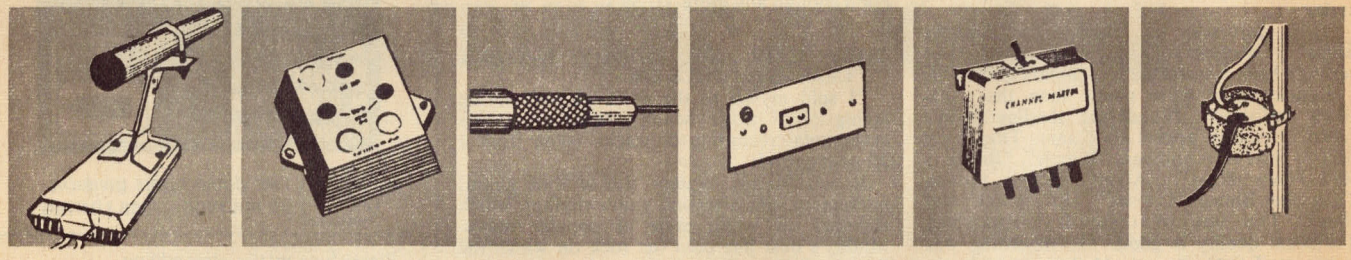
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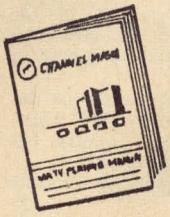
MODEL	TYPE	GAIN H/B L/B	Maximum Input Level (before cross modulation occurs) 4 Channels (Note 1)	Maximum Output Level (before cross modulation occurs) 4 Channels (Note 2)	Maximum Output Capability (ONE CHANNEL ONLY)	Maximum Number of Outlets (under favourable conditions) (Note 3)	Trade Price + 27½% Sales Tax if applicable
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TRADE REVIEWS AND RELEASES

Marlux Cassette Recorder

The Marlux Model 2000 stereo cassette recorder is a machine intended to break into the hi-fi range of recorders. It boasts outstanding performance and incorporates type B Dolby circuitry.

The Marlux 2000 recorder was submitted to us for review by International Dynamics (Agencies) Pty Ltd. It presents a determined effort on the part of its makers to produce a machine that is comparable in performance to similarly priced open reel machines. Its physical appearance is certainly impressive enough, featuring piano key type operating switches, a single large switchable VU meter, and individual input level controls in addition to a common "master" control.

As the instrument is intended to compliment an existing hi-fi system, it does not contain any loudspeakers or amplifiers of its own. It is, however, fitted with a single playback level control at the rear of the instrument, which controls both the line and headphone outputs. Other worthwhile features of this instrument are a digital pushbutton-reset tape counter, a flashing end-of-tape indicator and a pause control.

The transport system controls are fully interlocked and are all of the latching type. The second row of piano switches on the right control power, stereo/mono recording, Dolby circuit operation and tape bias/equalisation.

This last control is responsible for much of the recorder's performance. In the REGULAR position, recording bias as well as recording and playback equalisation are set for standard cassette tapes. In the SPECIAL/CrO2 position, the recording bias is increased and equalisation changed for optimum results with chromium dioxide tapes. By recording with the switch in this position and playing back in the REGULAR mode, improved performance can also be obtained from TDK-SD tapes.

An unusual feature and one that we have not come across before in any tape recorder, is the provision to monitor the input and output levels of both channels simultaneously on a single VU meter. In the initial setting up stage, the meter can be switched to read the level of either channel. Then, for normal operation, the meter is switched to the HIGHER OF A OR B position. In this mode the meter reads the higher signal level coming through either of the two channels. The master gain control may then be used to adjust the maximum recording level of both channels simultaneously.

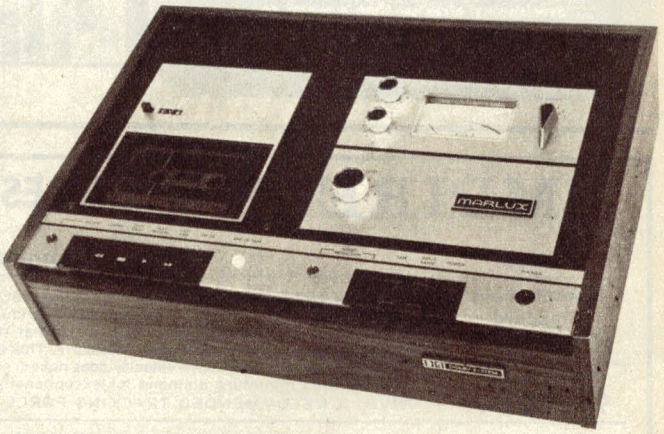
To avoid overloading the recorder at high frequencies during the recording process, the manufacturers have deliberately given the meter increased sensitivity at the high end of the frequency spectrum. We consider this a very worthwhile feature as it greatly minimises the danger of overmodulating the tape with complex musical tones containing powerful upper harmonic structures. During playback the meter is also operative, but has a flat response. It is not effected by the output level control, so that it can be used as an independent means to monitor the output level.

Internally, the instrument is a delight to the eyes. Printed wiring boards are used throughout. The main circuit board, which is situated directly above the transport system, is provided with edge type plug-in connectors, making access to this part of the recorder extremely easy.

The transport system itself is powered by an electronically speed controlled motor. The motor also supplies the drive for the supply and take up spools, with relative simplicity in the way of belts, pulleys, levers etc.

The remaining particulars of the recorder as shown in the manufacturer's specification panel, are reproduced below.

TAPE SPEED: 1.875 ips ± 1%.
WOW AND FLUTTER: Less than 0.15%, DIN weighted.
INPUTS: 1 Microphone (200 ohms or less) -0.2mV
1 Line, selectable between 60, 200, or 500mV at greater than 100K input impedance.
OUTPUT: 1 Volt RMS from 0VU, at 5K output impedance.



The Marlux 2000 stereo cassette recorder. The cassette compartment is on the left, the piano key type switches along the front, and the VU meter on the upper right of the panel.

FREQUENCY RESPONSE: 38-14,000Hz ± 3dB.
SIGNAL to NOISE RATIO: Referred to 0VU, Dolby System off: Better than 48dB with "low noise" cassette tape. Better than 51dB with Advocate Crolyn (chromium-dioxide) tape.
NOISE REDUCTION: With Dolby System on:
3dB at 600Hz.
6dB at 1200Hz
9dB at 2400Hz, 10dB at 4000Hz and above.
CROSSTALK: 40dB
BIAS OSCILLATOR FREQUENCY: 105KHz.
POWER REQUIREMENT: 117 or 220 volts AC, 50-60Hz.

Our findings on the above specifications were as follows.

The nominal tape speed was found to be within the stated tolerance. We also checked tape speed against line voltage variations and noted no change in speed with supply voltage as low as 180 volts.

The performance with regard to wow and flutter seemed to vary somewhat in the sample recorder. When it was first received there was quite an audible amount of wow present with the demonstration tape. Yet none could be detected on a number of other pre-recorded cassettes. After running the demonstration cassette a few times, however, the wow disappeared indicating, most likely, that the cassette itself needed some "freeing". This experience could possibly be repeated with some new and unused cassettes as well.

When we tried to obtain the specified input sensitivity figures, we found that in every case the sensitivity was approximately twice as high, ie, only half the stated input voltage was required for 0VU deflection. Note that there are in fact three separate pairs of line inputs, each with its own sensitivity rating. Input impedance of all but the most sensitive input was found to be above 100K. The nominal 60mV input only measured 30K. However, in most cases this should not prove a problem.

The output level from a 0VU recorded signal measured 1.3 volts RMS. This is a little higher than specified, but of no consequence as it is fully adjustable by means of the playback level control.

We did notice, however, that a considerable amount of distortion was introduced if the control was set for maximum output with the machine set in the record mode and adjusted for 0VU, ie, using the internal line amplifiers for monitoring purposes. The distortion was found to decrease as the control was set back from its maximum position. Whilst this is not a serious problem if it exists only in the "record" mode, it does mar the performance if it is also present during playback. We could not verify if this indeed was the case, however, as it is difficult to measure distortion levels below about 1% from tape media. With a 0VU recorded signal, the distortion on playback measured 3%, which is relatively normal.

As it stands, it is possible to obtain a distortion level close to 0.5% if the playback control is adjusted for a 300mV output. All of the foregoing applies to the whole of the audio range, on both channels.

We contacted the distributors over this issue, but they were unable to shed any light on the matter. We are thus unable to say whether this is an isolated fault or a genuine design error.

Perhaps the boldest claim made by the manufacturers of this machine, next to the Dolby noise reduction system, is the flat and extended frequency response. In view of this and the fact that the makers claim this recorder to be good enough to supplement or even take the place of similarly priced open reel machines, we took particular care in checking out these claims.

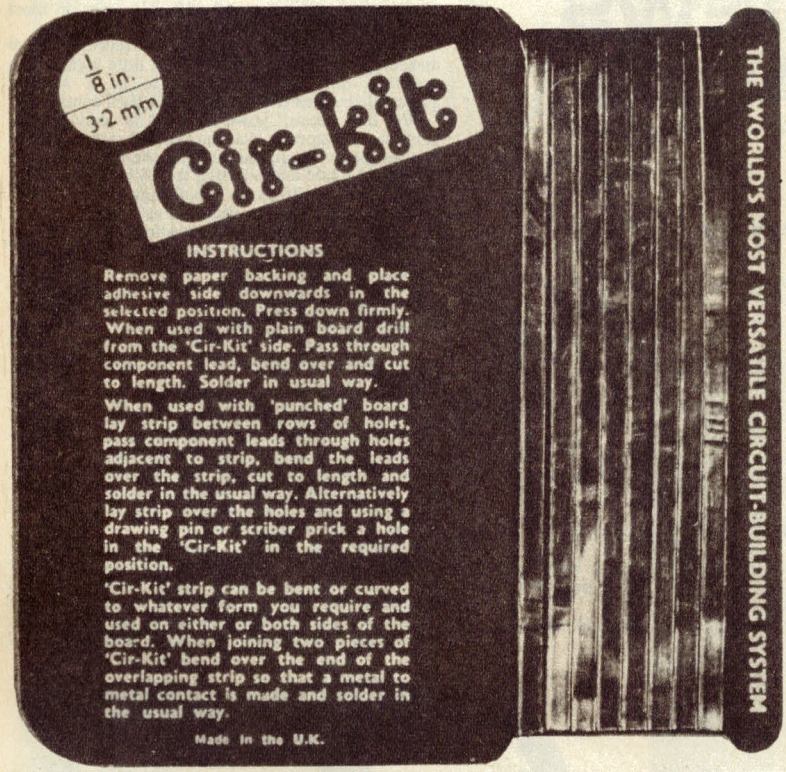
In all, we tested the recorder with three types of cassettes. They were a Philips low-noise cassette, a TDK-SD cassette and a cassette with chromium dioxide tape. Because of the presence of the Dolby system, we also tested the recorder's frequency response at a number of different recording levels, but found he "standard" level (-20dB re 0VU at 1KHz) to give the most favourable results.

The first test was conducted with Philips low-noise tape. With the Dolby circuit switched out of circuit, the response was well within the limits of ± 3dB over the specified frequency range. We should add here that it was also the "flattest" response curve we have yet seen produced by a cassette recorder. Signal to noise ratio, measured wideband, was also found to be well within specifications, measuring 48dB, which is extremely good for this type of tape recorder considering the very narrow track width involved.

We next tried the recorder with the same tape, but with the Dolby system switched in. The frequency response this time was not quite as good at the high end, being about 9dB down at 14KHz. Signal to noise ratio was improved, however, by some 4dB bringing it to 52dB, measured wideband. Audibly, the reduction in hiss level was substantial, this because of the fact that the Dolby system works primarily on signal frequencies above 4KHz. It is over this frequency range that noise is most objectionable.

The next test was made with the TDK-SD tape cassette. It was here that we found large deviations

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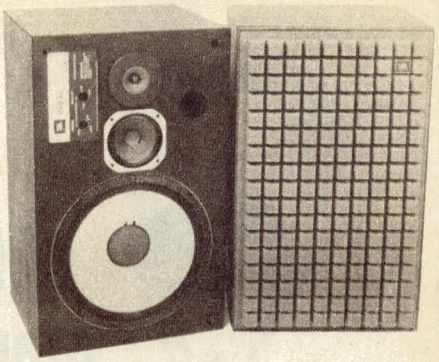
Model	Technical Specifications	Price
Measurement Standard 1000ZE / X	1000ZE / X TRACKS AS LOW AS 0.1 GRAM IN LABORATORY PLAYBACK ARMS. Each 1000ZE / X and 999VE / X cartridge is individually adjusted to have a flat frequency response within ± 1dB from 20-20,000Hz. Stereo separation is better than 35dB at 1KHz and remains 25dB or better all the way out to 20,000Hz. Overall frequency response a phenomenal 4-40,000Hz. There are no electrical or mechanical peaks and total IM distortion at the standard 3.54cm / sec. groove velocity does not exceed .05p.c. at any frequency within the full spectrum. Uses a .2 x .7 mil hand polished miniature diamond for exceptionally low mass. 999VE / X RECOMMENDED TRACKING FORCE ¼ TO 1¼ GRAMS.	**$110**
Professional 999VE / X		**$80**
Deluxe 999TE / X	Surpassed in overall quality only by the 999VE / X and the 1000ZE / X, this cartridge combines high compliance with low tip mass for excellent tracking between ½ and 1½ grams. Full frequency response is 6-36,000Hz, separation 35dB, .2 x .7 mil biradial hand polished elliptical diamond. Recommended for high performance turntables and changers.	**$70**
Deluxe 999SE / X	Delivers a fine frequency response of 8-32,000Hz in top quality manual and automatic turntables and tone arms tracking at 1½ grams of less, .2 x .7 mil biradial hand polished elliptical diamond stylus.	**$60**
Deluxe 999PE / X	A tracking range of ¾ to 2 grams, coupled to a .3 x .7 mil biradial hand polished elliptical diamond stylus, makes this an outstanding cartridge for high quality playback systems. Frequency response 8-32,000Hz.	**$50**
Deluxe 999E / X	Designed to track from ¾ to 2 grams in many of today's better changers. Will faithfully reproduce frequencies between 10-30,000Hz while maintaining 35d B of channel separation. .3 x .7 mil biradial hand polished elliptical diamond stylus.	**$45**
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J. B. Lansing "Century" System



James B. Lansing Sound Inc have a reputation for producing high priced loudspeaker systems which have superlative performance—a relationship which does not necessarily hold good in all brands. However, the JBL Century L100 carries on the JBL tradition. It is a three-way system with a music power handling capability of 50 watts.

There is no doubt that, in these times of relative affluence, there is a strong market for high priced high fidelity equipment. A certain "status" flows from the possession of expensive equipment in the home. People are awed into thinking that units must be good if their price climbs into the three to four figure bracket.

In terms of price the JBL L100 must have considerable merit if these criteria apply. In fact, the JBL L100 has superlative performance based on any standards.

Essentially a domestic version of the JBL 4310 studio monitor loudspeaker system, the JBL Century L100 is probably one of the most eye-catching systems on the market. Instead of the usual synthetic grille fabric, the L100 has "Quadrex 2" grille assembly; this is of plastic moulded foam which apparently has very good sound transmission characteristics. The Quadrex grille is available in colours of Ultra Blue, Burnt Orange or Russet Brown, indicating that the manufacturers are not too far behind car makers in naming colours.

Removing the Quadrex grille reveals the three loudspeaker driver units and the attenuators for midrange and tweeter units. The massive 12in woofer has a 3in edge-wound copper ribbon voice coil. The curvilinear cone is coated witha stiffening material to reduce cone break-up at high power levels. Instead of the often-seen rubber roll surround, the woofer has the usual multi-corrugated edge suspension which is treated with a viscous material to increase the compliance. Free-air cone resonance is a low 27Hz.

At frequencies above 1500Hz, the 4in midrange unit takes over. This, too, is ruggedly built and weighs almost 3lbs. It also has an edge-wound voice coil and a viscous-treated edge suspension. Above 5KHz, the 1¾in diameter tweeter takes over. It appears to be the same tweeter as used in the JBL Lancer 77 which was reviewed in these pages in September 1969. The attenuators for the high and midranges are continuously adjustable over a range from 0 to minus 9dB.

Dimensions of the cabinet are 23½in H x 14in W x 13in D. Cabinet finish is oiled walnut. Apart from the Quadrex grille, the cabinet is unusual in that it is particularly heavy, with a total weight of 44lbs. The baffle is made of 1in thick particle board while the other panels are made of ¾in thick particle board. The cabinet is lined with 1in thick fibreglass, as is the separate midrange enclosure which prevents the woofer modulating the midrange driver.

On sinewave tests the unit performed impeccably in the bass and treble registers. The woofer has very smooth output between 40Hz and 1500Hz and the tweeter is similarly smooth above 5KHz. The middle register, handled by the 4in driver, is not quite so smooth and appears to be overemphasised. This emphasis of the midregister, giving so-called "presence" is quite pleasant on popular instrumental and vocal music, but on classical music it can all too easily impart a harshness to the stringed instruments. We found the best overall response was obtained with the middle range attentuator set to about minus 6dB.

With classical organ music, the woofer was really shown to advantage. Even at very high power levels it remained "clean" and apparently completely free from intermodulation or harmonic distortion. And on complex orchestral and choral passages such as in Beethoven's Ninth Symphony it was a revelation. Again, at very high or low sound levels, the clarity of reproduction was faultless.

With a power rating of 50 watts music power it may be thought that the Century L100 shares a common drawback with many high-quality systems — that of inefficiency. In fact, we found it to be slightly higher than average. It can be driven to more than adequate sound levels with a 10 watt per channel amplifier.

We tried the effect of removing the Quadrex grille on the high frequency response and dispersion. It appears to have no noticeable attenuation of the high frequencies and, in fact, may be better than conventional grille cloths.

Very little more can be said about the JBL Century L100. It is expensive but it performs extremely well. Recommended retail price, including Quadrex grille is $501, including sales tax. JBL loudspeakers and amplifiers are available from selected retail outlets throughout Australia. Trade inquiries should be directed to the Australian distributors for JBL equipment, Auriema (Australasia) Pty Ltd, 443 Kent Street, Sydney, NSW 2000. (L.D.S.)

MARLUX RECORDER . . .

from the specified figures, in relation to frequency response. Besides being a rather "bumpy" response, it also fell well down at the high end, being some 10dB down at 10KHz. We strictly followed the specified procedure here, recording the signal with the TAPE selector in the SPECIAL position and playing back with it in the REGULAR position. On the strength of the results of the previous test and the one to follow we feel, however, that these poor results were probably due to some maladjustment in the recorder itself and not inherent in the design.

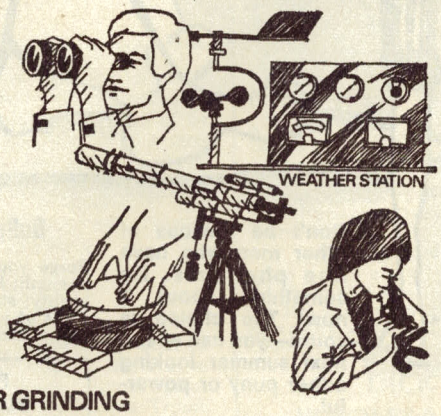
Results with chromium dioxide tape were once again fully up to specifications, and we were again impressed by the "flatness" of the response curve. Signal to noise ratio of this tape and the TDK-SD both measured the same (wideband) at 55dB below a O VU recorded signal. The same comments made earlier apply to both these tapes regarding audible differences with the Dolby system in operation. As far as we could ascertain, the differences between chromium dioxide and TDK-SD tape are minimal when used on this machine. Overall, however, the chromium dioxide tape seemed to suffer less from dropouts.

Driving the recorder was straightforward, although loading of cassettes sometimes proved a little troublesome. We found that there was a definite "right" way to load some cassettes, otherwise one of the edges tended to catch, preventing the lid from completely closing. A minor point, but something that could easily be improved on.

Summing up, we would say that the Marlux Model 2000 recorder holds a special position among stereo cassette decks. Retailing at $279.00 it is the most expensive, the most professional and to the best of our knowledge among the very few top ranking cassette recorders. Admittedly there are some performance points which one would like to see improved, the high distortion level in the line amplifiers being a case in point. Nevertheless, in totality, this machine is a most impressive recorder.

Inquiries should be directed to International Dynamics (Agencies) Pty Ltd, 23 Elma Rd, Cheltenham, Vic. (J.P.P.)

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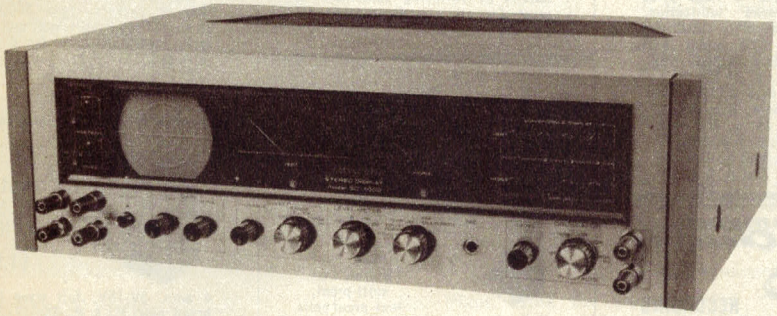
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Stereo Test Unit from Pioneer

The Pioneer Stereo Display unit is a specialised test instrument intended for the advanced audio enthusiast. It features a 2½in CRT, a pair of calibrated level meters and a built-in audio oscillator which can be set for a constant tone or to sweep the range from 20Hz to 20KHz.



The Pioneer SD-1000 could be called a combination oscilloscope/voltmeter with constant tone/sweep audio oscillator. A large number of tests which can be done with the unit are listed in the comprehensive instruction manual. But before discussing tests the unit can perform, it may be appropriate to describe the physical layout of the device.

Overall dimensions are 17in W x 13½in D x 5½in H and total weight is 19 pounds. The front panel has a brushed aluminium escutcheon and a dark, translucent panel behind which are mounted the VU meters. These are lit up when power is applied. At the left of the panel is the 3in diameter oscilloscope tube face and two trace-positioning knobs. Below the tube face are two pairs of sockets for horizontal and vertical amplifier inputs. To the right of these are two knobs for horizontal and vertical amplifier gain.

Below the left-hand VU meter is a pair of knobs for selecting the sweep frequency for the oscilloscope timebase. To the right of these are controls for the 10dB/step attenuator, function selector, audio output level and audio frequency. Finally, on the extreme right of the front panel are a pair of sockets for the oscillator output signal and eight pushbuttons to select the signal viewed on the oscilloscope screen. A 50K microphone input socket completes the list of front panel features.

Because of the large number of controls on the SD-1000 the user will find that he has to take some time familiarising himself with the unit before he can "drive" it confidently. The most important tests the unit can perform relate to the power output, the gain and the frequency response of audio amplifiers.

With a suitable microphone connected and the sweep oscillator operating, it can be used to check the overall response of an audio system from amplifier input to loudspeaker output.

Again, using a calibrated RIAA preamplifier and a test record such as the CBS STR-100, one can check the frequency response, channel separation and tracking performance of phono cartridges.

Other less important tests are the checking of stereo balance in audio amplifiers and the measurement of amplifier phase shift using the Lissajous figure method. One other test facility, which is of no use to Australian buyers, is the observation of FM Multipath reflections using the oscilloscope.

Once the user is familiarised with the unit it performs well and reliably. However, to make the unit more versatile and easier to use, we would suggest the following modifications to the SD-1000: (1) Calibration of the two meters in volts as well as decibels. Having to convert to volts when making repetitive measurements can be tiring. (2) Incorporation of dummy loads inside the unit to simplify the measurement of amplifier power output. (3) The addition of a variable sweep rate for the audio oscillator. As it is, with a sweep time of 25 seconds approx from 20Hz to 20KHz, the rate is a little fast to identify peaks in loudspeaker response curves.

Aside from the above remarks, the Pioneer SD-1000 fulfils the application for which it is intended and is worthy of consideration by those audio enthusiasts who require the testing facilities provided by the unit. Recommended retail price of the unit, including sales tax, is $644. Pioneer equipment is available from retail outlets throughout Australia. Trade inquiries should be directed to the Australian distributors for Pioneer, Astronics Australasia Pty Ltd, 161-173 Sturt Street, South Melbourne, Victoria 3205. (L.D.S.)

New RF Oscillator from H-P

Hewlett-Packard have recently announced a new addition to their range of solid-state instruments, the Model 8651A RF Oscillator.

"Laboratory-grade in performance but priced for general purpose use" — that's how Hewlett-Packard describes its new 22KHz-to-70MHz RF Oscillator. Applications for the all-solid-state HP Model 8651A include testing antennas, filters and amplifiers, driving bridges, and providing calibration signals for wideband test equipment such as oscilloscopes, voltmeters, and counters.

Among the major features are:

- Pushbutton selection of frequency range (22KHz to 70MHz in seven bands).
- Calibrated output, continuously adjustable from 3 volts to 1 mV into 50 ohms.
- Output flatness ±3% to 22MHz, £5% 22 to 70-MHz.
- Frequency stability of 20 ppm per minute after warmup.
- Low distortion: harmonic content less than 3% at maximum output.

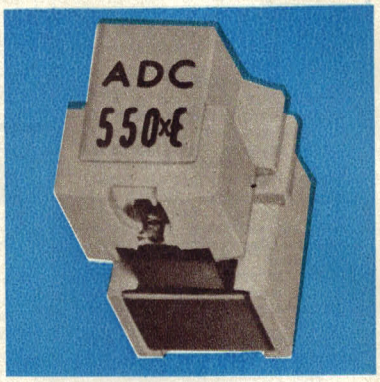


The HP 8651A RF Oscillator is well shielded (< 10 micro-volts leakage) so it can be used with sensitive or susceptible equipment. Its compact size, 6½in high by 11in deep by 7¾in wide (half rack width), makes it convenient for bench use, for rack-mounting with other equipment, or for field work.

Price of the 8651A RF Oscillator is $695 in the United States.

Inquiries should be addressed to Hewlett-Packard Australia Pty Ltd, at 22-26 Weir Street, Glen Iris, Vic 3147.

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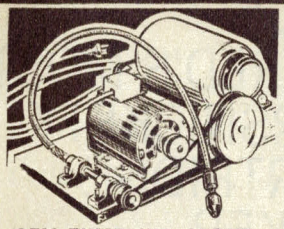
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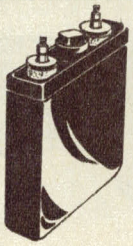
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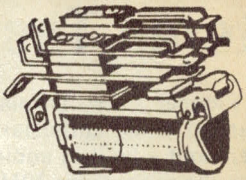
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NIFE BATTERIES 95c

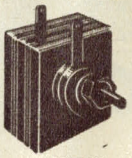
Brand new! Nickel, iron, spill-proof, leak-proof cells. Lasts for ever, 4 A.H., 1.2 volts. Size 3 1/2" x 2 1/2" x 1". Couple together for any voltage—superb for spotlights, lamps, bells, flash equipment, etc. Govt. cost $7 ea.

Set of 10 gives 12 volts 4 A.H. $7.95 (Pack post $1); Set of 5 for 6 volts, $3.95 (Pack post 75c).



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New in packets. Type 3000. Impregnated coil switched multi-leaf type. Rating 3 amps for 6 or 12 volts DC. Size 3 1/4" x 2 3/4" x 7/8". As new condition 85c. P. & P. 25c.



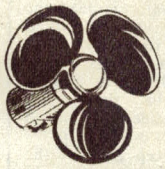
ENGLISH SOLENIUM RECTIFIERS

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4 amp. 3V-18V, full wave bridge, brand new. P. & P. 25c. 1/2 amp. 85c. P. & P. 25c.

English dry reed switches, gold plated contacts 1" long x 0.15" up to 250V AC. 250 M.A. 2 for 80c. Post 5c.

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12V ELECTRIC FAN $1.25

Well made hi-speed brush motor, reversible rotation for blowing or extracting air, cont. duty, has 3" dia. 3-bladed plastic fan. Rush an unrepeatable bargain. P. & P. 20c. 12V DC motor separately $1. P. & P. 25c. Post free if with another article.



ENGLISH SOLENOIDS $1.50

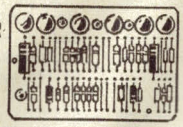
Operates on 4 1/2 to 12 volt DC. (300mA on 4 1/2 volts). DC resistance 15 ohms. quick acting, overall size 1 1/2" x 1" x 3/4". Two tapped holes for mounting, vertically or horizontally, maximum stroke 1/2". Brand new. P. & P. 25c.



MORSE KEYS $1.95

Adjustable, beautifully made for British Army, new. P. & P. 70c.

COMPUTER BOARDS



Enormous purchase from famous computer manufacturer. Each board comprises a minimum 4 transistors and up to 6 transistors, plus host of resistors, diodes, capacitators, inductors, etc. Transistors are NPN & PNP germanium type TO5 & TO18 for R.F. audio, hi-speed switching, etc. 100's of uses. Size of board 2 1/2" x 4".

4 boards with minimum of 16 transistors $2, post 20c.
8 Boards with minimum of 32 transistors $2.75, post 25c.
16 Boards with minimum of 64 transistors $4.95, post 70c. Special price for quantity. 32 Boards $7.95. P. & P. 90c.

TOP QUALITY HI-FI STEREO OUTFIT PACKAGE DEAL $87.50 p. & p. $4.50

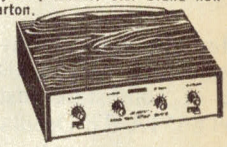
Build your own stereo from these famous brand components and save dollars. All components are brand new and fully guaranteed. Consists of 4-speed fully automatic GARRARD RECORD CHANGER wired for stereo, MIDLAND 12 watt AMPLIFIER and two (2) eight inch hi-fi dual cone PEAK 8 watt speakers, may be purchased seperately as under.



GARRARD RECORD CHANGER

$32.50 — p. and p. $1.50

Quality checked by Garrard, automatic record changer and player wired for stereo. Latest 240V model, just released, takes all size records: 45's, 10" and 12" up to 9 records at a time. 4-speed laboratory series motor, adjustment for pick up height, adjustment for stylus pressure, etc. Brand new in carton.



MIDLAND STEREO AMPLIFIER

$37.50 — p. and p. $1.00

12 watt output stereo amplifier, solid state, famous "Midland" brand new in carton with 3 months guarantee.



PEAK 8" SPEAKERS

$10.95 — p. and p. 60c

Famous 'Peak' 8" hi-fi dual cone speaker, 8 watt, new in carton

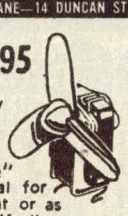
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2 SHOPS BRISBANE—14 DUNCAN ST., VALLEY—36 HELEN ST., VALLEY—PHONE 5 4833—ESTABLISHED 27 YEARS

A.C. FAN $2.95

Post 60c.

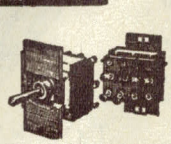
Small but very powerful 240v. mains motor by "VARLEY" England. With 5½" 3 blade fan, ideal for cooling equipment or as extractor fan. Self-aligning bearings, silent but very efficient. Mounts from back or front. Brand new. Motor separate **$2.45.** Post **60c.**





BRAND NEW VOLTMETERS & AMPMETERS

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Magnificent "Cutler Hammer" TOGGLE SWITCHES

Post pack 10c. 4-Pole, 3-way (3 position) panel switches (centre off) luminous tip. Handles 10 amps. at 12 or 24/32 volts DC. Ideal for panels, control boards, 75c.

Co-ordinatograph from Royston

Royston Electronics Pty Limited has announced an addition to their range of electronic circuit production equipment. The Scribemaster Co-ordinatograph, manufactured in Great Britain by Apollo Electronics, is a precision low cost co-ordinatograph which eliminates the need for photography in preparing "masters" for printed circuits, including double-sided and multi-layer boards and thin film, thick film, and silk screen masks.

This precision-made apparatus has a laminated glass working area of 12in by 10in (305 by 254mm), illuminated from underneath.

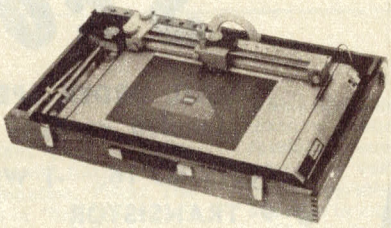
For making printed board masters, tungsten carbide scribing blades are used to remove selected areas of the opaque top layer of a dual layer scribing film by a "shaving" action. For thin and thick film and silk masks, a knife blade cuts outlines in a peeling film and the top layer of this film is then stripped away from the areas enclosed by the outlines.

The base layer of both films is transparent restablished polyester, a material having a dimensional stability several times better than photographic film. Error-correction and modifications are easily effected on both types of film using retouch fluids. The Scribemaster is a high quality instrument able to produce intricate designs with a typical accuracy of ±0.002in (±0.05mm).

The equipment has apparently met with immediate success in Europe and the United States, due to the considerable time-saving which can be obtained with the use of this new technique of master-making.

Special features claimed for the unit are:

- Cuts the cost of prototype and production masters by up to 90%.
- Preserves R & D impetus by avoiding frustrating delays — saves up to a month for each master.
- Allows immediate modification and error-correction — the master can have racks and pads added or deleted in minutes.
- Larger companies can procide over 30 R & D teams with their own independent "in-house" wiring board and mask-making equipment at lower expense than one central facility.
- Small and specialised firms can undertake their own wiring board and mask production at economic cost and with low capital or leasing outlay.
- Research establishments and Universities can develop and test new concepts at low cost and with minimum of delay.
- Technical colleges can demonstrate and give practical training in the techniques of modern industrial electronics, easily and economically.



For further inquiries contact Royston Electronics Pty Limited, 22 Firth Street, Doncaster, Vic 3108, or 17 Burwood Road, Burwood, NSW 2134.

TRADE RELEASES — in brief

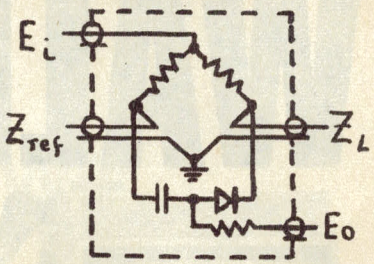
AUSTRALIAN MUSICAL INDUSTRIES PTY LTD, 108 Elizabeth Street, Melbourne, 3000. Agent for Teac Corporation, USA. A range of new hi-fi equipment is now available including: A-110 stereo cassette deck; A-1230 stereo tape deck; A-1250 stereo tape deck; A-4070 bi-directional record and playback tape deck; AG-3000 AM/FM stereo receiver; AG-6000 AM/FM stereo receiver; AG-7000 AM/FM stereo receiver. Full specifications may be obtained from Australian Musical Industries or their agents in all states.

JACOBY, MITCHELL & CO PTY LTD, 469-475 Kent Street, Sydney, 2000. Agent for Kokuya Electric Co, Japan. **Logic tester,** HL series. Enables easy check by two-lamp indication of digital andlogic control circuits, including gates, flip-flops, counters, shift registers, etc. Features separate AND test terminal in addition to standard probe; it also has a gated output for pulse time relation tests. Price is $97 for small quantities.

EMI (AUSTRALIA) LTD, Commercial & Advanced Electronics Division, 14-18 Parramatta Road, Homebush, NSW 2140, has been appointed Australian distributor of high stability vernier-controlled EHT power supplies manufactured by Miles Hi-Volt Ltd, of England. The units are suitable for photomultipliers, and for inclusion in test equipment associated with the manufacture of CRTs or equipment using high-voltage tubes.

IRH INDUSTRIES LTD, The Crescent, Kingsgrove, NSW 2208, has been appointed Australian distributor of products manufactured by the Wallacetown Engineering Co Ltd, of Scotland, including flameproof electrical equipment for mining and industrial applications, as well as specialised industrial switchgear.

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Frequency Range—150KHz-200MHz • Reference Imp.—50/75/300 Ohm (Specify) • Input Power—2 Watt Max. • Det. Output (VTVM)—8 Volts Max. • Sockets—B&L with RF Cable Plugs • Size—2¼ x 2¼ x 2¾ inches.

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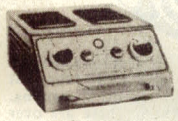
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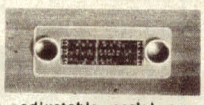
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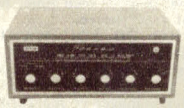
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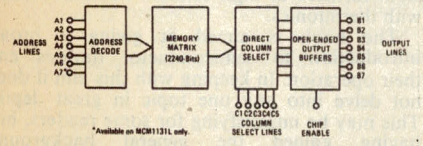
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WARBURTON FRANKI PTY LTD, PO Box 182, Chatswood, NSW 2067. **Printed wiring board layout system,** the DRL Masterplan. The system involves the selection of a number of cutout silhouette shapes of the discrete components specified for a circuit, and arranging them in position to form a convenient layout on one side of a transparent acrylic sheet. This sheet is accurately printed with a grid matrix on both sides and represents the circuit board on a scale of two to one. The silhouettes cling firmly to the sheet by finger pressure, but can be removed and repositioned at will. By turning the sheet over, the component side is visible through the sheet reversed left to right, and the circuit side can be sketched with a wax pencil. Alterations can be made easily and quickly. A sheet of dimensionally stable film is then taped over the circuit side of the film, and the circuit prepared in its final form with tape and adhesive patches, etc.

MOTOROLA SEMICONDUCTOR PRODUCTS, 37-43 Alexander Street, Crows Nest, NSW 2065. **Character generator,** type MCM1131L. This MOS IC generates voltage patterns needed to form numbers, letters and symbols on visual displays such as LED arrays or CRTs. It can be driven by address codes from a computer or other data source. It supplies 2mA output current, eliminating output transistors normally required for interfacing to the display system. The speed is higher than previous units: the maximum access time is only 500nS.



The circuit consists of an address decoder, a read-only memory (ROM) matrix, column select logic, and output buffers. The heart of the generator is a 2240-bit ROM that stores all the different patterns needed for the 64 different characters, each composed of a 5 x 7 bit matrix. A 6-bit address code provides sufficient flexibility to trigger output from any of the 64 different character matrices. The MCM1131L is in a 24-pin package, with seven address inputs, five column select inputs, and a chip-enable input.

A similar unit, the MCM1132L, is housed in a 28-pin package but does not include chip feature A7 which is part of the MCM1131L.

SOUTHERLEY ELECTRONIC ENGINEERING, 34 East Parade, Mount Lawley, WA 6050, has been appointed sole Australian representative for Technical Communications Corp, USA, manufacturer of a range of voice privacy devices or scramblers. Easily connected to either radio or telephone equipment these devices electronically encode voice transmissions with up to 10,000 separate code combinations. They can be operated in either the clear or private mode. The technique used is proprietary: It is not an inverter, a band splitter, or any combination of these systems.

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Consists of 6 amp. triac, diac, switch pot., ferrite rod inductor, 4 res., 2 caps., and circuit.
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RACAL ELECTRONICS PTY LTD, 47 Talavera Road, North Ryde, NSW 2113, has announced that its parent company, Racal Electronics Ltd, UK, has acquired Amplivox Ltd. Amplivox is best know for its activities in the hearing aid field, but also produces microphones, earphones, and amplifiers.

ELECTRONIC EXPORTS, PO Box 72, North Melbourne, Vic 3051. A newly formed wholesale firm, interested primarily in exports. The company is interested in acting as export agent or overseas distributor for any Australian company. Managing director is Mr George Szekely.

BUILDING MINIBIKES

Many readers have requested copies of the second article on Minibikes, which was to have appeared in the September issue of "Modern World". Copies of this story, "Minibikes — How to Build Them", are now available from our Information Service for 50 cents.

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TECHNICAL BOOKS AND PUBLICATIONS

Opto-electronics

INTRODUCTION TO OPTICAL ELECTRONICS, by Amnon Yariv. Published by Holt, Rinehart and Winston Inc, New York 1971. Hard covers, 6½in x 9½in, 342pp, many illustrations. Price in Australia $17.50.

This recent addition to the HRW series in Electrical Engineering, Electronics and Systems is intended as an up-to-date introduction to the area of quantum electronics dealing with the "interaction of optical radiation with various atomic media" — in short, optical electronics. It is intended for senior undergraduate students in physics and electronics, but should also be of interest and value to graduate students, practising designers and research workers seeking a good introduction to this field prior to specialising. The author is Professor of Electrical Engineering at the California Institute of Technology.

The scope of the content material and its logical order of treatment are indicated quite well by the chapter headings: 1— Electromagnetic Theory; 2— The Propagation of Rays and Spherical Waves; 3— Propagation of Gaussian Beams; 4— Optical Resonators; 5— Interaction of Radiation and Atomic Systems; 6— Theory of Laser Oscillation; 7— Some Specific Laser Systems; 8— Second-Harmonic Generation and Parametric Oscillation; 9— The Modulation of Optical Radiation; 10— Noise in Optical Detection and Generation; 11— The Detection of Optical Radiation; 12— The Interaction of Light and Sound; 13— Two Laser Applications. The book ends with a data appendix and a topic index.

The text of the book appears to this reviewer to be particularly well written. The language is clear and concise, and well illustrated by diagrams. Each chapter concludes with a comprehensive reference list.

Incidentally the author deals with most of the basic concepts using the classical formalist approach. He does not seek to lead the reader through quantum mechanics, and only when introducing the concepts of stimulated and spontaneous transitions does he ask the reader to accept on faith statements which can only be supported by quantum mechanics.

A book which may be very warmly recommended to those seeking a thorough introduction to the field of optical electronics pitched at approximately graduation level.

The review copy came from the local office of the publisher, who advises that copies are in stock at all major bookstores. (J.R.)

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Diffusion data

DIFFUSION DATA, edited by F. N. Wohlbier, No 1, 1971. Published by Trans-Tech Publications, Germany. Paper covers, 5¾in x 8¼in, 269pp, many graphic illustrations. Price for one volume (total of four issues) $US38.00.

This is the first issue in a new and revised volume of a reference manual on solid-state diffusion phenomena, first produced by Trans-Tech Publications in 1967. Like the first volume, it is intended to provide a source of up-to-date reference material on the subject, for use by solid-state physicists, research engineers and metallurgists.

The revised volume expands the original concept, being designed to cover in a comprehensive way all new reference information available dealing with atomic transport in crystalline and amorphous solids, and in liquids which are solid at normal temperature and pressure. It deals not only with diffusion but also with ionic conduction, thermotransport, electromigration, permeation, inert gas release kinetics and isotope effects. It also covers transport within the crystal lattice, along grain boundaries or dislocations, on surfaces or along interfaces, and in thin films, and includes mechanical effects, pressure effects, and magnetic field effects.

The first issue provides a good illustration of the thoroughness of the volume. It contains a bibliography of some 38 pages, together with no less than seven separate indices, organised in terms of author, host substance, phenomenological topic, and experimental technique.

In short, a most specialised volume, but one which should be of very great value to those at research level working with atomic transport phenomena in solid materials.

The review copy came direct from the publisher. Subscriptions may be ordered from PO Box 9787, Cleveland, Ohio 44140, USA. (J.R.)

Electronic principles

BASIC PRINCIPLES OF ELECTRONICS, VOLUME 2: SEMICONDUCTORS, by J. Jenkins and W. H. Jarvis. Published by Pergamon Press, Oxford, 1971. Hard cover or flexicover, 5in x 7¾in, 254pp, many circuits and diagrams. Price in Australia $4.50 flexicover, $6.75 hard cover.

This is the second volume of a series written to provide an introduction to electronics for science and engineering students in technical colleges and universities, and for specialising sixth formers at high school. Volume 1 dealt with thermionics.

The book is aimed at giving a broad introduction to semiconductor devices and their operation. In keeping with this aim it does not delve into any one topic in great depth. This may be unsatisfying for some readers, but having gained the general background provided by the book these readers should be able to satisfy their curiosity for further insights by reference to more advanced literature.

The chapter headings give a good idea of the material presented and its order of presentation: 1— Conduction in the Solid State; 2— Conduction and Heat; 3— Semiconductors; 4— Semiconductor Technology and Simple Devices; 5— The P-N Junction; 6— P-N Junction Devices; 7— The Transistor; 8— Transistor Production and Characteristics; 9— The Transistor as a Circuit Element; 10— Common Transistor Circuitry; 11— Special Devices, Processes and Uses. The book ends with seven mathematical and data appendices, and a topic index.

The text of the book is well written, with adequate illustrations to aid the reader in grasping concepts. The overall presentation is a little old-fashioned in its heavy emphasis on the bipolar transistor in comparison with other devices (most other devices being lumped together in Chapter 11, and given very short shrift), but this is perhaps not of great importance in a general introduction.

In short, a book which should be of interest to anyone seeking a readable and not-too-deep introduction to semiconductor devices, particularly the bipolar transistor.

The review copy came from the local office of the publisher, who advises that copies may be ordered via all local bookstores. (J.R.)

Pickups & speakers

PICKUPS AND LOUDSPEAKERS by John Earl. Published 1971 by Fountain Press, London. Hard covers, 203 pages 8½ x 5½ inches.

The full title of this book is "How to Choose and Use Pickups and Amplifiers". It is a companion volume to another by the same Author "How to Choose Tuners and Amplifiers".

As with the earlier volume, the approach in this one is descriptive rather than mathematical, the Author's stated intention being to meet the desire of many enthusiasts to know more about the equipment they own or

want to own. Let it be said that an enthusiast who digested the contents of this book would be well equipped indeed to choose equipment, but he would have done some solid study in the process.

In short, it is a text book to be studied, well written and well illustrated — not a frothy instant guide to making decisions in the hifi showroom.

The chapter headings are: Basic Principles — Pickup Mechanics and Electrics — Using Pickups — Choosing A Pickup — Loudspeaker Units and Systems — Using Loudspeakers — Choosing a Loudspeaker — Turntable Units — Headphone Sets.

The text and illustrations cover most of the aspects of pickup and loudspeaker lore that one encounters in hifi situations and literature and the book can readily be recommended to anyone who wants to better appreciate what it is all about.

Our copy came direct from the publishers. (W.N.W.)

LITERATURE — in brief

TIME AND FREQUENCY: A bibliography of NBS literature published July 1955 to December 1970, by B. E. Blair. National Bureau of Standards Special Publication 350, issued June 1971, 52 pages, price 55c US (plus 25% postage). Lists 232 NBS papers and reports in field of time and frequency within the following five categories: time and frequency standards; time scales, time; distribution and reception of time and frequency signals; statistics of time and frequency analyses, frequency stability; general, summary and status reports. In addition, there is a selected list (94 items) of articles about NBS work by non-NBS authors. Orders should be addressed to the Superintendent of Documents, US Government Printing Office, Washington, DC 20402, USA.

HEWLETT-PACKARD AUST PTY LTD, 22-Weir Street, Glen Iris, Vic 3146, has available copies of application note No 935, "Microwave power generation and amplification with IMPATT diodes". Published by the parent company in the USA, the 32-page note discusses the principles of operation and construction of IMPATT diodes, and describes how they can be designed into oscillator and amplifier circuits. Applications should be on company letterhead.

TELECOMMUNICATION JOURNAL, Vol 38, No 8, August 1971. The monthly review of the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. Contains the following articles: Basic principles of television network planning; Subscriber trunk dialling in Italy today; Some problems of telecommunications training in Africa. Under the heading "Ideas and Achievements" are features on: NASA's manned space flight network; Telecommunications in Japan; Guglielmo Marconi. The section on "Union activities" contains short reports on meetings of: CCITT working parties MAT (automatic telegraph maintenance) and TGX (world-wide telex and gentex routing plan); and CCITT study group XV (transmission systems).

SCHLUMBERGER INSTRUMENTATION AUST PTY LTD, PO Box 138, Kew, Vic 3101, has available copies of the following to inquiries on company letterhead: catalogues of the complete Schlumberger/Weston-Transicoil range of servo motors, oemerators, synchros, resolvers, serve amplifiers, etc; Schlumberger servo engineer's handbook (128 pages); short-form catalogues on the Schlumberger/SIS and Schlumberger/EMR range of telemetry equipment and processing instrumentation.

HEWLETT-PACKARD JOURNAL, Vol 22, No 11, July 1971. Published by the Hewlett-Packard Co, USA. Contents: General-purpose test system gets digital capability; Digital testing versus digital testing; Optical power measurements made easy; Multitudinous applications; Units of optical power. Inquiries to Hewlett-Packard Aust Pty Ltd, 22-26 Weir Street, Glen Iris, Vic 3146.

INVENTUS, Vol 8, Issue 3, September 1971. Journal of the Inventors' Association of Australia Ltd, GPO Box 3400, Sydney, 2001. Contents include: Design registration review; The patent office and the inventor, part 2; Association news; From the sidelines; Of men and inventions.

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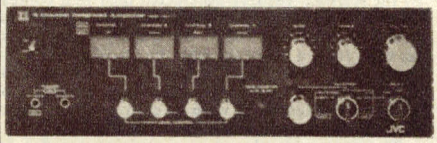
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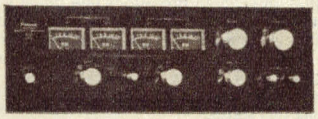
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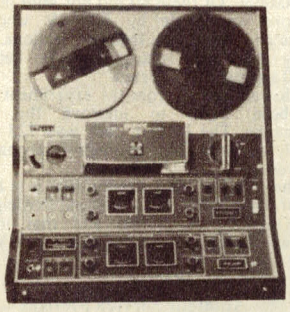
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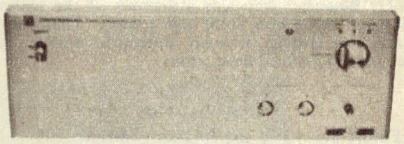
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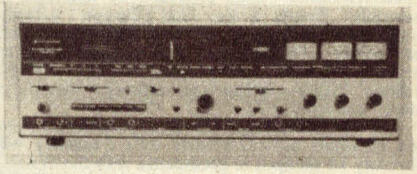
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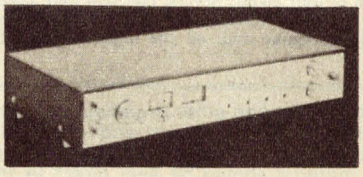
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AMATEUR BAND NEWS AND NOTES

by Pierce Healy, VK2APQ

Amateur Satellite Service approved

At the World Administrative Radio Conference for Space Telecommunications of the International Telecommunication Union held in Geneva during June-July 1971 the Amateur Satellite Service was brought into being.

The Amateur Satellite Service is officially described as — "A service using satellites to carry on a service with the same definition as the Amateur Service." This recognition and defination of an Amateur Satellite Service on an international level by the ITU, is the result of the work of the International Amateur Radio Union team of observers at the WARC on space communication.

The exact technical requirements for the Amateur Satellite Service will be known only after the regulations decided at the conference are studied. It appears that, in general, provisions laid down for the use of satellites will apply to the Amateur Satellite Service. It is understood that the successful operation of the Australis-OSCAR 5 satellite was a contributing factor in the decisions reached. Also that a continuing OSCAR program is essential in maintaining this status.

A number of amateur frequency allocations may be used, including a segment of the 432MHz band, despite initial opposition during the committee stages of the discussions. The Amateur Satellite Service is authorised to operate within the following bands: 7.0MHz-7.1MHz; 14.00MHz-14.25MHz; 21.00MHz-21.45MHz; 28.00MHz-29.70MHz; 144.00MHz-146.00MHz; 435.00MHz-438.00MHz and 24.00GHz-24.05GHz.

The IARU team was lead by Bob Dennison, W0DX, president of the IARU and included John Huntoon, W1RW, secretary IARU; Richard Balwin, W1RU, assistant secretary IARU; Wijnand Dalmijn, PA0DD, treasurer IARU, Region 1 Division; Noel Eaton, VE3CJ, treasurer and Member Executive Committee, Region 2 Division; Tom Clarkson, ZL2AZ, Director, Region 3 Association. Perry Klein, K3JTE, of AMSAT corporation and Roy Stevens, G2BRN, secretary IARU Region 1 who was a member of the United Kingdom delegation, were also present. There were nearly 40 leading amateur operators among the members of national delegations.

Future Activity

Future activity in the Amateur Satellite Service is now centered around the OSCAR VI program which plans to launch a repeater satellite early in 1972. This satellite, sponsored by the Amateur Satellite Corporation in Washington USA, will contain several repeater/translator units produced by amateurs in Australia, United States and Europe. Already prototype units have been tested and found satisfactory. The Australian translator built by Les Jenkins, VK3ZBJ was tested during "HIBAL Balloon" flights at Mildura in north-west Victoria in March and April 1971.

This translator accepts signals on 146.00MHz FM and transmits on 432.50MHz (this frequency will obvously be changed in accordance with the WARC frequency table). It was flown at heights from 70,000 feet to 120,000 feet and recovered undamaged from each of four flights. Several contacts were made via the translator between stations operating in Adelaide and Melbourne and, on the higher altitude flight, stations in Canberra, ACT, and Cootamundra, NSW, were also contacted.

In the United States, the AMSAT Corporation took a different approach to test a two-to-ten metre translator. This unit will accept signals in the band 145.9MHz-146.0MHz and retransmit on 29.45MHz-29.55MHz. On the weekend May 15-16, 1971, World Telecommunication Day, a light aircraft carrying a prototype translator flew over a large section of the north-eastern part of the United States.

In conjunction with the flight, and co-sponsored by the ARRL, AMSAT conducted their first contest. The rules were simple. Two points were gained for two-way contacts through the translator, one point for each station heard through the translator and five points for reporting reception of the beacon transmitter operating from the aircraft on 29.45MHz. Multipliers were given for the number of ARRL sections or divisions heard or worked.

The contest developed as a training exercise for the planned 1972 satellite launch. With an output of less than 0.5 watt the down link signals were weak and CW was the order of the day, particularly over paths of 40 to 50 miles from the aircraft. For relatively short paths SSB worked quite well. A 40 metre net provided information on the location of the aircraft.

One of the aircraft crew, WA4GEY, kept a list of stations heard through the translator and had a tally of 80 stations. Of these 40 did not send in logs. The top score was made by K1HTV who had 10 contacts and heard two, from six sections. Including listening stations, it is estimated that between 200 and 300 stations participated.

Much was learned from the experiment and plans have been made to improve the translator performance. The longest path was 725 miles and probably resulted from sporadic-E propagation on 10 metres.

As the result of these experiments it is hoped that amateurs throughout the world will participate in the 1972 OSCAR VI project and that many long distance contacts will be made on the VHF/UHF bands.

Amateur Service Prefixes

Listening on the DX bands during recent months has been interesting in respect to the comments and discussions on the authenticity of some call sign prefixes. In fact, if time was taken to sort out some of the "pile-ups", it was apparrent that the prefix hunters were having themselves a field day.

Even after having succeeded in working a previously unheard prefix doubt as to whether it can be claimed as a new country or call area remains. In a number of instances the prefix and the suffix have been issued by the local licensing authorities to commemorate a special event and are used for a limited period, very often for only one day.

The September issue of "CQ" magazine listed a number of these prefixes and, with due acknowledgement, they are given here to clarify any doubts.

KA5EE is a rare KA. QSL to W4UC.

KC0KC operated April 1 1971. QSL to Box 753, Shawnee Mission, Kansas 66201.

KD2UMP operated April 1 1971 by Buffalo Amateur Repeater Association. QSL to W2RSJ.

KD4ITU operated May 15-23, 1971 in commemoration of World Wide Telecommunication Day. QSL to W3ZA.

KF4SJ The Puerto Rico Amateur Radio Society station July 1971, to commemorate 450th Anniversary of San Juan. QSL to PO Box 626, Ponce, Puerto Rico 00731.

KQ0NEB From Nebraska State Fair, September 1-9, 1971. QSL to W0YOY.

WD6WD From national convention at Disneyland, September 1-4 1971.

WL2NAS In June 1971, to commemorate 50th anniversary Lakehurst Naval Air Station.

WM8ICH Michigan Week station. QSL to 250 Martin Street, Birmingham, MI 48011., WS0ATA June 26-July 7, 1971. 25th anniversary of the Strategic Air Command. QSL to K0BLT.

WU3SNA Naval Acadamy station on Armed Forces Day. QSL to W3ADO.

WZ6SNI From San Nicolas Island on Armed Forces Day. QSL to WA6WWC.

IM0KH Expedition to Maddelena Island. QSL to 12JQ. ON 6CE 36th General Meeting of the International Electrochemical Convention in Brussels, June 7-19, 1971.

PA9QX August 10-20 was on ON4QX operating from Netherlands with special call sign.

SP0ITU Telecommunications Day prefix. QSL to SP5PEK.

3F1IE and 3F1JC For ITU activity. Operated by HP1IE and HP1JC respectively.

4U3 International Radio Club on Telecommunications Day. QSL to Box 6, Geneva Switzerland.

5T3ITU From Mauritania by 5T5AD. QSL to F8RU.

9L9ITU Special station operated by 9L1RP.

Arabian Knights Certificate

This will probably become a much sought-after award. The certificate is awarded by the Middle East DXing Society to amateur operators who work 10 Arab countries, one of which must be JY1. Contacts must be made after January 1, 1971. Eligible countries by prefix are: CN8; HZ/7Z; JY; MP4B; MP4Q; MP4M; MP4T; OD5; ST2; SU1; 7X; 9K2; YK1; 3V8; 4W1 and VS9.

The Middle East Society members meet on Saturdays at 1800GMT on 14.295MHz to contact interested DXers.

To obtain the award send a list of stations worked, verified by two other amateur operators, together with seven IRC's to King Hussein, JY1, who issues the award.

Diplome De Geneve

As a contribution towards furthering worldwide contact between radio amateurs, and in recognition of the role played by the city of Geneva as an international meeting place, the Geneva section of the Swiss Union of Short-Wave Amateurs, USKA, inaugurated the "Diplome de Geneve". To obtain this award, stations outside Geneva must have contacted, after January 1, 1970, six different stations resident in Geneva and operating fixed, mobile or portable from Geneva.

Amateur radio operators may obtain the "Diplome de Geneve" by making application to — USKA, Section de Geneve, PO Box 524, CH1211 Geneva 3. Applications must be accompanied by a log extract with date, GMT, station callsign, mode, band, reports both ways, and first name of Geneva operator. QSL cards need not be sent. Contest QSOs not acceptable. The cost is seven IRCs. Short-wave listeners, send log extract as above, plus callsign of station worked by Geneva amateur. The award is free to blind or invalid amateurs.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, NSW 2200.

Amateur Radio Training

In recent months opinions have been expressed on the standards of proficiency that should satisfy the Amateur Service licensing authority in Australia. But how many have stopped to consider how far reaching amateur operator's training really is?

It will be recalled that 1970 was United Nations "Education Year" and that the theme for the ITU Telecommunications Day was designed "Telecommunications and Education". It was therefore fitting that the theme for the International Amateur Radio Club convention, held in Geneva late 1970, was "The Radio Amateur and Education".

At the Convention papers describing amateur radio training were presented by delegates from several countries. Each described in some detail training programs in their particular country. The papers, and some of the addresses, were published in the International Amateur Radio Club — Newsletter No 15.

In view of the interest and discussion concerning the current novice licence proposals, we present condensations of these papers.

In his introductory remarks at the opening of the convention, Dr M. Joachim, OK1WI, Vice-president of the IARC, made these observations.

". . . . . the education of radio amateurs represents a good example of the concept that, in modern education, practical work should be interleaved with theoretical studies.

"On the theoretical side of the radio amateur's education can be found the study of electronics, geography, elements of international law and operational techniques. On the practical side; electronic circuit assembly, with multiple mechanical tasks, including measurements, building antennas, towers, the practical operations of transmitters and receivers, etc.

"From this combination of all kinds of theoretical and practical knowledge, together with much patience and a deepening of understanding between peoples of different nations, the relatively rare specimen of 'homo sapiens' is formed — the amateur radio operator".

German Democratic Republic.

Herbert Gotze, DM2HGO, president of the Radio Club of the GDR gave details of amateur radio training in the German Democratic Republic. The present regulations came into force in 1965 and were worked out, in co-operation with experienced radio amateurs, by the Ministry for Post and Telecommunications. The regulations are considered to be very liberal and progressive.

A radio amateur licence is available to citizens from the age of 14 years. There are four classes of licence. Class 2 is for newcomers. It requires the ability to send and receive Morse code at 40 letters per minute, plus a relatively simple knowledge of radio technology. Operation is permitted on the 80 and 20 metre bands, with a maximum antenna input of 20 watts.

A holder who has operated under a class 2 licence for one year may apply for a class 1 permit. This allows operation on all bands with a maximum input of 300 watts. The third (technical) licence is for VHF and no code ability is required.

The fourth type is for those who wish to use only RTTY. No code ability is required, only proof of competence in operating a teleprinter.

The Radio Club of the GDR has worked out a comprehensive program of training, both theoretical and practical. Training schedules in the clubs are based on this program. There are more than 600 clubs. The future radio amateur passes a qualification stage as a receiving amateur. This is held in the club before an examining committee of licensed radio amateurs. A knowledge of code is not required.

In his advanced training, the "receiving amateur" qualifies in the club station or in the central courses of the radio club, as a transmitting amateur. This is so experience and knowledge may be gained under the direction of experienced amateur operators.

There are a large number of publications available for the trainee and the radio club of the GDR issues special instructions for amateur construction activities.

Yugoslavia

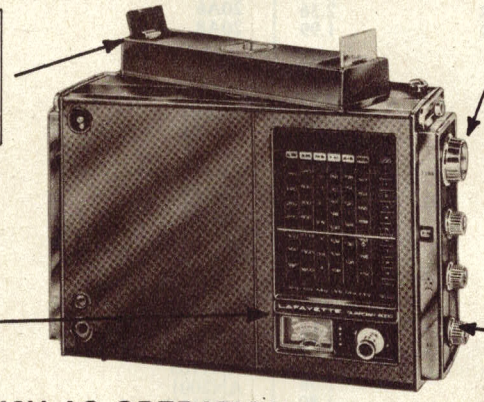
The Union of Radio Amateurs of Yugoslavie (Savez radioamatera Jugoslavija — SRJ) is one of the youngest national organisations of radio amateurs in Europe. It celebrates the twenty-fifth anniversary of its foundation in 1971 and of its membership of 42,000 there are 10,000 licensed radio operators.

The basic organisational unit of the SRJ is the radio club. There are 415 radio clubs and 348

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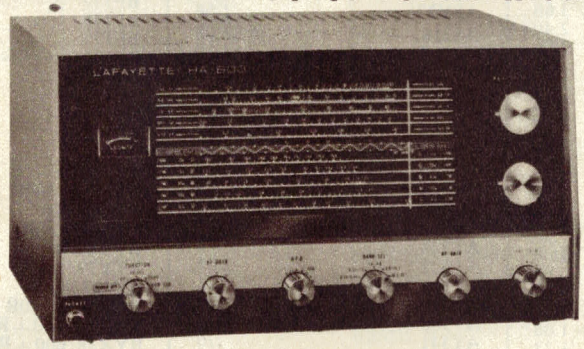
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WILLIS TRADING CO., 445 Murray Street, Perth, W.A.
McCOY'S RADIO & MUSIC CENTRE, 379 Invermay Road, Mowbray, Launceston, Tas.

TRADE REPRESENTATIVES

S.A.: Tyquin Distributors Pty. Ltd., 13 Deacon Ave., Richmond — Phone 57 8153.
W.A.: Athol M. Hill Pty. Ltd., 613-615 Wellington St., Perth — Phone 21 7861.

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2N174	6.09
2N217	1.24
2N277	2.32
2N301	2.66
2N301A	3.84
2N384	2.88
2N404	.78
2N406	1.01
2N417	1.77
2N441	1.80
2N443	3.22
2N456A	4.20
2N489B	14.76
2N591	2.20
2N649	2.12
2N696	1.13
2N697	1.17
2N706A	1.08
2N930	1.80
2N1038	3.92
2N1046	17.94
2N1073B	7.59
2N1302	1.01
2N1303	1.01
2N1305	1.13
2N1306	1.32
2N1307	1.32
2N1308	1.64
2N1309	1.64
2N1546	5.85
2N1639	1.20
2N1908	27.74
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2N2148	3.60
2N2160	2.40
2N2188	2.79
2N2270	2.40
2N2646	2.19
2N2669	6.53
2N2996	3.15
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2N3053	2.48
2N3054	2.63
2N3055	2.63
2N3525	3.70
2N3563	.90
2N3564	1.08
2N3565	.86
2N3566	1.01
2N3567	1.08
2N3568	1.08
2N3569	1.23
2N3638	.90
2N3638A	1.13
2N3641	1.13
2N3642	1.26
2N3643	1.26
2N3644	1.13
2N3645	1.44
2N3646	.90
2N3691	.86
2N3692	.90
2N3693	.86
2N3694	.90
2N3702	1.01
2N3703	.96
2N3704	1.77
2N3705	1.73
2N3706	1.65
2N3707	1.14
2N3708	.80
2N3731	3.17
2N3819	1.77
2N3826	1.68
2N4121	1.04
2N4250	1.17
2N4354	1.28
2N4355	1.65
2N4356	1.65
2N4360	1.58
2SB186	1.50
2SB407	3.30
2SB474	3.30
3N140	2.55
3N141	2.34
20A2	.78
20A4	.92
20A6	1.04
20A8	1.22
AA119	.36
AB1101	1.20
AB1102	.87
AC107	2.28
AC125	.96
AC126	.96
AC187/188	2.36
AC128	1.05
AC132	1.01
AC172	1.20
AC187188	2.36
AD149	2.45
AD161/162	4.32
AN1102	.68
AN1103	.60
AN1104	.60
AN1105	.60
AN2001	.45
AN7102	.90
AN7105	.68
AS147	.80
AS148	.76
AS208	1.46
AS301	.81
AS306	.84
AS307	.84
AS308	.84
AS310	.99
AS311	.96
AS312	.93
AS313	.92
ASY73	2.12
ASY76	2.10
ASY77	1.68
AS216	3.03
AS217	2.59
AS218	2.91
AS220	.98
AS221	2.16
AT316	.68
AT318	.68
AT319	.69
AT321	.69
AT322	.63
AT323	.68
AT324	.68
AT325	.83
AT331	.92
AT337	.69
AT338	.70
AT341	.70
AT350	1.14
AT1138	2.66
AX1101	1.53
AX1103	1.70
AX1104	1.86
AX1108	1.86
AX1127	1.50
AX1130	1.50
AX1131	1.77
AX1132	1.50
AX1142	1.20
AX1143	1.58
AX1144	1.44
AX1166	1.37
AX6168	1.98
AY1101	.68
AY1102	1.04
AY1103	1.35
AY1104	1.35
AY1108	1.65
AY1110	1.50
AY1112	.69
AY1113	.69
AY1115	.60
AY1116	.68
AY1117	.68
AY1119	.60
AY1120	.98
AY1121	.98
AY6108	1.65
AY6109	1.65
AY8108(8103)	3.75
AY8109(8104)	3.00
AY8110	6.22
AY8111	6.75
AY8112	6.75
AY8135	5.40
BA100	.44
BA102	1.46
BA114	.39
BC107	.83
BC108	.76
BC109	.91
BC147	.76
BC148	.68
BC149	.79
BC157	.89
BC158	.76
BC159	.89
BC177	.91
BC178	.84
BC179	.92
BC186	.79
BC207	.72
BC208	.63
BC209	.75
BCY10	2.59
BCY11	3.24
BCY12	3.14
BCY39	5.19
BCY71	2.05
BCZ210	1.95
BCZ211	2.37
BCZ212	2.16
BDY20	2.63
BDY38*	2.62
BF115	.87
BF145	.64
BF173	1.14
BF177	1.63
BF178	1.80
BF179	2.04
BF184	.72
BF185	.72
BF194	.67
BF200	1.32
BFY51	5.19
BSX19	2.16
BSX20	2.39
BT100A/500R	3.00
BT101/500	5.40
BTY79/100R	2.70
BTY79/300R	3.45
BTY79/500R	5.19
BY127/800	.78
BYX21L/200R	1.35
BYX38/300+R	1.32
BYX38/600+R	1.62
BYX38/900+R	2.08
BYX38/1200+R	3.03
BYX39/600+R	3.14
BYX39/800+R	3.88
BYX39/1000+R	4.53
B2X70Scvies	1.95
B2Y88C303toC11	.83
B2Y88C12toC30	.98
BZY95 Scvies	2.16
BZY96 Scvies	2.16
BZZ15to29	2.37
C20D*	6.60
C106/Y1	2.10
C122D	3.78
D13TI	1.95
DTG110B	6.96
DTG1010	15.16
EM402	.45
EM404	.63
EM408	.80
EM410	1.40
FPT100	1.80
H35	8.07
MB1	2.03
MB3	2.65
MB6	3.40
MB8	4.30
MJE2955	4.55
MJE3055	3.06
OA5	0.65
OA10	0.87
OA47	0.65
OA90	0.32
OA91	0.33
OA95	0.39
OA202	0.75
OC20	6.38
OC22	3.03
OC23	3.80
OC24	3.45
OC44N	1.11
OC45N	1.11
OC74N	0.96
20C74N	1.92
OC140	1.95
OC141	2.60
OC201	3.80
OC202	3.70
OCP70	2.60
OCP71	4.32
ORP12	0.95
ORP60	1.75
PA40	4.83
PB40	7.26
SC45D	11.10
SC50D	13.00
SE1001	1.13
SE1002	1.20
SE1010	1.80
SE2001	0.98
SE2002	1.20
SE3001	1.12
SE4001	1.05
SE4002	1.13
SE4010	1.20
SE5001	2.10
SE5002	2.10
SE5003	2.48
SE5020	4.05
SE5023	3.15
SE5025	1.35
ST2	1.50
T1/40/A2	3.30
T13027	2.61
TIC44	1.68
TIC45	1.88
TIC46	2.05
TIC47	2.30
TIP31A	2.10
TIP32A	2.70
TIP33A	2.98
TIS34	2.46
TIS43	2.36
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40361	2.70
40407	2.52
40408	2.98
40409	3.15
40410	3.30
40411	9.70
40669	3.50
FETS	
2N4889	2.70
2N5245	2.62
2N5458	1.77
2N5459	1.77
2N5485	1.77
MPF102	1.75
I.C.'S.	
FUL709	2.25
FUL723	4.50
FUL739	5.20
FUL900	1.20
FUL914	1.20
FUL923	2.25
LM370	6.75
LM372	5.62
MC1303	5.20
PA246	13.60
TAA300	4.32
TAA840	5.30

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AY1001 pkts 10	4.25
SE1001 pkts 10	7.50
2N3693 pkts 10	5.70
EM404	0.22
TT4010	0.40
2N3055	1.58

branch clubs in Yugoslavia. These are organised into amateur radio unions of the six Federal Republics and two provinces. All the clubs, unions of radio amateurs and the SRJ are headed by committees elected by members. There are no local, republic or federal state authorities in these committees.

Every licensed amateur radio operator must by law be a member of a Jugoslavia Radio club.

The basic method of education are evening courses in electronics, radio techniques, Morse code, etc. These are organised by radio clubs or their branches, public schools, universities, factories or other institutions where sufficient candidates can be found to justify the preparation of such a course.

The SRJ sets down a certain minimum knowledge required to become a radio amateur.

Under Yugoslav law, the SRJ has the right and duty to form examination boards, the members of which are Class I or II operators. All operators using YU or YT call signs are the exclusive products of the education acquired in SRJ radio clubs.

In addition, there are also special seminaries and courses to enable individuals to qualify as lecturers at evening courses in radio clubs. These seminaries, lasting from 10-20 days, are usually organised in summer camps by the unions of radio amateurs, during vacation periods. In addition to theoretical lecturers, participants quite often build instruments, converters, antennas, etc, to improve the equipment they already possess. Seminaries are also held for other aspects of amateur radio such as VHF and UHF work by meteor scatter, moonbounce, etc.

All the work by the lecturers at evening courses, seminaries and other forms of education of radio amateurs in Yugoslavia, is on a voluntary basis.

These extracts were taken from a paper presented by A. Stipanic, YU3BH, secretary of the SRJ.

Poland

Education of radio amateurs in Poland is by the Polish Amateur Radio Society, PZK, in close co-operation with the Polish PTT (telephone and telegraph) Administration. This co-operation is based on the fact that the field of amateur radio is one of the best training schools for highly qualified radio and telecommunication specialists. And what is also important — this specialised training is provided by the amateurs themselves, without any expensive buildings, equipment or teachers.

The educational program of the PZK is also carried out in co-operation with two other youth organisations, the Polish Boy Scouts and the League of Home Defence. This is orientated in three directions:

1 The propagation of the basic principles of amateur radio among a wide section of the public.

2 The technical and general education of newcomers, both short-wave listeners and novices.

3 The specialised training of experienced amateurs.

The first of these is administered by the Public Relations Commission of the PZK headquarters council, directed by the vice-president, SP5JE, who is Director of the Technical Training Department in the Polish PTT Ministry. The methods used include amateur radio programs on broadcasts and television together with articles in newspapers and magazines. Also PZK's own publications such as — 'How to become a Radio Amateur' and 'Amateur Radio'.

The second part is supervised by the Headquarters Commission for Amateur Education, managed by PZK vice-president SP5JH, who is also Chief of communications in the Boy Scouts Headquarters.

The specialised training of experienced amateurs is provided by two PZK specialists clubs: the SP-DX Club and the SP-VHF Club, with the co-operation of the PZK Technical Commission, presided over by Vice-president SP5BM, and Sports Commission presided over by vice-president SP5SM. Both clubs organise conventions each year, with technical lectures, exhibitions of equipment and motion pictures on the programs.

The training programs of the PZK are officially accepted by the Polish PTT Ministry and are co-ordinated with the official requirements for amateur radio examinations. Some of the successes as the result of the education program stated in the paper presented by K. Slomceynski, SP5HS, secretary of the PZK, are:

— the rapid growth of interest and knowledge about amateur radio among the general public.

— the increase in the number of active radio amateurs; from 1,000 in 1965 to 6,000 PZK members in 1970, 3,000 of which are licensed transmitting amateurs.

— the financial support given to the educational programs by the Polish Government for the purchase of equipment for club laboratories.

TECHNICAL ARTICLES OF INTEREST

CQ magazine September 1971:

Five articles on antennas from 160 meters to 10 meters.

WIA ACTIVITIES

The Federal Awards manager of the Wireless Institute of Australia, Geoff Wilson, VK3AMK, has issued a reminder that anyone wishing to apply for the Cook Bi-Centenary Award must have their application in by December 31, 1971. After that date applications will not be accepted. At the beginning of September the awards issued totalled 1,380.

NEW SOUTH WALES

Illawarra Branch

The publicity officer of the Illawarra Branch of the NSW Division, WIA, Barry Hartley, VK2FE, submits the following information.

General Meetings are held every second Monday of the month at 7.30 pm, in the committee room of the Wollongong Town Hall. Visitors are welcome.

Regular activities include a monthly "Fox Hunt", commencing at 1.30 pm from the Wollongong Lighthouse, on the Sunday after the general meeting. This event carries a perpetual trophy donated by Basil Dale, VK2AW. It is held on 53.982MHz AM. Local interest in amateur TV and UHF has grown considerably in recent weeks. Several 432MHz converters have been constructed and others are being constructed. Barry Lacey, VK2ZYL, has transmitted pictures with good defination and is currently working in conjunction with Graeme Dowse, VK2AGV.

The Channel 1 repeater, a modified Plessey commercial repeater unit, is now complete and awaits PMG approval for manned tests. It is hoped that a site will be obtained on the Southern Highlands near Robertson to enable a good take off towards Canberra, ACT.

At the time these notes were being prepared, Branch members were making preparations to participate in the annual Models and Hobbies Exhibition to be held early in October.

The aim was to provide working and static displays of amateur equipment working on all frequencies 148MHz and below. Amateur television was to be included in the display.

VICTORIA

Geelong Amateur Radio-TV Club

A scrap metal drive is the novel way that members have chosen to swell the fund for a SSB tranceiver for the club. Good progress is reported and the scrap bins are provided for all who wish to contribute.

The annual dinner held in August at the Silver Horse-shoe Reception Rooms, Queenscliff Road, Moolap was a great success. All who attended enjoyed themselves.

The AOCP course commenced in October and is held each Friday night commencing at 7.00 pm. This course is designed to bring prospective candidates up to the standard required in time for the February 1972 exam.

The committee for 1971-72 are:

President	Alan Bradley	VK3LW
Vice-president	Mike Trickett	VK3ASQ
Secretary	Bob Wookey	VK3IC
Treasurer	Murray Farrell	VK3YEU
PR Officer	Colin Lowne	VK3ZZS
Technical Officer	Terry Leith	VK3ZXY
Property Officer	Darvl St John	VK3AQR

The GARC Newsletter is published monthly, subscription is $1.20 per year postage paid.

All details of the club's activities may be obtained by writing to — Geelong Amateur Radio-TV Club, PO Box 520, Geelong, Victoria 3220.

WESTERN AUSTRALIA

Members of the Ockley Radio Club entertained a number of fellow amateur operators who motored from Perth, Albany, Kalgoorlie and Bridgetown it the Dryandra State Forest, 20 miles north of Narrogin, at a field day which members hope will become an annual event.

Following a "Novelty Drive" over a distance of 19½ miles a barbeque was held at a lookout tower a further seven miles into the forest. Much to the

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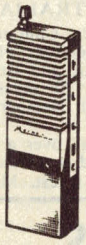
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Melbourne, Vic. 3000. 'Phones: 67 7329, 67 4286

4-WAY ALARM SYSTEM KIT Science Fair Catalog No. 28-240 / 7
An easy-to-build transistor controlled relay kit that activates by touch, water, light — or a door switch.
PRICE: $7.50. Postage 40 cents.

2-SET TELEPHONE / TELEGRAPH KIT Science Fair Catalog No. 28-242 / 7
Build your own 2-WAY COMMUNICATIONS SYSTEM
PRICE: $12.50. Postage 40 cents.

AM TUNER / AMPLIFIER KIT Science Fair Catalog No. 28-241 / 7
Build your own AM Tuner and Amplifier with Speaker — 2 separate chassis — all solid state — safe, battery operation — no soldering — no high voltage.
PRICE: $12.60. Postage 40 cents.

IC-20-in-1 ELECTRONIC PROJECT KIT Science Land
Builds radios — amplifiers — code oscillators — complete with solar battery — IC unit — speaker and Morse key.
PRICE: $11.50. Postage 40 cents.



SCOOP PURCHASE

1 WATT TRANSCEIVER, 13 TRANSISTOR, 3 CHANNEL and Call System. Specifications: Circuit: 13 Transistors, 1 Diode, 1 Thermistor. Range: Up to 10 miles (depending on terrain, etc.). Frequency: 27.240 MHz (PMG approved) Freq. Stability: Plus or minus 0.005%. Transmitter: Crystal controlled, 1 watt. Receiver: Superheterodyne, crystal controlled. Antenna: 13 Section Telescopic. Power Source: 8 UM3 1.5 volt pen batts. Size 8¼in. x 3¼in. x 1¾in. Weight: 25 ozs. Other features: Leather carrying case, battery level meter, squelch control, earphone jack, A.C. adaptor jack, etc.
Price $75 A PAIR. Single units available, $37.50 each. Be early!

CRYSTAL RADIO KIT NEW

Model 28-207. Tunes AM.B / casts complete with all ass. Price $4.50. Postage 30c.
NEW C / X. CABLE ½" DIAM. 50 ohms. **95c yd.**
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TWO CORE & SHIELDED CABLE. NEW **30c** yd.
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T / V RIBBON 7c YD. 300 OHM.

GENERAL COVERAGE COMMUNICATION RECEIVERS



"REALISTIC" DX150. Solid state (as reviewed in Electronics Today product test page 61, June'71 issue) 4 bands covering 535 kcs to 30 mcs fully transistorised SW / CW / SSB / AM broadcast 240V A.C. or 12V D.C. operation. Product detector for SSB / CW plus fast and slow AVC — variable pitch BFO — illuminated electrical bandspread, fully calibrated for amateur bands, Cascode R.F. stage — ANL for R.F. and A.F. — Zener stabilised — OTL audio — illuminated "S" meter — built-in monitor speaker. Price **$234.20.**
Matching speaker 8 OHM for use with "Realistic" DX150. Price **$13.60.**
"TRIO" 9R59DS. (General coverage.) 4 bands covering 540 kcs, valve type, to 30 mcs. Two mechanical filters ensure maximum selectivity. Product detector for SSB reception. Large tuning and bandspread dials for accurate tuning. Automatic noise limiter. Calibrated electrical bandspread. "S" meter and B.F.O. 2 microvolts sensitivity for 10 db S / N ratio. Price **$178.50.**
SP5D. Matching 8 OHM speaker unit for use with Trio Equipment. Price **$15.30.**
LAFAYETTE HA-600, five-band, bandspread tuning, solid state SSB-AM-CW. **$199.50.**
LAFAYETTE HA-800, solid state, as above but Ham Band Only, SSB-AM-CW. **$195.00.**

10 / 1 ELECTRONIC CONSTRUCTION KIT

Complete with all parts to build radios, amplifiers, etc. 10 Easy projects. PRICE: **$9.00**

BROADCAST BAND TUNER

Locally made, Model 401 uses a shielded 3-stage I.F. Module with a single transistor mixer-osc. An AGC voltage is developed and applied to the 1st I.F. stage. High sensitivity is obtained with a ferrite rod, 8-in. long, ⅜-in. diam. Sensitivity 150 uV; bandwidth: 8 KHz; supply voltage: 9V; supply current: 5 mA; audio output voltage: 0.5-1.0V; load impedance: not less than 47K. Complete in plastic box with dial. Ready to plug in. Price **$25.00 nett.**

SOLID STATE STEREO AMPLIFIER

8 watts RMS per channel. Input for magnetic, crystal and ceramic type microphone. P.V. cartridges, tape recorder input and output, tuner input, stereo headphone jack. Reduced to **$55.00.** Postage **$1.20.**

surprise of those who knew the area, no one got lost on the way.

After lunch visitors inspected an old Aboriginal ochre mine and the habitat of some of the wildlife in the area. Quite a number of contacts were made during the day on the 7.0MHz, 52.0MHz and 144.0MHz bands, the lookout tower being used to support the antennas.

To end the activities discussion took place on WIA affairs and local matters. All who attended voted the day an enjoyable one.

VHF Group News

The Annual General Meeting of the VK6 VHF Group was held in July. The officers elected for the coming 12 months are:—

Patron	Mr F. W. Dawson	
President	Neville Chamberlain	
Vice-president	Kevin Bicknell	VK6AB
Secretary	Tom Berg	VK6ZAF
Treasurer	Milton Harris	VK6ZGV
Committee members		
Stan Stewart	VK6SS	
Bruce Varley	VK6BV	
Bruce Weir-Smith	VK6ZBZ	
Bulletin Editor	Jack Sullivan	VK6ZFO
Technical Editor	Tom Berg	VK6ZAF
Program Director	Wally Howse	VK6ZAA
Press Officer	J. Leigh Harrison	VK6ZJH
Beacon Officer	Kevin Bicknell	VK6AB
QSL Officer	Colin Murray	
Record Keeper	Rolo Everingham	VK6BO
Activities Officer	Igor Iskra	VK6ZFG

The VHF Group meets on the fourth Monday of each month in the DCA Workshop Canteen, 86 Guildford Road, Maylands, at 8.00 pm. Visitors are welcome.
Subscriptions: $4.00 payable July 1st each year. VHF Beacons operate on 52.006MHz and 145.00MHz callsign VK6VK, mode CW.

WIA YOUTH RADIO SCHEME

Maitland Radio Club

Two VHF transmitters have been made available to the Maitland Radio Club by the NSW Division of the WIA. These will operate on 52.525MHz and 146.00MHz FM, and will replace the lower powered units used at present. They will be installed in a special transmitter building and will be remotely controlled from the club's communication room.

At the invitation of the Morpeth Parents and Citizens Association the Maitland Radio Club gave a demonstration of amateur radio at the gathering attending the opening of the new Waddy wing at the Morpeth Public School. Parents and visitors were permitted to speak over the air with club members at the club headquarters in Maize Street, Tenambit, East Matiland. During the afternoon contacts were made with interstate stations.

Westlakes Radio Club

Membership of the Westlakes Radio Club includes 51 licensed amateurs, among them being JA3API and Z11BKO. It is anticipated that this number will be increased when the results of the August AOCP examination are released.

The club operates a free QSL service both inwards and outwards for members of the club. Cards from members should be addressed to QSL Bureau, Westlakes Radio Club PO Box 1, Teralba, NSW 2284.

A suggestion is being considered that a short-wave listener's group be inaugurated. Those interested are invited to write to the secretary or contact the Junior Members representative, Arthur Day, VK2BBI for further information.

St George Amateur Radio Society

The St George Amateur Radio Society hold a get-together each Tuesday night at 8.30 pm EST on 14.10MHz and meet at the School of Arts, Short Street, Carlton on the first Wednesday of each month. The society's education officer, Noel Ericsson, VK2MF, has produced a "White Paper" setting out various aspects of novice licensing. This paper is to assist members to become familiar with the subject prior to a debate planned to be held in the near future. Plans are being finalised for a social gathering of members and their wives and families to be held at National Park. The date will be announced when arrangements have been completed.

This club has established its own YRCS training annex at 17 McIntyre Avenue, Brighton-Le-Sands. Classes are held every Tuesday night.

At present there are eight students studying under

the visual/aural guidance method conducted by Noel Ericsson, VK2MF. Vacancies exist for high school students wishing to improve their knowledge in radio and electronics. Telephone 59 1658 for full details.

Details of club activities may be obtained from Alf Cutting, VK2AAC, telephone 587 0406.

Taree OK Radio Club

The keenness of a member of the Taree OK Radio Club, recently gained some excellent publicity for the club and the hobby of amateur radio. A letter written by Terry Pearce on the hobby of "radio" resulted in club members being interviewed by Barry Hibbard, ABC Regional Manager at Kempsey. The interview was included in the "Young World" program, relayed over the national network on September 30, 1971.

The lads interviewed were, Paul Kidd, Peter Langdown, and Robert Worthington. Robert, who passed the Amateur Operators Limited Certificate of Proficiency before he was 15 years old, now has the call sign VK2ZVI. The program also included an on-air contact between the club station, VK2BRC, and Kevin Collins, VK2ANY, in Sydney.

The supervisor of the Taree Radio Club, Geoff Hunziker, VK2BGF, at present has 15 very keen members attending the YRCS classes. So far, the club has helped three of its members to obtain their amateur operators licence, including a father and son. Another member, Bill Collinson, has received notification of his success at the exam and is awaiting the issue of his call sign.

Details of the activities of the Taree Radio Club may be obtained from Geoff Hunziker, VK2BGF, 26 Chatham Avenue, Taree, 2430.

Quarter Century Wireless Association

The annual meeting of the Sydney Chapter of the Quarter Century Wireless Association was held in conjunction with the monthly get-together on the second Wednesday of the month, September 8, 1971.

The retiring committee were re-elected for a further term of office. They are: President, Harry Caldecott VK2DA; Secretary, Pierce Healy VK2APQ; Treasurer, Brian Anderson VK2AND.

As usual business was kept to an absolute minimum, and those present were entertained with an excellent selection of colour slides by Eric Collier, VK2BEL. The slides were of mainland China, taken by Eric during a business trip to that country a few years ago. These were supplemented by a number he had taken in other parts of the world ranging from the ice wastes of the north coast of Alaska to the tropic highlands of New Guinea.

Membership of the QCWA is open to amateur radio operators who have been licensed for 25 years or more. Details can be obtained from any of the committee members.

WESTERN AUSTRALIA

Club activity in Western Australia is at a high level in all clubs. The Ockley Radio Club YRCS section have a number of members at the Elementary examination level. While at the Aquinas club several boys have reached the Senior standard.

The Wesley College younger members are busy building many types of crystal sets, transistor amplifiers and telephones.

At the Rossmoyne High School Radio Club a PYE transceiver, and an antenna on top of a 45-foot tower, enables members to have interesting contacts on 52.6MHz.

Two members of the Southern Electronics Group Youth Radio Club have gained positions in the electronics industry. Good progress is also reported among the other members.

Photographs for Reproduction

As indicated in the footnote to these notes photographs submitted will be published when possible. However, several inquiries have been received regarding technical and artistic aspects that should be taken into consideration when submitting such photographs. Having a very limited knowledge of the finer techniques myself, the opinion of an experienced illustrator was sought. Here are points that were suggested should be kept in mind when taking a photo for reproduction. No doubt experienced photographers are already aware of them.

Technical:

1. Avoid the use of colour film if possible. Black and white prints can be made from it but this involves extra processes. In addition, the definition is invariably degraded compared with that from black and white emulsions.

2. A 35mm camera can produce perfectly satisfactory pictures if it is a good one properly handled. If in doubt, try to use a larger format, such as 2¼in square.

3. The ideal print is reasonably large, say 6in x 8in or larger, glossy and on single weight paper. It should be correctly exposed, fully developed and have good contrast. If in doubt, submit the negative with the best possible print, so that a new print can be made.

Artistic:

1. Do not crowd too much information into one picture. Remember that the space it will occury will be small and that there will inevitably be losses in reproduction. The picture should not depend on fine detail to tell its story.

2. Try to eliminate from the picture anything which is not needed to tell the story.

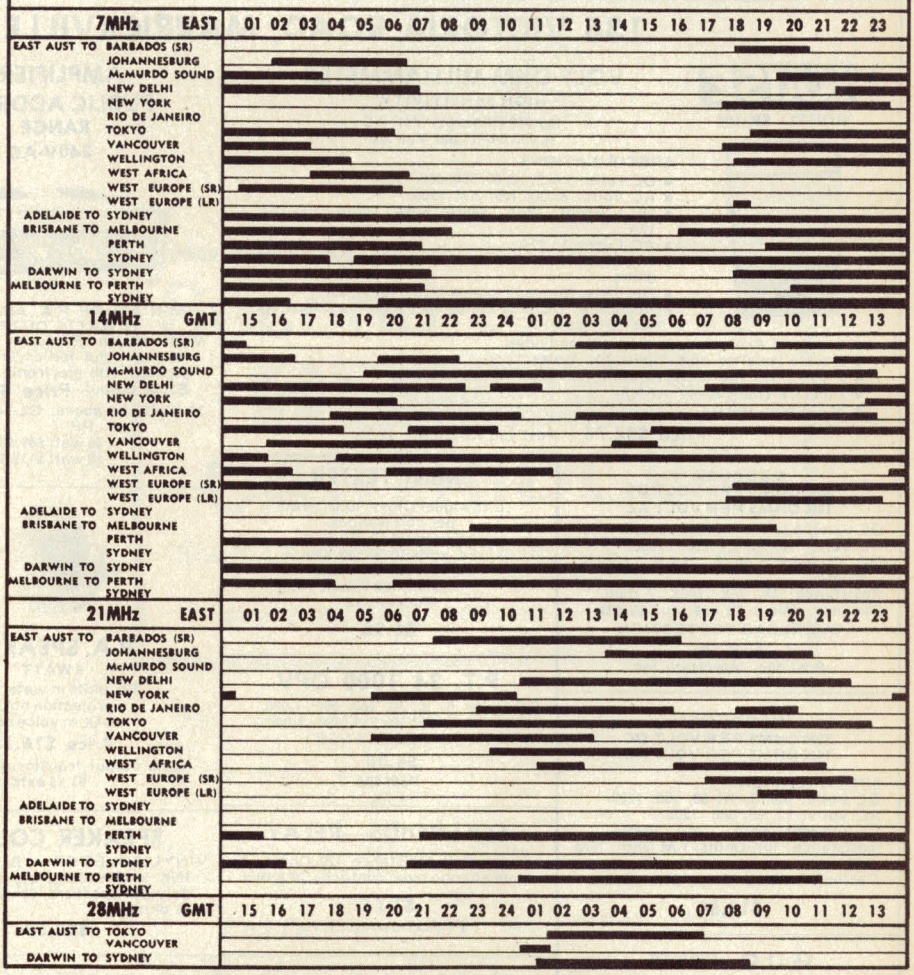
3. Give your models an opportunity to "tidy up" before pressing the shutter; to brush their hair, replace a discarded tie, or don a coat, if these are appropiate.

4. Watch for distracting backgrounds. Where appropiate close doors or draw curtains. Out of doors avoid paling fences, weatherboard walls, and out-houses.

5. Remember that everything which needs to be done to make a good picture must be done before the shutter is fired. It is too late afterwards.

IONOSPHERIC PREDICTIONS FOR NOVEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). They have been prepared for the four most popular amateur bands over a number of interstate and international circuits. Black bands indicate periods when circuit is open. 11/71



SO YOU WANT TO BE A RADIO AMATEUR?

To achieve this aim, why not undertake one of the Courses conducted by the Wireless Institute of Australia? Established in 1910 to further the interests of Amateur Radio, the Institute is well qualified to assist you to your goal

Personal classes for 1972 will commence on February 24th, 1972. Applications, which are accepted in order of priority, are now being received. Correspondence courses are available at any time.

For further information write to:

THE COURSE SUPERVISOR, W.I.A.,
14 ATCHISON STREET,
CROWS NEST, N.S.W. 2065.

A.C.E. RADIO

AMPLIFICATION · COMMUNICATION · ELECTRONICS

★★★★★★★★★★★★★★★★★★★★

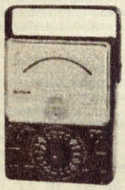
PHONE 51-3845
51-7008

136 VICTORIA RD., MARRICKVILLE NSW 2204

WEEKENDS & AFTER HOURS 40-5391

136 VICTORIA ROAD, MARRICKVILLE — 51-3845

KAISE
MODEL SK-100



VOLT-OHM-MILLIAMMETER
HIGH SENSITIVITY
100,000 Ohms per Volt DC
10,000 Ohms per Volt AC

SPECIFICATIONS:
- DC Volts: 0.6, 3, 12, 60, 300, 600, 1200.
- AC Volts: 6, 30, 120, 300, 1200.
- DC Current: 12uA, 300uA, 6mA, 60mA, 600 mA, 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 3pc, AC plus minus 4pc (of full scale).
- Overload Protected by dual silicondiodes.
- Double-jewelled plus minus 2pc Meter.
- Plus minus 1pc temperature-stabilised film resistors.
- Polarity changeover switch.
- Scale with mirror.

Price $34.75 Post 75c Interstate $1.00.

MODEL SK-70
30K OHMS PER VOLT DC
10K OHMS PER VOLT AC

DC Volts, 0.5, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 7K, 70K, 700K, 7 meg.
Decibels: Minus 10 cps plus 62 dB.
OVERLOAD PROTECTION
$18.50
Post 50c. Interstate 75c.

MODEL SK-55
30K OHMS PER VOLT DC
14K OHMS PER VOLT AC

SPECIFICATIONS:
DC Volts: 0.6, 3, 12, 60, 300, 1200.
AC Volts: 12, 60, 300, 1200.
DC Current: 60uA, 12mA, 300mA.
Resistance: 10K Ohms, 1.M Ohm, 10M Ohms.
Decibels: Minus 10 cps plus 23dB
$19.50

G.D.O. UNITS
Post: N.S.W. 50c I'state 75c. T.E. 15
Transistorised, 7 Band.
360KHz to 279 MHz
$43.50

RADIO RECEIVER
BC348-Q. Frequency coverage 200KHz — 18MHz. 6 bands. 45:1 slow motion tuning. Crystal filter. BFO, AVC. Complete with 28VDC genemotor power supply.
$75.00

TRANSMITTING TYPE VARIABLE CAPACITORS.
2KV double spaced. Ceramic insulation. ¼-in shaft. 100pF, 60pF, 30pF.
$2.50 each.

SOLDERING IRON
240V. AC. 30 Watts. Lightweight 2½oz. Heating time 1-8 mins.
$7.25

MINI TESTER
Life model C1091. 1000 OHMS per volt Ranges.
AC volts 10-50-250-1000
DC volts 10-50-250-1000
DC current 0-1-100MA
Resistance 0-250K
Pocket size
$6.95

P.T. 34 1000 OPV
DC Volts, 0, 10, 50, 250, 500, 1,000.
AC Volts, 0, 10, 50, 250, 500, 1,000.
MA 1-100-500 RESISTANCE.
$6.50
Post 50c

SOLENOIDS—RELAY
12V DC Coil resistance 120 Ohms, 4-pole change over contacts, 10 amps.
$1.75
Pack and post. 25c.

Receiver-Indicator UNIT
Type R-65/APN-9, 3BPI CRO 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

DYNAMIC LO-IMP STEREO PADDED HEADPHONES
With cord and stereo plug.
$3.50
Pack and Post., 50c.

PANEL LAMPS
6.3V. .3A. Pkt. of 10, 75c

VERNIER DIALS
8:1 Ratio

3in.	$2.95
4in.	$7.25

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. **Price $49.50**
30 Watt. As above, EL-34 PP $57.50
40 watt $89.50
60 watt $115.50



P.A. SPEAKERS
8 WATT
8in. units in waterproof projection horns.
15-Ohm voice coils.
Price $16.15
Line output transformers to suit.
$1.75 extra.

SPEAKER COLUMN
VINYL COVERED — BLACK 33in. x 10in. x 10in. Complete with 4 heavy duty 6in. speakers. 25 watts — 4, 8 or 16 ohms.
$32.50

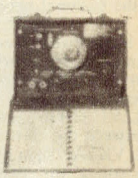
MICROPHONE STANDS
Floor Model. 6ft. adjustable with heavyweight cast-iron base.
$11.75
TABLE MODEL, $3.50
Flexible Goose Necks

9in.	$2.75	18in.	$4.35
12in.	$3.50	24in	$5.00

MICRO SWITCHES
S.P.D.T. 240VAC 3 amps
Button, lever, plunger, lever/roller actuated types available.
95c each

SELSYN MOTORS
Differential type.
50v. AC 50 cps. **$5.75.**

LIFE MODEL 1092
5000 ohms/volt
Ranges:
DC volts: 3 — 15 — 150 — 300 — 1200
AC volts: 6 — 30 — 300 — 600
DC current: 0-300uA, 0-300mA
Resistance: 0-10K, 0-1Meg.
Decibels: — 10 to +16
$9.95



BENDIX BC-221
Frequency meter 125KHz to 20MHz. Complete with calibration book and 100KHz crystal. 240VAC supply.
BRAND NEW $75.00
USED, GOOD ORDER $49.50

BRAND NEW LIGHTING PLANTS
Johnson 1 hp engine
12V 30A generator
$72.00
110VAC 50Hz 2½KVA
Powered by Briggs & Stratton 4-cycle petrol engine $195.00

522 TRANSCEIVER
Freq. coverage 100-150Mhz. Multi-channel crystal-locked. Suit 2-meter mobile or base station TX. Operating voltage 350VDC, 250mA. RX operating voltage 250DC, 100mA.
Power supply not included **$35.00**
Separate transmitter $17.50
Separate receiver $17.50

NEW GRAMO MOTORS
240V. AC
3 Speeds, $2.75.
Post: 40c.

PORTABLE FIELD TELEPHONES
Magneto powered—complete with handset and sturdy metal carry case. $9.50 each or $18.00 per pr.

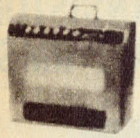
CRO TUBES

DG4-1 Philips 1"	$6.75
5JP1 Dumont 5"	$8.75
DP 16-22 Mullard 6" x 2"	$7.75
3API 3"	$2.75
ACR10/WCR139A 3"	$3.00
3BP1. Shield and socket, 3"	$12.00

AN/APX-6 TRANSPONDER TXRX
900-1200MHz
Complete with cavity tuning, resonator, digital counters, 2C42-2C46 lighthouse tubes, 28V DC blower motor.
$17.50

COAX. CABLE

Imp.	Dia.	Per Yd	Per 100yd
75	3/16"	25c	$ 5.00
75	1/4"	30c	$ 9.00
75	3/8"	45c	$ 0.00
50	1/4"	40c	$ 4.00



GUITAR AMPLIFIERS

14-watt, 4 inputs, bass and treble boost, 2 twin-cone speakers. 17-watt 4-channel, bass and treble boost. Two twin-core speakers.

$83.85

35 watt

4-channel, bass and treble boost. 4 twin-cone speakers.

$119.00

Vibrato with foot control and 2 preset controls for frequency and intensity. $10.50 extra on above models.

14 watt, etc	$69.50
17 watt	$83.85
35 watt	$119.00

50 WATT SOLID STATE GUITAR AMPLIFIER

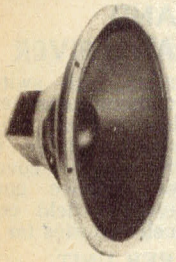
E.A. July and August issue.
Kitset, including cabinet.

$98.00

Wired and tested.
$114.00

TOP QUALITY AUST. MADE SPEAKERS

12in Woofer 50 watts RMS	$42.95
12in Woofer 20 watts RMS	$24.25
12in Woofer 15 watts RMS	$22.00
12in Twin-cone 15 watts RMS	$19.00

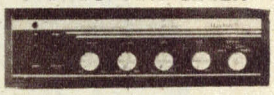


15" PIONEER

15in Pioneer low frequency speaker, Imp. 8 ohms. Power, 30 watts, RMS designed especially for use with bass guitar or electric organ. Also ideal for stereo woofer speaker.

$30.00

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

REVERBERATION UNITS

Deluxe model.
Freq. response. 60-5500 Hz.
Decay time at 300 Hz 2 seconds.
Dimensions 16¾in x 4⅜in x 1¼in.

$19.95

STANDARD MODEL

Freq. response, 60-3000 Hz.
Decay time 1.5 seconds.
Dimensions 4¾in x ⅜in x 1¾in.

$5.75

Full specs. and circuit supplied with units.

HI-FI STEREO HEAD PHONES



DELUXE MODEL WITH INDIVIDUAL TONE CONTROL

$12.95

Imp: 8 ohms.
Standard model. $6.50.
20-12000 cps
Pack. and Post. 35c

STEREO RECORD PLAYER

240V AC—4 speeds, ceramic cartridge. Separate motor, 7in turntable, pickup arm and rest. Post 50c.

$7.90

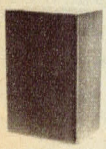
Mounting platform available, $5.50. Post 40c.

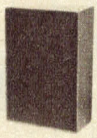
8 TRACK STEREO CARTRIDGE TAPE PLAYER

240V AC. 8 watts RMS per channel. Solid State. Provision for radio tuner and stereo record player.

$79.00

SPEAKER ENCLOSURES







NEW MAGNAVOX 8-30 SYSTEM
Ref. Jan. 71 E.A.
1.6 C.F.T. 30 watt. 8-6 OHMS.
Complete ready for use.
$60.00 ea.

8-30 speaker only	$18.50
3TC Tweeter only	$3.75
Cabinet only	$30.00

HI FI SYSTEM with 8WR MKV and 3UC tweeter
16 watts, 8-16 ohms, 22in x 14in x 8in.
$43.75 ea.
Hi power system with MSP 12UAX and 2MBC tweeter. 23½in x 17in x 12½in. 20 watts ea. $53.75

FAMOUS MULLARD MAGNAVOX
Bookshelf enclosures 6WR MKV and 3UC tweeter, 8-16 ohms, 15½in x 8¼in x 8½in.
Complete ready for use.
$26.75 ea.
Cabinet only $13.95

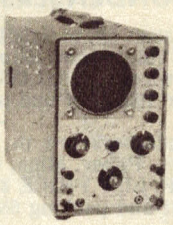
All cabinets are constructed of Pineboard and veneered with oiled teak Formica and are complete with cross over network — tweeter — innerbond packing.

WIDE BAND OSCILLOSCOPES

VERTICAL AXIS
Deflection sensitivity (at 1KHz) 0.1Vp-D/cm.
Frequency characteristics: 1.5Hz to 1.5MHz.
Input Impedance, 2 M ohms 25pF.
Calibration voltage IV p-p/cm.

HORIZONTAL AXIS
Deflection sensitivity 0.9V p-p/cm
Frequency Characteristics, 1.5Hz to 800KHz.
Input Impedance 2 M ohms 20pF.
Sweep Oscillator (5 range): 10Hz to 300KHz.
Synchronisation Devices Internal (Positive and Negative, external).
Power 240V AC 50/60 cps. Cathode-ray tube 3KF1F.

3-inch $119.75



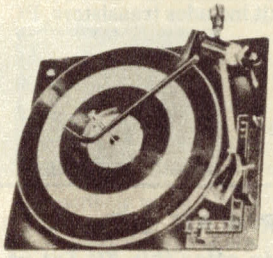
TV BOOSTER

240V AC. Especially designed for fringe area reception. Also up to 3 TV sets can be operated off common aerial for improved signal strength.

$15.95 Post free.

STEREO RECORD CHANGERS

C109 — C116 — C117 — C117A3



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.

CHANGER PLATFORMS

Teak. Cut out to suit C109-MA65-MA70-MA75 $9.00
Fully moulded tinted perspex cover. 17¼in x 13½in x 4in. $9.00

$9.00

CASSETTE TAPE RECORDER

Solid state, 2 track mono. Piano key push controls. Slow-fast speed adjuster. Rim drive. Supplied complete with microphone with remote switch, cassette tape, batteries, earphone, instruction book, circuit.

$28.75 Post 75c.

TAPE CASSETTES TENSILISED MYLAR

C60	95c
C90	$1.80

HEAD CLEANER

$1.70 Post 10c.

2-STATION INTER-COM

Press to call—volume control. Complete with plugs and cable. 9V transistor battery. Post 50c.

$9.95

MODEL TE-65

VTVM

DC Volts: 1.5 — 5 — 15 — 50 — 150 — 500 — 1500
AC Volts RMS: 1.5 — 5 — 15 — 50 — 150 — 500 — 1500
AC Volts P-P: 1.4 — 4 — 14 — 400 — 1400 — 4000
Resistance: X10 — X100 — 1K — 10K — 100K — 1M — 10M
Decibels: 100 plus and minus 65
240V AC

$43.75

Tech. P.V.58 $40.50



AUDIO GENERATOR

Deluxe Model — TE22D

Freq. Range: Sine 20Hz to 200KHz. Square 20Hz to 25KHz.
Output Voltage: Sine 7V. Square 1V P. P. Output Impedance: 1000 ohms.
Accuracy: 5p.c. 4-range attenuation, 1/1, 1/10. 1/100, 1/1000. Printed circuit, 240VAC.

$42.95

SIGNAL GENERATOR

Deluxe Model TE20D.

Freq. range 120 KHz—500 MHz 7 bands. Accuracy 2pc. Output 8V. Provision for Xtal. Suitable for self-calibration Marker generator. Printed circuit. 240V AC.

$35.75

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

S.W.R. METERS

0-100MHz.
1KW. POWER OUTPUT.

$14.75

Pack and Post 75c.

MODEL SE-405

0-150 MHz 75 ohms, 2 KW

$27.50

PILLOW PHONES

3in dia. x ¾in. Cream plastic housing. 8 ohms.

$1.95 Post. 25c.

NEW RANGE OF RESISTORS, CONDENSERS & POTENTIOMETERS

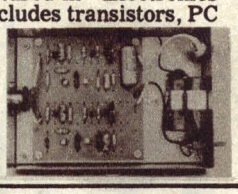
The resistors are mainly IRC and Morganite and are in a wide range of values from 100 ohms to 3 meg. in ½, 1 and 2 watt and include wire wound. LIST PRICE $9.00 per 100. OUR PRICE $2.00 per 100. Post and packing 35c extra.

The condensers are in most popular brands and include Polyester, Paper, Mica, Ceramic and Electrolytic in values up to 8uF. LIST PRICE $11.00 per 100. OUR PRICE $2.00 per 100. Post and packing 65c.

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.

A TRANSISTOR PREAMP FOR MAGNETIC PICKUP OR TAPE HEAD

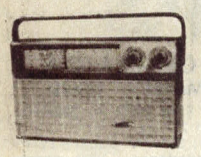
Using 2 transistors per channel, as featured in "Electronics Australia" (Sept. 1971). Complete kit includes transistors, PC board, resistors, capacitors.



Circuit and full details supplied.
Kit (not incl. box) $7.90
240V Power Supply $5.40
State if required for pickup or tape head.

NEW TRANSISTOR 8 KIT SET

Special Purchase enables us to offer this Kit Set at $24.00

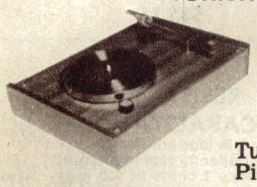


DIMENSIONS
9" x 5" x 3" deep

- Complete kit of parts with circuit and full instructions.
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all States.
- Available in colours of off-white, red, black.

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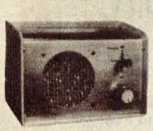
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$22.50 Post 50c

NEW SILICON ALL TRANSISTOR PA AMPLIFIER 25 WATT RMS



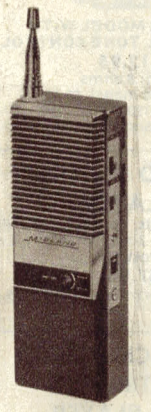
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(FREIGHT EXTRA)

THESE AMPLIFIERS ARE SUITABLE FOR INSTALLATION IN CLUBS, SCHOOLS, RESTAURANTS, FACTORIES, ETC., WHEREVER THE AMPLIFICATION OF SPEECH OR MUSIC IS REQUIRED.

SPECIFICATIONS:

INPUTS. Two microphone and aux inputs with mixing facilities and master volume control, aux input switching for radio, phono or tape. TONE CONTROLS. Separate bass and treble controls. FREQUENCY RESPONSE 20 to 20,000 Hz. OUTPUT IMPEDANCE 8 to 15 ohms. The circuit incorporates regulated power supply with switching protection for output transistors. Circuit uses 23 silicon transistors plus 4 diodes. DIMENSIONS 12½" x 4½" x 10" deep. Weight 14lbs.



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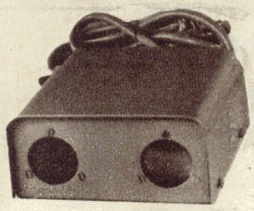
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for 27,240KHz operation with switch provision for two additional channels, tone call signal, background noise squelch control, battery voltage indicator, steel case with separate cover, good for five miles distance communication under average field conditions, with penlite cell-batteries for

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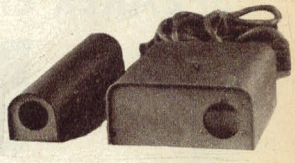
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LISTENING AROUND THE WORLD

by Arthur Cushen, MBE

Expanded service from Radio Canada

Radio Canada's service to Europe has operated with the increased power of 250KW from July. The station has also conducted tests with this power to other parts of the world.

The introduction of two new transmitters has enabled Radio Canada at Montreal to expand its services. It is now using as many as five frequencies at the one time, as three old 50KW transmitters are still being used. Listeners in the South Pacific will not receive the signal on the higher power for some months yet.

During October further tests were carried out for reception in Japan between 1015 to 1048GMT on 9625 and 11720KHz. Other frequencies observed include 7140KHz at 2200 to 2230GMT and 6150KHz from 0600 to 0630GMT.

Programs to Western North America are carried for Deutsche Welle on 15165 and 11865KHz from 0158 to 0415GMT. Another new frequency is 11845 which is used from 2158 to 2230GMT.

"Speaking to the World" was the theme of an airmail postage stamp issued by the Canadian Post Office recently to commemorate Radio Canada International. The special stamp issue was to coincide with the opening of CBC's 250KW transmitters at Sackville, New Brunswick. Early last July the 50KW transmitters, which have been in operation since the CBC International Service began regular transmissions to Europe in February 1945, were supplemented by the first two of five 250KW transmitters. These transmitters are scheduled to carry the European Service transmissions. The transmitters, supplied by the Collins Radio Company, have many new features including 12 second tuning computer controlled scheduling and unique protective devices.

NEW BOGOTA STATION

A new station at Bogota, Colombia, announcing as "Radio Super", has been heard on 6065KHz from around 0630GMT till after 0900GMT. Signals are very good in New Zealand. The station has typical Latin American music and plenty on announcemenets in Spanish. Reception was first brought to our notice by Chris Davis of Featherston, NZ, who received the signal in early September. There is no information about this station in the Summer Edition of the "World Radio Handbook". The frequency is allocated to HJJQ "La Voz del Llano". There is some interference from Buenos Aires on 6060KHz, which opens at 0900GMT.

RECENT VERIFICATIONS

DOMINICAN REPUBLIC: Radio Cristal, Station HIMI on 5010KHz using 1000 watts has confirmed our reception with a letter by airmail. The verification is signed by the Director General, Elizardo A. Dickson. The station address is PO Box 949, Santo Domingo.

PORTUGAL: Our verification from IBRA Radio, which has studios in Stockholm, but transmitters at Sines in Portugal, came in the form of a verification card, pennant, schedule and covering letter. The verification card is in orange with a view looking up the transmitter mast; and on the reverse side there are complete verification details for a report on 9660KHz.

The station address for reports is PO Box 821, S 101, Stockholm 1, Sweden. The pennant is in two colours of blue with a map of the world and a mast. We first heard this station in the early 1950s, broadcasting from Tangiers. They were interested to receive a letter from former listeners as the station had been silent for many years. Operations recommenced on April 2, 1971, after a break of 11 years.

VENEZUELA: YVKB Radiodifusora Venezuela, located at Caracas, has verified Chris Davis, Featherston, NZ, with a friendly letter from the announcer Raul Varela. YVQP which operates on 3365KHz, has been heard at 1000GMT by Chris Davis. The station has confirmed reception with a detailed verification letter signed by the Director, Rodolfo Enrique Fuentes.

AUSTRIAN ARMY RADIO

The Austrian Army Radio, one of the lowest powered stations operating on short-wave from Europe, has been heard on 6255KHz to signoff at 1900GMT. The power of the transmitter is only 1KW and though the station suffers from telegraphic interference reception is fair. The station has the callsign OYE21.

Our reception included a program of popular English and continental music up to 1900GMT. At this time full station identification and mailing address was given in German. Then followed the Austrian National Anthem and the station's interval signal was played three times before transmission closed. The station has the slogan Schulungssender Des Osterreichischen Bundesheeres, and has the mailing address of Gussriegelstrasse 45, A-1100, Vienna, Austria.

VENEZUELAN RECEPTION

Most Venezuelan stations open around 1000GMT and during our summer months provide interesting signals in the 90 and 60 metre bands.

3215 YVZV Ondas Panamericanas has been heard at 1030GMT.
3275 YVMC Radio Mara signs on at 1000GMT.
3295 YVOG Radio Mar
3295 YVOG Radio Trujillo heard at 1045GMT.
3365 YVQP Radio Puerto La Cruz opened at 1000GMT.
4840 YVOI Radio Valera received at 0945GMT.
4880 YVMS Radio Universo opens at 0955GMT.
6120 YVSX Radio Angostura opens at 0900GMT.

Reception of these stations has been observed by several New Zealand readers including Chris Davis, Featherston, Bryan Clark and Dene Lynburg, Wellington, and the writer.

BOLIVIAN STATIONS

Interesting signals from Bolivia, which must be one of the two hardest countries to hear from South America (the other being Paraguay), have over the last few months been reported by readers. One of the interesting signals heard in August was that of CP70 on 4825KHz, broadcasting from Santa Cruz during the revolt in that country. At the same time, transmissions from other Bolivian stations provided interesting reception in New Zealand.

Radio El Condor, which is heard around 0900GMT, reports that the station slogan is "La Voz del Ferroviario". Broadcasts have been received on 6068KHz, but the nominal frequency is 6055KHz. The station lists its address as Casilla No 620, Oruro, Bolivia.

"Sweden Calling DXers" reports that Radiodifusor Pirai, at Santa Cruz della Sierra, is audible around 1000GMT on 9607KHz. This 31-metre band outlet seems to give a better chance for distant reception than 3320KHz, which was in use until now.

ALGERIA ON 9660KHz

A new high-powered transmitter which recently came into operation at Algiers has been heard by John Mainland of Wellington, NZ, on 9660KHz. The station, heard around 2010GMT, had news in Arabic at 2015 with signoff at 2055GMT. There is some interference on the frequency from IBRA Radio and VLQ9. This new 120KW transmitter brings the total of short-wave transmitters operated by Radio Algiers to eight. The station says they have no plans to start broadcasts in English and Spanish though these languages were heard during the test transmission. This new service is beamed towards South and South-East Africa. During the test period the station has also been using 15340, 15395, 15410 and 15430KHz.

BRUNEI SCHEDULE

Brian Dodgson, Darwin, reports in "ARDXN" that Radio Brunei is currently being heard, with good signals on 7215KHz for the evening broadcast period from 0800-1430GMT and again for the morning service from 2300-0300GMT. The present schedule for transmissions on 4865, 1240 and 1100KHz is: Malay 2200-0600GMT, 1100 1215GMT, and 1230-1430GMT; Iban and Dusun, 1215-1230GMT.

An alternative service is carried on 7215, 970 and 895KHz with English 2258-0030GMT, 0300-0500GMT and 1200-1430GMT; Chinese 0030-0300GMT and 0800-1100GMT; and for Ghurka Forces 1100-1200GMT.

FEBC KOREAN STATION

Some months ago we reported that the Far East Broadcasting Company relay station at Okinawa, which carries transcribed programs of a gospel nature to the Far East on medium wave, would have to close when the Okinawa area was handed back to Japan.

"SW DX Guide" now reports that the station will be re-established on Cheju Island, off the coast of South Korea. The station will broadcast in Chinese, Korean and Japanese and will use the power of 250KW. Religious broadcasting stations are not licensed under the laws of Japan.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. All times are GMT. Add 8 hours for WAST, 10 for EAST, and 12 hours for NZ.

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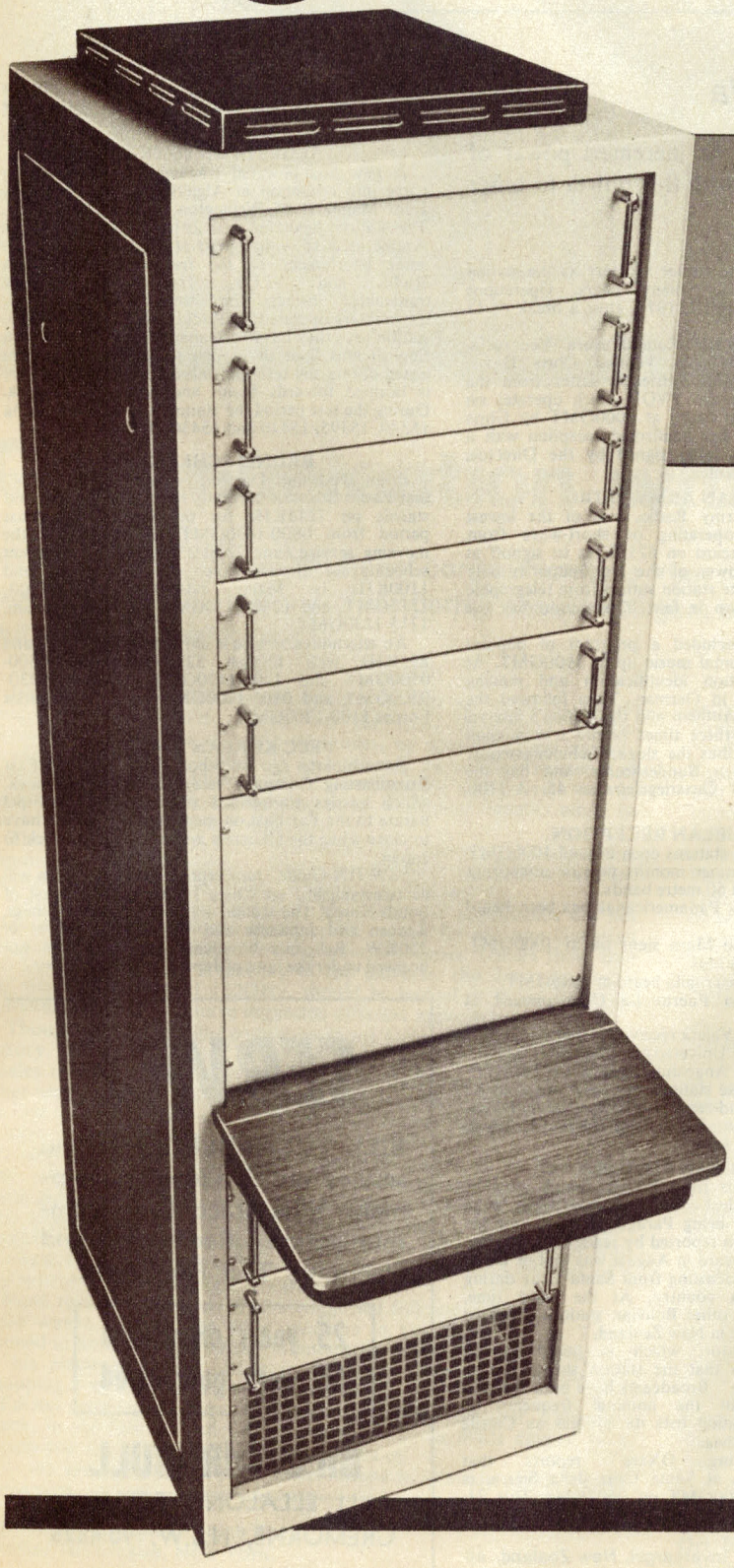
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● WOLLONGONG 2-5444

WF 1373

VUNC CLOSES DOWN

The Voice of the United Nations Command, which has broadcasts in Korean for the past 10 years, is reported to have closed down. Broadcasts originated from Deragawa on Okinawa and the station has closed because of the pending return of the area to Japan. It is understood that relays of the service from stations in Korea have also ceased.

NEW IRISH STATION

Tenders have been invited by the Eire Government for the building of a medium wave radio station at Connemara. Work could start this winter on a 4-acre site at Derrynea. There will be three studios, control rooms and offices. At Bealadangan, three miles away, will be a 300ft mast and a small control block. The name will be Radio Gawltacht. All programs will be in Irish. The station will be on the air late next year.

NEW INDONESIAN SIGNALS

Radio Republik Indonesia, Djakarta has been heard on the new frequency of 9795KHz at 1100GMT. Our reception included light music from the Djakarta studios, and at 1116GMT full identification was given including reference to the National program. The station has also been observed at 1230GMT carrying the same program as on 7175KHz.

"Sweden Calling DXers" says RRI Padang has been noted on the new frequency of 4760KHz at 1400GMT. Another Indonesian station was heard on 4695KHz at 1430-1715GMT at poor strength.

Radio Republik Indonesia has been heard with an English transmission on 11720KHz. The reception of this program has been at 0900GMT.

WVUR NEW HEBRIDES

Recently we gave details of a new medium-wave station for the New Hebrides, supplied by the ORTF at Noumea. This station will have the power of 1KW and operate on a frequency near 1400KHz.

This will be a new country for many listeners, but for the writer it will not be so. We first heard the New Hebrides on medium-wave during World War II when the American Armed Forces operated WVUR, from Espirito Santo. The station was using 1045KHz and carried the programs of the American Expeditionary Forces. Due to war time restrictions our letter from the station did not contain any technical information.

FIJI'S MEDIUM WAVE STATIONS

Some new transmitters have recently been put into service on medium-wave in Fiji. The current list of stations is as follows:

KHz	Location	Language
560	Suva	English
640	Lautoka	English
680	Labasa	English
710	Suva	Fiji-Hindi
810	Labasa	Fiji-Hindi
890	Lautoka	Fiji-Hindi
930	Sigatoka	Fiji-Hindi
1210	Sigatoka	English
1320	Rakiraki	English
1470	Rakiraki	Fiji-Hindi

JAPAN'S GENERAL SERVICE

Radio Japan broadcasts a general service from Tokyo, for 24 hours a day with news in English every hour. The following schedule is now in operation:

GMT	KHz
TO ASIA	
0100-0630	17880
0700-0930	15195
1000-2130	11815
2200-0030	15195
TO EUROPE	
0100-0530	15300
0600-1130	17855
1200-2130	9560
2200-0030	9735
TO NORTH AMERICA	
2200-0030	17785
0100-0530	15105
0600-1830	9505
1900-2130	15105

NIUE TO BOOST POWER

Radio Niue which has the callsign ZK2ZN and operates on 5500KHz is to have an increase in power. The station has used 200W since it commenced to operate in August 1967. The schedule includes a transmission from 0500 to 0800GMT, and this has been heard in New Zealand. Niue time is 11 hours behind GMT and the transmission is actually dated the previous day when received in New Zealand.

BROADCAST BAND NEWS

CYPRUS: Test transmissions from Radio Monte Carlo's new 20KW relay station at Cyprus are still being received. The station has been observed on 1232KHz with a popular music program up to 1900GMT. The identification is given in French and Arabic, with the frequency and mailing addresss for reception reports. This is followed by the Monte Carlo interval signal, which is the same as used by Trans World Radio, before transmission ends at 1902GMT. Radio Monte Carlo has the mailing address of PO Box 128, Monte Carlo, Monaco. By 1973 Radio Monte Carlo hopes to increase the power on this frequency to 600KW, and the station will be serving listeners in the Middle East and North Africa with commercial programs mainly in Arabic.

ALBANIA: Radio Peking recently established a very high power relay station in Albania on 1214KHz. English programs observed at 1830GMT are a direct relay of Radio Peking programs beamed to Europe. Reports should be sent to Radio Tirana, Albania, from which verifications have been received.

INDIA: Further new transmitters have been put into service by all India Radio. One of these, located at Leh near Kashmir, some 10,000ft up in the Himalayas, has the power of 100KW, and is on 1050KHz. Alok Das Gupta, Calcutta, writes that the station we have been hearing with All India Radio programs on 530KHz is not a new one, but is a frequency change. This transmitter is located at Jodhpur and was formerly on 820KHz.

NEW ZEALAND: Radio Otago, Station 4XO, broadcasting from Dunedin is to commence operation next month on 1210KHz. According to information from the station they will use two 1KW Marconi transmitters in parallel. The transmitting aerial will be a single non-supported tower of 150ft located at High Cliff, .4 miles on the city side of the present NZBC aerial site. The station will operate 24 hours a day and has the mailing address of PO Box 322, Dunedin, New Zealand.

PAPUA/NEW GUINEA: According to advice from the Australian Broadcasting Control Board three new 2KW medium-wave stations came into operation on August 14 in Papua/New Guinea. These stations are 9GR Goroka 900KHz, 9LA Lae 670KHz and 9MD Madang 860KHz.

IRAQ: "New Zealand DX Times" reports that Baghdad Radio has begun a new commercial radio service, the "House of Peace" radio (Huna Idha' at Dar es Salam) on 1090KHz. According to the Iraqi Government this is the first commercial radio operation in Iraq and will operate 16 hours a day.

HAWAII: A new station in Hawaii is on 1540KHz with 5KW. The station broadcasts from sunrise to sunset (1600 to 0400GMT) and reception should be possible at sign on. The station is operated by the Hagadone Capital Corporation, Honolulu.

LIBYA: The Libyan Broadcasting Service now has an English program on 1484KHz from 1600 to 2000GMT with English news at 1700GMT.

FLASHES FROM EVERYWHERE

NORTH KOREA: Radio Pyongyang has replaced 9540 with 951KHz for all its transmissions. The station has been observed on this new frequency with a program in Japanese 1000GMT, English at 1100GMT and Chinese 1200GMT. Other frequencies used for the English program include 15150KHz at 1100GMT and on 6540KHz at 1900GMT.

MONGOLIA: Radop Ulan Bator has been heard by John Mainland of Wellington, NZ on the unannounced frequency of 8893KHz. The broadcast was observed at 1220 during a program in English. Another frequency for Ulan Bator is 6384KHz; Fred Clements of Wellington, NZ has observed this frequency at 1045GMT with a program of folk music.

MALAYSIA: Kuala Lumpur has been heard by John Corder, of Timaru, NZ, on 6175KHz opening at 1100GMT. The station at this time has a program in Mandarin. Another frequency observed is 11900KHz and on this channel the interval signal is broadcast at 0820GMT, with announcements in English.

TURKEY: Radio Ankara is using 9550 and 1519 KHz for its broadcast in English at 2200-GMT. A service in German 2100-2130 is carried on the same frequencies. Radio Ankara is now issuing a pennant with its verification card, and we also received copies of their program magazine and schedule.

PERU: Radio Continental, at Arequipa, which for some months has been heard on 9455KHz to signoff at 0600 with "Born Free" has now appeared on 9685KHz. Signals have been observed on this new frequency around 1000GMT.

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"HANDYMAN"

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Pocket-size 3¼" x 4½" x 1¼".
Instruction sheet and circuit.

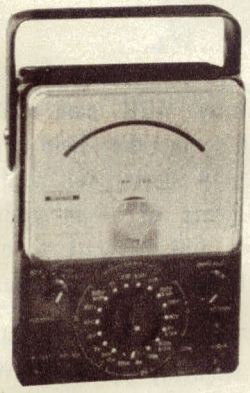
SPECIFICATIONS:

DC Volts: 2½, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: .1, 25, 250mA.
Resistance: 20K and 2M.
Decibels: —20db, +62dB, 0.7KHz.
Capacitance: .0001, .01, .0025, .25uF

MODEL RH-100 $39.75. Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

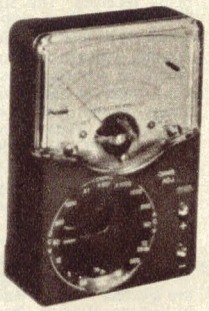
• Overload protected by dual silicon diodes • Double-jewelled ± 2 per cent meter • ± 1 per cent temperature-stabilised film resistors • Polarity changeover switch • Mirror scale • Instructions for operation with circuit diagram.



SPECIFICATIONS:

DC Volts: 0.6, 3, 12, 60, 300, 600, 1200 (100,000/V).
AC Volts: 6, 30, 120, 300, 1200 (10,000/V).
DC Current: 12A, 300A, 6mA, 60mA, 600mA, 12 amps. AC Current 12 amps.
Resistance: 20K, 200K, 2M, 20M.
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.

MODEL RH-20 $13.95. Postage 50c

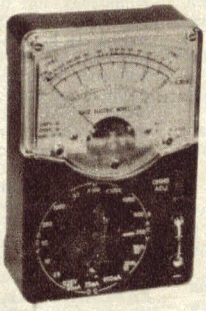


20,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current, 50uA, 25mA, 250mA.
Resistance: 7K, 700K, 7M.
Decibels: —10, +22 (at AC/10V) +20, +36 (at AC/50V). Upper frequency limit 7KHz.
Batteries: Two 1.5V dry cells.
With overload protection $15.00.

MODEL RH-55 $20.00. Postage 50c

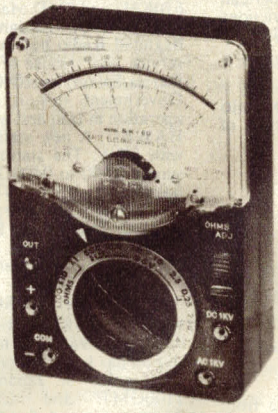


30,000 Ohms per Volt DC
14,000 Ohms per Volt AC.

Specifications:

DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V
AC Volts: 12V, 60V, 300V, 1200V.
DC Current: 60uA, 12mA, 300mA.
Resistance: 10K, 1M, 10M.
Decibels: —10dB +23dB.
Overload protected.

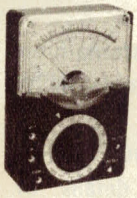
MODEL RH-60 $25.00. Postage 50c



50,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA.
Resistance: 10K, 100K, 1M, 10M.
Decibels: —10 +62dB.
Accuracy: DC ±3 p.c., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

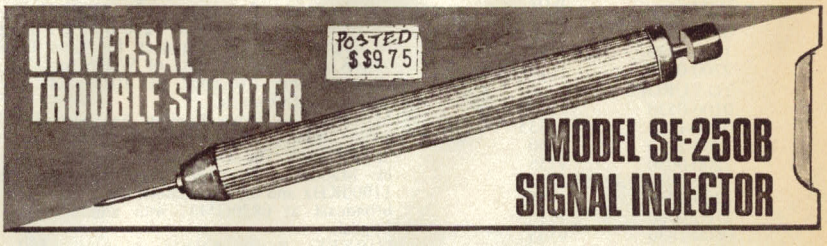


MODEL RH-80
$18.00 Postage 50c.

20,000 Ohms per volt DC.
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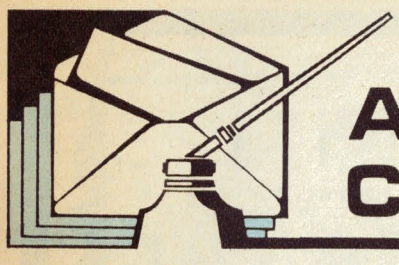
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ANSWERS TO CORRESPONDENTS

WHAT IS PHASING? Can you give me any information about the musical effect known as "phasing"? Have you ever published any circuits which would do this? I believe the signal is split, one half is slowly delayed and advanced, then recombined with the original signal. (A.B., Murrumbeena, Vic.)

Phase modulation can be achieved in a variety of ways, some of them mechanical. Mechanical systems involve such items as rotating capacitors, rotating transformer elements, or rotating loudspeakers. Only a limited amount of phase shift can be obtained with purely electronic means. An electronic phase modulation unit was described in our issue of March 1969, in an article entitled "Organ Tremulant, Vibrato". Project reprint material for this can be obtained from the Information Service for the usual fee. (File No 1/EM/21.) A rotating loudspeaker system is described in the September, 1971 issue.

BATTERY TO MAINS CONVERSION: I have two old portable battery radios, and should like to build at least one mains supply for them. Do you have a circuit on file, and what is the cost of construction? It is good to see that EA has at last covered the heavier rock and "Pop" music in the record reviews. Keep up the excellent standard of selection, but perhaps you could find a reviewer who would appear more at home in this field. (I.R., Horsham, Vic.)

The article "Power Supplies for Transistors and Portables" published in the November, 1964 issue should provide you with the information you need for operating your battery portable from mains supply. A project reprint is available for 50c (File No 2/PS/14). We wonder what caused your comment about our rock and pop reviews. Gil Wahlquist, who writes these reviews, is one of the best known reviewers of this type of music in Australia. and not only has he reviewed rock and pop in the Sydney "Sun-Herald" for some years but also he has been a national judge of the Hoadley-2SM Battle of the Sounds. If you care to make any specific criticisms, we will pass them along to Mr Wahlquist for his comments. Concerning the cost of construction of our projects, we have said many times in these columns that we are not in a position to advise on prices. Such information is readily available from the various suppliers of components who advertise regularly in the magazine.

KHz AND METRES: Can you tell me the difference between KHz, MHz and metres, and how to convert one to the other? Have you ever published simple circuits for the following: a low-power amateur-band transmitter — simple short-wave receiver, solid-state — simple transistor amplifier — transistor receiver built around an IC? What is the lowest age for obtaining an amateur licence? Where do I go for the tests? I have enclosed a circuit for an electronic organ for your "Reader Built It" section. Congratulations on a good magazine. (P.V., Morwell, Vic.)

KHz and MHz (also Hz) are a means of expressing frequency of operation, or the number of times any regularly repeated cycle of operations will occur in one second. Hertz (Hz) is the basic unit, and 1Hz means that the sequence will occur once every second. KHz means thousands of Hz and MHz means millions of Hz. What we know as radio waves have a frequency from a few KHz to thousands of MHz. Audio frequencies (those which the human ear is capable of distinguishing) vary from about 20Hz to something over 20KHz for a person with good hearing. The term metres, when applied to radio waves, means the wavelength, or the distance between successive peaks of the signal. Frequency and wavelength are related by the formula $L = d/f$, where L = wavelength, d = distance travelled per second by radio waves(300×10^6metres/second), and f = frequency of operation in Hz. Provided you know either frequency or wavelength, you can calculate the other, using this formula. The chapter entitled "Radio Transmission" in our Basic Electronics Course provides useful background on the subject. A simple stereo amplifier using transistors is the 3-plus-3, described in the August, 1968 issue (File No 1/SA/28).

We have published numerous circuits for amateur use, and project reprints for most of these can be obtained through the Information Service for the usual 50c fee. However, we suggest you obtain your amateur licence first before attempting to build and operate a transmitter. For receivers we suggest the All-Wave series published over the period August to December, 1967. The series started with the fairly simple All-Wave Three and progressively built up to the All-Wave Seven, incorporating many useful features (File Nos 2/SW/42-3-4-5-6). A simple broadcast band receiver using an IC was published in the April, 1969 issue (File No 3/MC/1). A person cannot hold an amateur licence until they have reached the age of 15 years. However, a younger person may sit for the examination, and if successful, he or she can apply for the licence on reaching the qualifying age. We suggest you contact the organsiers of the WIA Youth Radio Scheme in your State. Write to Youth Radio Scheme, WIA, PO Box 36, East Melbourne, Vic 3002.

The examinations for amateur licences are conducted by the Radio Branch of the Postmaster-General's Department. Write to the Radio Branch in Melbourne for information concerning the dates the examinations are held, and for sample papers.

Thank you for the circuit submitted for "Reader Built It". We now call this "Circuit and Design Ideas". If suitable for publication it will be used in a subsequent issue, and appropriate payment made.

DAMPING FACTOR: The author of "Damping Factor in Hi-Fi Audio Amplifiers" in the August issue makes a number of serious errors. The most significant is one of omission. The writer fails to mention that moving coil loudspeakers have a voice coil (DC) resistance which is typically 80 per cent of the nominal impedance. Clearly there can be little advantage in having a damping factor greater than five or so. The second major error is that the article treats the output coupling capacitor as if it was a resistance. A capacitor is not a dissipative element. An amplifier with a reactive output impedance can behave in a distinctly different way from one with a resistive output impedance, when connected to a loudspeaker. (G.T., Killara, NSW.)

The point you raise about voice coil resistance is a legimate one, which would undoubtedly have been well known to the author. The technical "chip

"ELECTRONICS AUSTRALIA" INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2) A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 50c per project. Prior to December 1959, circuits and diagrams only are available. From December 1959 onwards, complete articles are available. No material can be supplied, additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 30c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by seperate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects. Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1 These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply negative transparencies, actual size. Price: 50c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 10c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 50c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in 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 equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia. Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

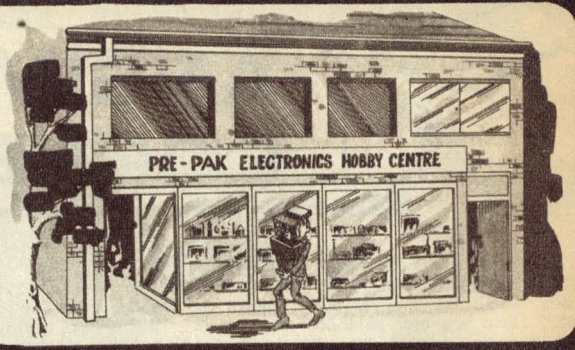
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— (10/71)

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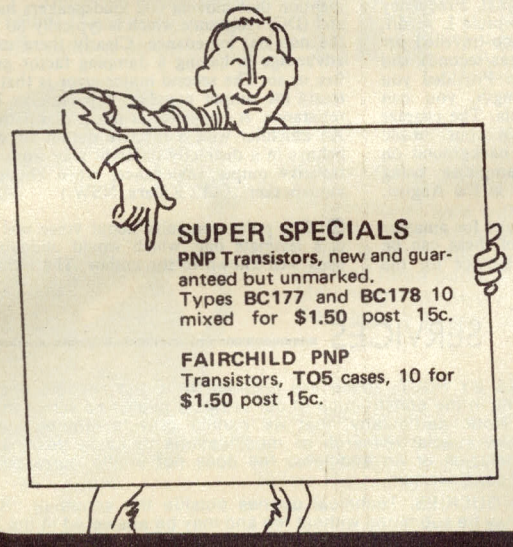
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SD 34	75 v	90mA	15c	GERM
SD 34	75 v	90mA	15c	GERM
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AS 539	300 PIV	.75A	20c	

2N291	GERM	25v	TO1 PNP	(AC128)	40c
2N336	SIL	45c	TO5 NPN	(2N697)	40c
2N442	GERM	30v	TO36 PNP	(ADZ11)	1.90
2N456A	GERM	20v	TO3 PNP	(ASZ17)	1.00
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2N526	GERM	30v	TO5 PNP	—	40c
2N527	GERM	30v	TO5 PNP	—	40c
2N1039	GERM	60v	TO5 PNP	—	40c
2N1225	GERM	40v	TO33 PNP	—	40c
2N1613	SIL	50v	TO33 NPN	(BFY50)	40c
2N828	GERM	10v	TO18 PNP	—	35c

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2SC97	SIL	30v	TO5	NPN	40c
2SC182	SIL	20v	MICRODISK	NPN	40c
2SC183	SIL	18v	MICRODISK	NPN	35c
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2SC267	SIL	20v	MICRODISK	NPN	50c



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OC440	SIL	30v	TO18	PNP (OC203)	35c
OC440K	SIL	30v	TO44	PNP (OC203)	35c
OC445	GERM	10v	TO18	PNP (BCZ12)	35c
OC449	GERM	60v	TO18	PNP (BCZ12)	35c
OC469	GERM	20v	TO18	PNP (BCY33)	35c
OC470	GERM	30v	TO18	PNP (BCY34)	35c

BCY42	SIL	—	TO18	NPN	35c
BCY70	SIL	50v	TO18	PNP	35c
BFY17	SIL	—	TO18	NPN	35c
BFY22	SIL	5v	TO18	NPN	35c
BFY23A	SIL	5v	TO18	NPN	35c
BFY29	SIL	30v	TO18	NPN	35c
BFY30	SIL	30v	PICO	NPN	35c
BFY75	SIL	—	TO18	NPN	35c
BSY24	SIL	—	TO5	NPN	40c
BSY28	SIL	—	TO18	NPN	35c
BSY84	SIL	35v	TO5	NPN	40c
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2N3072	SIL	60v	TO5	PNP	40c
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2N3110	SIL	40v	TO5	NPN	40c
2N3250	SIL	60v	TO18	PNP	35c
2N3252	SIL	30v	TO5	NPN (BFX89)	40c
2N3301	SIL	30v	TO18	NPN	35c
2N3326	SIL	45v	TO5	NPN (BFX61)	40c
2N3503	SIL	60v	TO5	PNP	40c
2N3504	SIL	45v	TO18	PNP (2N2904A)	35c
2N3564	SIL	TO5	TO5	PNP (BFX43)	40c
2N3671	SIL	50v	TO5	PNP	35c
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on his shoulder" which caused him to write his brief article was that amplifier manufacturers establish a figure for output resistance in the middle of the audio range and let it be assumed that the figure applies at the lower frequencies also. We did not get excited about the point you raise because we knew that it had been covered in George Tillett's article on "Choosing An Amplifier", which we already had set up in type. It appears on page 76 of the September issue. Incidentally, George Tillett sets a target figure of not less than 20, which would support Ron Cooper's dissatisfaction with the kind of figure you are prepared to accept. In regard to your second point, undoubtedly a long paper could be written about the implications of a capacitive output impedance, and the possible effects of resonance with transformers in electrostatic systems. However, the author's intention was not to get deeply involved in all this but simply to stress that the loudspeaker is more able to pursue its own inclinations if, at the frequency involved, it is isolated by a substantial reactance from the low impedance point of the drive circuit.

NOISE PROBLEM: While looking for a particular article recently, I found that I had apparently loaned or lost the relevant magazine. The article concerned the construction of a circuit to be connected in line with an AC outlet to eliminate and

(continued on page 143)

6V IGNITION . . . from page 77

between conventional and capacitor discharge ignition. However, this feature is somewhat of a mixed blessing because contact resistance may develop in the plug pin connections, so that the plug itself can be a possible source of unreliability.

The prototype was installed on a 1965 VW 1200. It is mounted on the firewall, adjacent to the fan housing, on the same side as the ignition coil. Since it is mounted in the air stream to the fan intake, it runs quite cool. If the unit is mounted in a conventional car it should be mounted on the bulkhead, as far from the engine as possible, and be protected from possible water spray.

Brackets are needed to mount the unit to the firewall. These can take the form of two flat steel strips, 6in x 1in, screwed or welded to the back of the case. The unit is mounted by four long screws (with nuts and washers) which pass right through the firewall, into the passenger compartment.

Spark plug and point settings were left as set for conventional ignition. There seems to be little point in deliberately increasing the spark plug gaps to obtain a better flame front — this places a higher load on the insulation of the coil, ignition leads and the distributor housing and means that the settings have to be redone if there is need to change back to the conventional ignition.

All ignition leads and spark plug connections must be in top condition with CDI, as the higher voltages will rapidly find any weaknesses in the system and cause misfiring. The author made up insulating spacers to suspend the ignition leads away from the fan housing and from each other to avoid misfiring. The insulators clip over the inlet manifolds and are made of a material similar to Paxolin or SRPB (synthetic resin paper board). These measures may not be necessary if double-insulated high tension cable is used. TVRS (television and radio suppression) ignition cables should be replaced with standard cable if their resistance is much above 20K per lead.

RADIO: Unofficial history

My passion in amateur radio is known as "contest capering", and I have been at it more years than I care to remember. Winning a two-day contest requires a big effort, and even a few minutes away from the rig can mean many lost points. Being an old timer, I don't last as well as those in the prime of youth. Aches and pains develop from prolonged sitting as a contest wears on — and there's always a headache from the constant QRM.

Recently I was going great guns and really piling up points but began to suffer from the aforesaid aches. My modus operandi in the radio shack at night is to have a small light that shines only on the receiver and log book — the rest of the room is in darkness. Hearing my six-year-old daughter in the bathroom, I called to her to bring me a glass of water and a headache powder from the cabinet. This she did and I gulped it hurriedly down. It seemed to taste odd, but I was too busy to bother.

The contest dragged on and the headache only got worse. at bedtime, my daughter came in for a goodnight kiss. I asked for another powder and again it tasted lousy, but I blamed it on the dryness of my mouth. About one hour later I began to feel queasy and light-headed, and finally had to lie down on the divan in the shack.

"Honey," I called weakly to my wife, "you still up?"

"What's wrong?" The voice from the bedroom was unsympathetic.

"I don't feel so good — musta bin somethin' I ate."

"Well it wasn't dinner or supper 'cos you've been too busy to eat".

"I've only had a couple of headache powders and it couldn't be them".

There were sounds of the wife hurriedly getting out of bed. She appeared from the bathroom, switched on the light and held out a box of powders.

"There aren't any powders. I forgot to get some in".

"Well, what are these?"

"De-worming powders for the dog".

"De — WHAT?" Rage overcame my aches and pains. I sat up and bellowed, "That flaming hound has more status round here than the rest of the family. Since when does its medication mix with ours?" I sank back miserably on to the divan. "Get the doctor, I feel lousy".

"It's 11 pm. You can ring him up at this hour with a tale like that, but not me!"

The local GP is a pretty good friend of mine so I dialled him. "—er Mac", I said sheepisly, "I've swallowed a couple of de-worm dog powders. I thought they were aspirin —"

"You're on the booze —"

"No, no, no. It's fair dinkum. I feel crook and —"

A great guffaw echoed out from the headset. "Listen, pal, you don't need me, you need a vet!"

"Very funny", I said testily, "all I want to know is — well — will I be OK?"

"Ha, ha, ha. They're a purgative, you know, but they'll probably do an old dog like you more good than harm. Just ignore the symptoms and carry on".

I did carry on — all the next day — but not in the contest. (A.S., VK4SS, West End, Brisbane, Qld.)

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 rephrase contributions as necessary to preserve uniformity of style.

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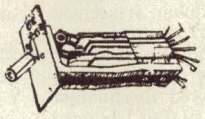
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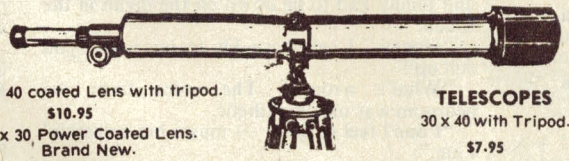
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SIMPLE BUZZER . . . from page 89

the armature and contact, through the electromagnet, and back to the battery.

Suppose, however, that at the instant we turned the electromagnet on, contact was broken. Current would stop flowing, the bolt would no longer be magnetised, and the armature would immediately spring back to its rest position.

This is exactly what happens with the buzzer — the armature breaks contact with the contact screw, current stops, and the armature springs back. But when it springs back, it makes contact, and once more is attracted towards the bolt. Contact is broken, and the armature springs back. This process is repeated hundreds of times per second, and this movement, pushing against air in its way, produces the audible "buzz".

Once set up, briefly touch the key. A "buzz", naturally enough, will indicate that the buzzer is working properly. However, it is more than likely that it will not work first time. There are two things which will probably require adjustment. One is the set screw for the contact, and the other is the distance of the blade from the bolt. First of all adjust the screw with a screwdriver, holding the nut(s) with a pair of pliers.

If this doesn't work, then try moving the blade closer to the bolt. If none of these work, try adding another battery in series with the other(s). If this doesn't work, then there is probably something wrong in your wiring.

Our buzzer worked quite satisfactorily down to four and a half volts (three cells in series), but was much better on a single six-volt lantern-type battery (Eveready type No 509). It may be necessary to go as high as seven and a half volts, or even nine, but this is unlikely.

One final point we might raise about this buzzer. You may notice, particularly if you have moist fingers, that the buzzer gives you a tingle when you touch certain parts of the wiring. We can already hear the questions: Where does this tingle come from? Is it dangerous? What is the voltage and current?

We can assure you that it is not dangerous. The current flow would be in the order of one to 10 milliamps, and the amount of current at which danger starts is over 10 milliamps, according to electricity supply authorities.

The tingle you feel comes from the coil, or more precisely, from the collapsing magnetic field and the coil. What happens, briefly, is this: When the contacts break, current from the battery stops, and for an instant of time there is no current flow, but there is still a magnetic field around the core. Then this field rapidly dies away. When this happens, we have a changing magnetic field cutting across the coil of wire.

This changing field cutting across a coil "induces" an emf (electro-motive force) into the coil. Believe it or not, this emf can be well over 200 volts. In our buzzer, for example, we know that it was well over 120 volts. How did we know?

An easy but novel way to determine the order of magnitude of the voltage is to use miniature neon bulbs. (We understand that one of our advertisers, Circuit Components A/asia P/L, 460 Bexley Rd, Bexley, NSW, have neons available for 30 cents each plus 25 cents packaging and posting.)

Connect the neon in series with a 1000 ohm resistor, and connect it across the buzzer, that is, between the armature bracket and the contact bracket.

Press the buzzer key, and note what happens to the neon. It should be glowing brightly. As it takes at least 60-70 volts to turn the neon on, we can reasonably assume that the emf induced is at least 60 volts. More neons connected in series would also light up, until the number of neons multiplied by roughly 60-70 exceeded the emf induced. Our buzzer lit two neons, but not three.

"HOT SEAT" . . . from page 51

tubing for additional protection.

One pair connects to the primary circuit of the ignition coil, the other pair to a short flexible lead terminating in the player's trigger button.

The trigger buttons are simple affairs similar to the types used beside hospital beds or attached to slide projector control cables. A refrigerator door switch (normally open type) makes an excellent button, and may be housed in a discarded plastic pill bottle.

Indicator lamps used in the prototype were 150mA, 6V ones with coloured "stop" and "go" windows placed in front of them. You may be fortunate to "score" a couple of computer indicators. These may be equipped with 24 volt or 50 volt lamps, which would have to be replaced.

The last detail to attend to is the type of housing for the electronics and battery. Any large rectangular biscuit or chocolate tin would be suitable, or a large cigar box. Even disposal equipment cases may prove useful for this role.

Whatever is used, the layout is not critical.

BIBLIOGRAPHY:

"What is Fatal Current"? "Electronics Australia", Aug, 1969.

"Approval and Test Specification for Electric Fence Controllers". Standards Assoc of Aust AS C129 (1959).

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The above descriptions and numbers are given as a rough guide to the type of component only. Add postage on all orders.

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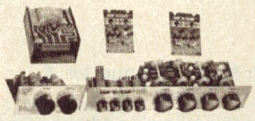
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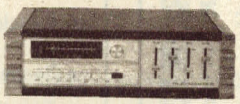
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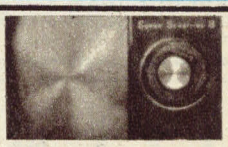
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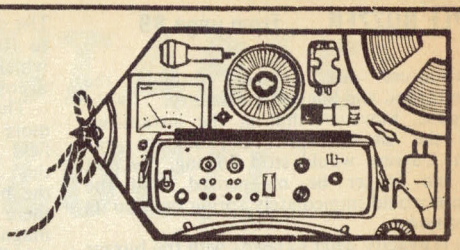
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ANSWERS . . . from p 139

suppress external noise, etc. I believe the article was in the January, 1968 edition, page 40, and called "Beating the Noise Problem". Is it possible for me to obtain a copy of this issue or of the relevant article? (S.P., Blaxland, NSW.)

You have correctly named the article, the page and the issue. Stocks of the January, 1968 issue are exhausted, but we can supply a reprint of the article (File No 2/AE/21) through the Information Service for the usual 50c fee.

QUADRAPHONICS, TV: I'm writing because I believe that, although disc recordings can be used for recording quadraphonic signals on supersonic subcarriers, recordings of this type would surely not be compatible with present cartridges which generally roll off at about 20KHz. The high frequency subcarriers would be destroyed by the stylus which would not be able to vibrate at such high frequencies. It seems to me that quadraphonic discs should be recorded so that the two rear channels can be simulated in a similar manner to that described in the April issue of "Electronics Australia", or with a simulator such as that manufactured by Sansui. These records could be played on present equipment with little more damage than present stereo records. By using thin lightweight discs such as those being manufactured by RCA in the USA (which weigh only 90g whereas normal discs weigh about 135g), manufacturers may be able to keep warp and surface noise below present levels and keep this cheap and convenient method of recording sound alive for another 20 years or so. A word or two about the television situation here in New Zealand. Our government appears not to know what it is doing. Announcements were made suggesting that we would soon have a second channel. A week later the committee investigating the courses our TV development should follow, announced that we should convert to colour before the Commonwealth Games in 1974. As usual the Government does not appear to know which course it should follow. By the time this is published, the Government will probably have chosen some other course that no one will like. (T.H., Avondale, NZ.)

Thank you for your comments about the TV situation in New Zealand. Australian viewers have a choice of programs — four in the capital cities, plus a couple of possible fringe services from adjacent provincial areas. The introduction of colour television is dependant on economic rather than technical considerations. There is no reason at all why present-day stereo discs should not be used with simulated quadraphonic; in fact, that was mainly what was in mind in the April issue. As to how discs with sub-carriers would stand up to present-day pickups, only time could tell. The wise person would make sure that they were played only on a suitable pickup, even if it meant buying such a pickup and using only the main front channels for the time being.

TECHNICAL TERMS: I am a young reader of your magazine and I particularly enjoy your "Home Sutdy Course". However, there are a few expressions which I do not understand. Among these are: FET, bipolar and feedback. Could you please tell me what they mean. (M.W. Geelong, Vic.)

FET is an acronym for "Field Effect Transistor". This, and the other term, "bipolar", refer to the type and construction of families of transistors. "Feedback" is the name given to the effect when a portion of output signal is diverted and fed back into the input of a device. This can be intentional, for example im amplifiers, where "negative feedback" is used to control, among other things, distortion. It can also be unintentional, where a microphone is placed too close to a speaker, and "positive feedback" causes a squeal to occur. All of these terms will be more fully explained as you read on in the "Home Study Course".

DEAD LETTERS: We are holding the following letters returned by the PMG's Department.

A letter addressed to Mr R. Pearson, Alderman Avenue, Seacombe Garden, SA 5047 was returned marked "Left Address".

A letter addressed to Mr S. Webb, 23 Springfield Avenue, Springfield, Tasmania, 7306 was returned marked "Unknown This Address".

Would the writers please contact us, giving details of their present addresses.

NOTES & ERRATA

ROTATING SPEAKER (Sept 1971): Smith's Industries have advised us that alternative electric clock motors are available, in case of shortage, for the type QM25 mentioned in the materials list on page 43. The types available are QM26 and QM65. Electrically, the QM26 is identical to the QM25, the difference being the number of drive teeth on the output gears. The QM65 is a higher torque type, and used in our application, will achieve the same voltage/rpm figures.

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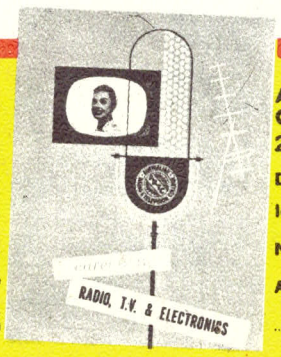
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