AUSTRALIA'S DYNAMIC MONTHLY SEPTEMBER 1971 50c*

electronics TODAY

NEW WAY TO TEST SPEAKERS

300 MPH HOVERTRAIN

IMPROVING ROOM ACOUSTICS

2 PROJECTS: FET 4-INPUT MIXER

INFRA-RED ALARM

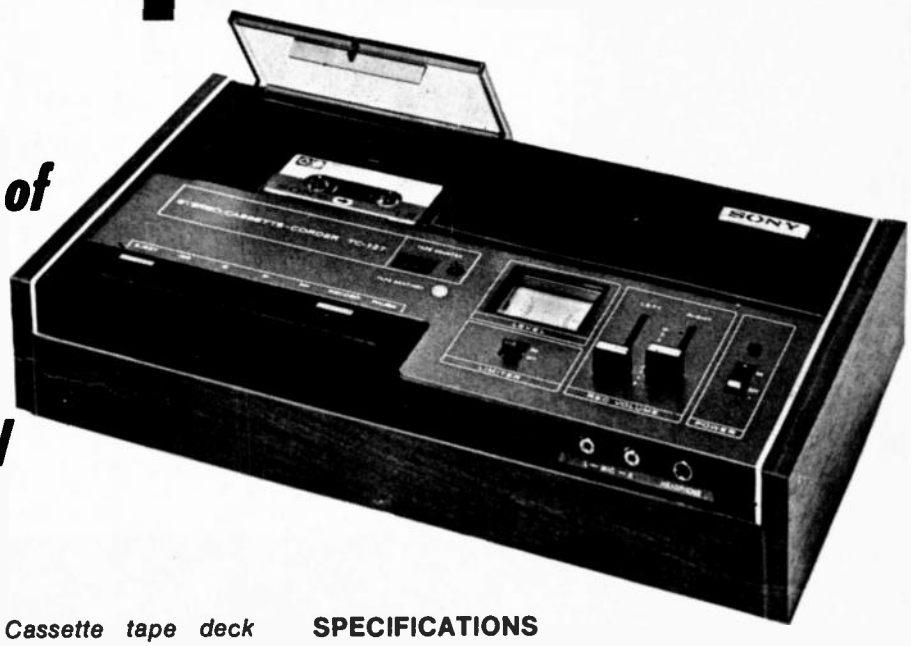
+2 SIMPLE PROJECTS

AMATEUR RADIO SATELLITES: FULL SURVEY

2 TESTS: FM RECORDER, SANSUI TURNTABLE

SONY® announces the TC-127 Stereo tape cassette

A new era of magnificent high fidelity tape cassette sound



This new SONY stereo Cassette tape deck brings you sparkling 4-track stereo/2-track mono recording/playback to satisfy even "reel to reel" men.

FEATURES • Limiter circuit (on-off) to control input level for distortion-free recording, even if input volume is unexpectedly large • Manual Control stereo recording . . . sliding type recording volume controls for each channel, dual VU meters • Precision engineered solid-state amplifier for superb hi-fi sound quality • Compact, attractive design in good looking woodgrain cabinet.

SPECIFICATIONS

Recording system: 4-track stereo/2-track mono recording and playback • **Tape:** SONY cassette C-60, C-90, C-120 or equivalent • **Tape speed:** 1⅞ ips • **Frequency response:** 30-12,000 Hz • **Signal-to-noise ratio:** 48 dB • **Flutter and wow:** 0.2% • **Harmonic distortion:** 2.5% • **Recording time:** 1 hour with C-60, 1½ hours with C-90 • **Fast forward and rewind times:** 2 minutes with C-60 • **Inputs:** Microphone input, sensitivity: −72 dB (0.2 mV), mic impedance: low. Auxiliary input, sensitivity: −27dB (0.035mV), input impedance: 560k ohms. Rec/PB connector, sensitivity: −40dB, input impedance: 3.9k ohms • **Outputs:** Line out, output level: 0dB (0.775V), load impedance: 100k ohms. Headphone out, load impedance: 8 ohms. Rec/PB connector, output level: 0dB, output impedance: 8.2k ohms • **Power requirements:** 240V, 50Hz • **Dimensions:** 15¾w x 3⅞h x 8⅝d • **Weight:** 10 lb 9 oz.

SONY®

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To: Jacoby, Mitchell & Co. Pty. Ltd., 467-475 Kent Street, Sydney, 2000.
Please send me information on the Sony TC-127.

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electronics TODAY

SEPTEMBER 1971 Vol. 1 No. 6

main features

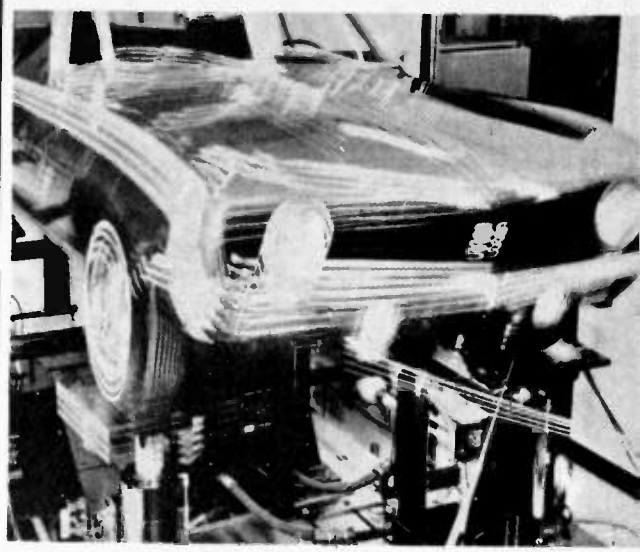
projects

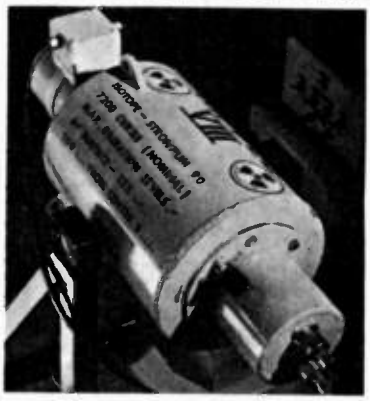
product tests

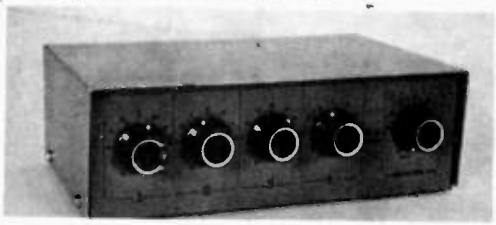
reviews

news & information

COVER: The Parkes radio telescope, which played a vital role in the recent and dramatically successful Apollo 15 lunar mission – (full story on page 67).







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(* Recommended and maximum price only.)

What's inside the cassette matters too

It's one thing to have a lightweight cassette and container to save you mailing costs. And to give you address labels and index cards, free.

But when it comes to recording or playing-back, that's when it matters what's **inside** the cassette.

The BASF tape inside this cassette is the world's finest quality tape. It has been acknowledged as such since tapes were invented. And since the BASF introduction of truly "low noise" levels into the tape field, you can now get BASF cassettes which give you a much wider dynamic range with much lower basic noise level.

Also BASF cassette tapes will help your tape recorder to last longer. Because the tape surface is smoother, you get less wear on the head of your recorder.

And, at all times, a better sound.

The playing times:

C 60	= 2 x 30 mins.	= 60 mins.
C 90	= 2 x 45 mins.	= 90 mins.
C120	= 2 x 60 mins.	= 120 mins.

BASF Compact Cassettes available everywhere in your choice of either "Trans" or "Plastic Pack."

BASF

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solving kit parts problems

CONSTRUCTIONAL projects have no value to readers unless the components required to build them are readily available. And despite the fact that we do our best to specify standard components, many of our readers tell us they have considerable difficulty in buying them. They also tell us our magazine is not the only one affected — the problem is general, in fact world-wide.

We have discussed this with a number of kit set and component suppliers and they are, naturally, as concerned as we are about the problem.

As a result of our discussions we shall — as from next month — include in each issue of ELECTRONICS TODAY a list of suppliers from whom the necessary components may be obtained. In exchange for free listing, each approved supplier will do his very best to maintain reasonable stocks.

This may not be a perfect solution, but with co-operation from all concerned there should be a vast improvement in the availability of project components.

COMMENTING on our product reviews, a reader asks, "how can we be so sure that we are right when our measurements sometimes differ from the manufacturer's specifications?"

The answer is simply that we use more accurate equipment.

All our product tests are carried out by professionally qualified engineers working in a laboratory that is registered by the National Association of Testing Authorities.

As a condition of membership of NATA, all equipment is checked regularly against National Standards and so has a proven order of accuracy.

Our testing procedures and equipment will almost invariably be more accurate than those a manufacturer can perform himself. In one case recently, when our test of a speaker differed considerably from a manufacturer's previously published results, our findings were accepted by that manufacturer as correct.

Our experience has shown, however, that the majority of specifications published by reputable manufacturers are not exaggerated, and it is not uncommon for us to find that the measured results exceed the maker's claims.

news digest

INDUCED SLEEP

For the past 22 years, Soviet scientists have been experimenting with a technique that uses low current electrical energy to reduce anxiety and tension, and so induce sleep in insomniacs.

Recent American work has confirmed the validity of the Russian experiments — and in fact — a New York company called Electrosone Corporation is manufacturing an 'electro-sleep' instrument under licence to the USSR.

Despite extensive research in the USSR and at the University of Texas Medical School in San Antonio, USA, no one knows how the technique works One theory is that it changes 'fields' in the brain and is in fact a very mild form of shock therapy.

In recent carefully controlled experiment eight out of eleven anxious, depressed insomniacs were almost totally cured after the treatment, which they described as 'painless, even enjoyable'.

KEEPING TRACK

The geographical location of a police car, ambulance, or fire engine can now be reported to base merely by the action of the driver touching a pressure-sensitive map.

This action sends a coded digital signal, representing the co-ordinates of the vehicle's position, to the base station.

There a computer converts the signal back into a map reference, the position of which is indicated on a large scale map.

Video screens are installed both in the vehicles and the base station to display messages, that are also transmitted digitally, in either direction.

WRONG NUMBERS PAY OFF

According to our New York office a local telephone subscriber has successfully sued the telephone company for the value of time wasted in obtaining connections.

The subscriber claimed that he had lost over 60 hours during the first six months of this year.

TALKING TO COMPUTERS

A new telephone set recently developed by Germany's Siemens Industries can also double as a data terminal.

With this set, also a Siemens development, a dialogue with a computer is possible — by means of a push-button keyboard. Answers from the computer are received as words through the earphones.

A built-in plastic-card reader checks whether the operator is entitled to computer access. The set can be connected to a display for checking the information punched out on the keyboard.

COMPUTER BODY DESIGN

Designers and engineers at the Turin design centre of Pininfarina make extensive use of computers from the earliest design stage onwards.

Numerical data relating to the bodywork, outlined in first-stage drawings and models is collected automatically by two and three-dimensional digitizers. In two dimensional drawings, a direct reading optical system follows the lines of the drawing point by point. Three-dimensional data collection is achieved by a stylus mounted on a swinging arm that follows the outline of the car body model.

The data collected is transmitted via a teletype terminal to a Honeywell time-sharing computer service, which inte-

(Turn to page 11)

The SANSUI AU-101 has been exposed for what it is.

They said "Surprise Packet". **That's exactly what it is.** The completely independent review in the May issue of "Electronics Today" also says . . . "Performance of the Sansui AU-101 stereo amplifier belies its low price". **And that's true, too!**

Frankly the Sansui AU-101 offers more real performance than any other amplifier ever available for only $138. Let's quote a little more from this unbiased and authoritative review . . .

"The measured performance of the amplifier is very good. The frequency response is exceptionally flat under all conditions of loading and the distortion is exemplary, being less than 0.8% under all conditions of testing. The intermodulation distortion was particularly good, being 0.3% at full load and less than 0.1% at 1 watt output. One of the features we liked best was the output damping factor of 70. This is the best damping factor we have seen in any amplifier under $300, and there are many amplifiers at $500 which don't have as good a damping factor. This means that both the bass and transient response of the loudspeakers attached to the amplifier is immeasurably improved when compared to that provided by an amplifier with a damping factor of, say, only 20. The hum and noise performance are both very good and better than most other amplifiers at twice the price." "The Sansui AU-101 is a very good buy, particularly at the price . . ."

There are the facts. Here are brief and necessarily abridged specifications:—

SPECIFICATIONS:
Music power: 50 watts at 4 ohms. 44 watts at 8 ohms.
R.M.S. power: 36 watts at 4 ohms. 30 watts at 8 ohms.
Total harmonic distortion: Less than 0.8% at rated output
Frequency response: 20-60,000 Hz. ± 2 dB.
Channel separation: Better than 45 dB.
Input sensitivity: 3 mV (Magnetic cartridge)
Dimensions: 16" x 11" x 4¾"
Price: $138

***Ask for full details. Send the coupon now . . . we know you'll agree that the Sansui AU-101 is a real "Surprise Packet"!**

Sound Satisfiers Sansui

Simon Gray Pty. Ltd.,
28 Elizabeth St., Melbourne 3000.

Please send me all the facts on the Sansui AU-101 and the name of my nearest Simon Gray franchised dealer.

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Simon Gray Pty. Ltd.

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the century L100

The Century L100 speaker is acoustically identical to the JBL professional monitor loudspeaker but has been styled for the home environment with a unique sculptural grille developed by JBL. This acoustical material permits freedom to exploit texture, colour and shape not previously available and is more acoustically "transparent" than cloth.

The Century L100 incorporates the powerful long-excursion 12" woofer. It has a 6-pound magnetic assembly and the low free air cone resonance of 27 Hz.

The midrange unit operates from 2500 to 7500 Hz. This speaker, though only 4" in diameter, weighs almost three pounds and is constructed in a form similar to the woofer. Its cone is edge-damped and operates as a true piston, with smooth response and wide dispersion throughout its operating range. Low-distortion performance is further ensured by placing the speaker in its own sealed chamber to prevent any possiblity of acoustical interaction with the woofer.

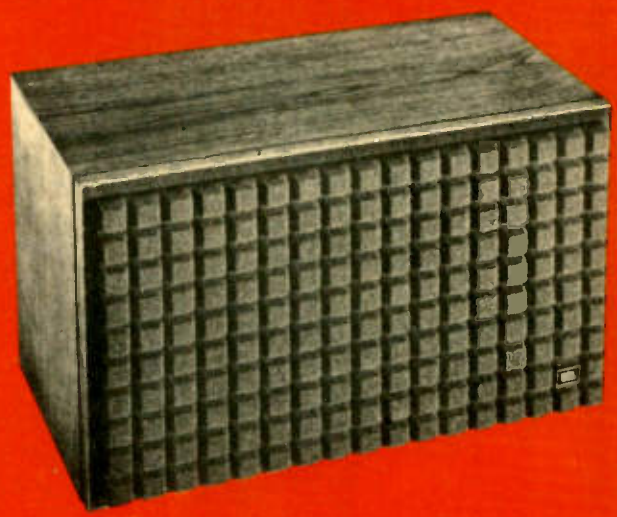
Above 5kHz, a third direct radiator is introduced, reaching full output above 7kHz. This speaker gives silky delineation of high frequency transients and musical overtones.

The network permits full control of tonal balance by providing more than 9dB of attenuation from laboratory standard for both the midrange and high frequency reproducers. For ease of calibration, the controls are marked in dB of acoustic output, and are located on the front of the cabinet, under the grille.

The enclosure is made from ¾" and 1" stock throughout, with lock-mitred and wood-welded joints.

While the specifications indicate that the Century L100 has impressive performance characteristics, they cannot convey the full impact as extensive listening experience. Clean, crisp performance across the entire music spectrum, even at very loud levels ... powerful bass fundamentals ... lifelike voice projection ... these are qualities found in few loudspeaker systems regardless of size or price. When heard from a system occupying less than 1.6 cubic feet, the effect is awesome. No other loudspeaker system approaches the JBL Century L100 in its combination of versatility, performance, quality and compact size.

Call your JBL dealer for a demonstration.



specifications

Power capacity: 50 watts continuous programme RMS *
Crossover frequencies: 2500 and 700 Hz
Normal Impedance: 8 ohms
Dispersion: 90° horizontal and vertical
Frequency response: 40-15,000 Hz ± 3dB
Efficiency: 1 watt input produces 78dB SPL at a distance of 15' (Note: 75-80 dB is comfortable listening level.)
Finish: Oiled walnut with sculptured Quadrex 2 grille in Ultra Blue, Russet Brown or Burnt Orange
Dimensions: 24" x 14" x 13" deep
Weight: 51 pounds shipping weight

*NOTE: Power capacity has no direct relationship to the rated power of the amplifier used. The Century L100 can deliver full-bodied performance when connected to an amplifier rated at only 10 watts output. The use of a larger amplifier permits a greater margin of reserve power for effortless handling of momentary musical transient sounds. These loudspeaker systems may be connected to the most powerful amplifiers available if desired, with little danger of overload.

QUEENSLAND:
Brisbane Agencies
Brisbane 2-6931

WEST. AUSTRALIA:
Leslie Leonard & Co.
Perth 21-5067

VICTORIA:
Keith Abernethy Stereo
Melbourne 663-1615
Allans Music
Melbourne 63-0451
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NORTHERN TERRITORY:
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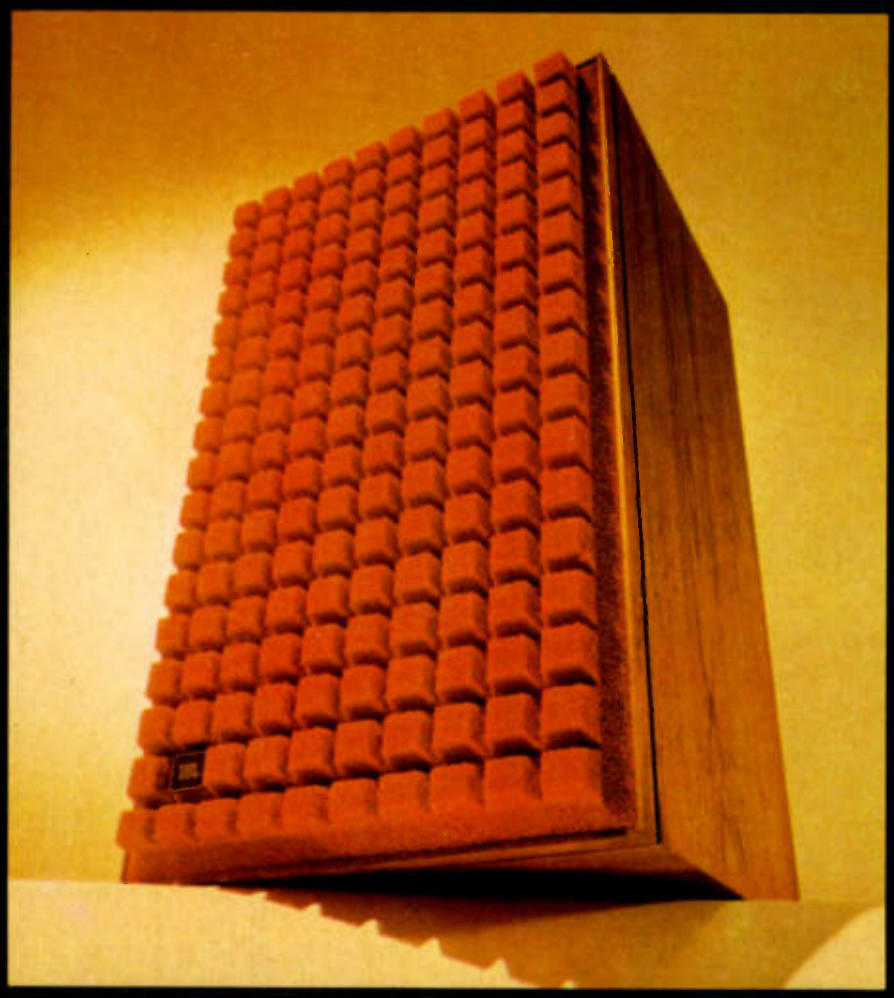
AU100

eat your ears out



JBL

IF you thought you could never go further than the speakers you own, or have ever heard, then eat your ears out.

Here before you, the JBL Century L100. There just is not another loudspeaker system that can be approached for its compact combination of versatility, performance, quality and sheer rich beauty of both sound and appearance.

Of course you'll need to be a little rich, or at least determined to own the ultimate. The JBL Century L100 is expensive.

But hear it at a JBL dealer's, and it won't sound like a cent too much. JBL is for when you're there.

AURIEMA (A/ASIA) PTY. LTD.,
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Brookvale 2100
Phone 939-1833

Selling sound to Australia — and selling for less!

Here's positive proof that Douglas Trading gives you extra purchase power . . .

GLORIOUSLY STYLED SANYO 3 speed, 4 track, stereo tape deck. Piano key operation, timber case, HI-FI performance. Fantastic value! **ONLY $139**

AKAI X-160 D

FINAL RELEASE!

Following sensational sell-out, further 80 released from bond! World patented cross field heads, etc.

FULL PRICE $229

Rush your order today!

AUSTRALIA-WIDE EXCLUSIVE! A scoop purchase of 500 of these stupendous SONY 3 head, 4 track, stereo decks brings the price plummeting down to only $199. Don't wait for a leaflet — post your cheque! **ONLY $199**

Amazing deal on this **NATIONAL AUTO-REVERSE** 4 head. 4 track, 3 speed, twin capstan Professional Tape Deck!

Hurry — limited stocks!

FULL PRICE $199

PIONEER HI-FI STEREO TUNER AMPLIFIER ONLY $139

Model AX330. Bass/treble/loudness control, tape monitor, AM tuner with tuned RF stage, black light dial, 12 watts RMS. Brand new in sealed cartons. Full warranty. Rush these!

Douglas Trading does it again — 2 colossal bargains!

Don't miss this one! PE 4 speed HI-FI Gramo Unit, anti-reverb suspension, turnover ceramic cartridge/pick up lift, teak and plexi-cover. Ideal for connection to tape recorders. Full price — a sensational **$29 COMPLETE.**

Here's more colossal value in a good quality pick up arm — standard plug-in head shell, twin gimbal bearings, anti-skate. **ONLY $14 FULL PRICE.**

Don't hesitate to write for further information. Post your order and cheque direct . . .

Douglas Trading
CITY HI-FI CENTRE
191 BOURKE ST.
MELBOURNE
—63-9321

news digest

grates and processes it by means of special interpolation programs written by Pininfarina engineers.

The processed data is returned to the same teletype in the design centre, and drives a graph plotter which draws a design of the car, or specific section details, in different planes and scales. Should alterations in design be required, the new parameters are fed to the computer, which immediately re-processes the whole design to incorporate the alterations.

In the near future, the service will also be used to guide numerically-controlled milling machines in the automatic production of silhouettes of three-dimensional models.

The service that Pininfarina use in Italy is identical to the service operated by Honeywell Information Systems Division from two computer time-sharing centres in Australia.

NEW MEDICAL TECHNIQUE

Ultrasonics and holography have been combined in a new medical diagnostic technique under development at New York's State University.

The technique has been devised to obtain three-dimensional images of internal organs that clearly show the presence of necrotic tissue and some soft tissue tumors.

A broad-band ultrasonic signal is used to permeate an entire organ, the resultant echo waves are impressed onto micro-thickness plastic membranes.

A holographic technique is then used to produce a precisely detailed three-dimensional representation of the original.

'MAGNETIC SUSPENSION' VEHICLES

Magnetic levitation may replace the traditional suspension layout of springs and shock absorbers in Ford vehicles of the distant future.

American Ford engineers are already investigating the concept's feasibility for use in high-speed train-like vehicles, following the award of a Federal Railways research contract.

"The contract emphasises the fact that Ford is in the transportation business as well as the automotive business," said Mr. Foster L. Weldon, Ford's Transportation Research and Planning Director.

He said that the study programme could lead to a system of vehicles gliding on a cushion of electromagnetic force at speeds of up to 300 mph. Such vehicles, he said, might be propelled along a road by linear-induction motors, jet engines or turbine-driven propeller systems.

"We are trying to take an accepted physical principle — such as the fact that magnets repel — and harness it to do useful work," Mr Weldon said.

By installing powerful electromagnets on the vehicles, currents can be induced in the roadway. The currents act as an opposing magnetic force, producing an invisible — but very real — cushion of magnetic energy. The vehicles would then be propelled along on this cushion.

A DIFFERENT SKY AT NIGHT?

Sunsets could undergo a marked change in the near future once supersonic jet transports, such as the Concorde, come into service. This is the opinion of senior research scientist at the CSIRO, Dr. Keith Bigg.

Because the planes will fly at extremely high altitudes, the water vapour contained in their exhaust gases could cause a physical change in minute particles found in the upper atmosphere.

At sunset the particles diffuse the sun's rays to produce a purplish glow 20 to 30 minutes after the sun has set . . . if the particles undergo a chemical change we could see more colourful sunsets, and possibly a different colour sky during the day. These particles have recently come under intense study by Dr. Bigg in conjunction with Dr. Cedric Shorey of the electron microscope unit at Sydney University.

Using a Philips EM300 electron microscope, Dr. Bigg and Dr. Shorey have been able to study these minute (as small as 1/50,000 of an inch) particles. The particles are collected by equipment attached to very large balloons released at Mildura, Victoria. The equipment collects specimens from between 60,000 and 150,000 feet before returning to earth.

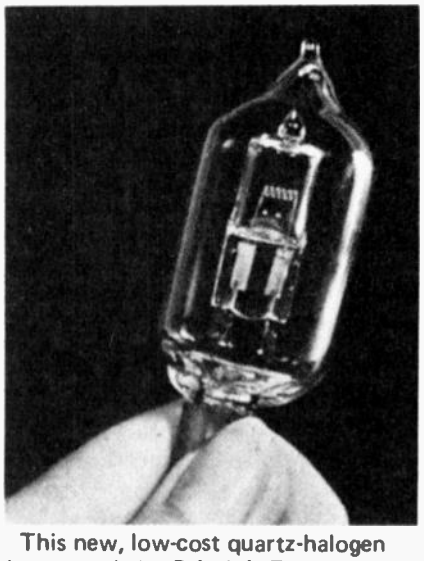
(Continued on page 12)

news digest

The method of collection is to impact particles on electron microscope screens mounted on a slowly rotating turntable, so that changes with altitude can be observed. Before examination under the microscope, the screens are placed in a vacuum chamber and coated with a thin layer of gold-palladium alloy by evaporation of these atoms from a hot wire. The atoms strike the specimen at an angle of 30 degrees; particles which are raised above the surface then leave "shadows" due to the extra transparency to electrons of regions screened by the particles. The shadows appear white and electron-dense regions, black in the usual photographic presentation.

Dr. Bigg's and Dr. Shorey's research has also shown that high flying aircraft could affect weather worldwide as the particles in the upper atmosphere are thought to have a bearing on rainfall.

UNDERWATER LIGHT



This new, low-cost quartz-halogen lamp, made by Britain's Electronic control and Surveillance Ltd, is a revolutionary development in underwater equipment. Its unique construction does away with bulky protective equipment and electrical insulation, while its low voltage requirements — only 24 volts — eliminates the possibility of electric shock.

The lamp has a recommended working depth of 10,000 ft (3048 m), though tests have shown that it can work quite well at greater depths.

PLESSEY ENGINEER OVERSEAS

Mr. Graham G. Hall, sales manager, professional components department, Plessey Ducon Pty. Limited, is leaving Sydney on August 22 to visit the United States, Britain, Japan and Hong Kong.

During his seven-week tour he will attend the Wescon Convention of the Institute of Electrical and Electronics Engineers in San Francisco and will visit Plessey establishments in the United Kingdom before returning to Australia via Japan and Hong Kong.

BIOGALVANIC BATTERY

Scientists at ESB Incorp. in the USA are working on a biogalvanic battery which uses metals and the body's own oxygen and fluids to generate power electro-chemically. The batteries, which are intended for heart pacer use, have been successfully implanted in animals, but not so far in a human being.

MICRO–ADS

A classified advertisement section will be included in Electronics Today starting with the next issue. Details are on page 117.

HOVERTRAIN – STOP PRESS

As Britain's first hovertrain gets underway, the French are wasting no time in cashing in on their experimental projects.

Le Moteur Lineaire, a subsidiary of Merlin Gerin, a major equipment manufacturer based near Grenoble, has won a significant contract to design the electrical propulsion system for tracked air cushion vehicles in the US.

The contract was placed by the Rohr Corporation of California which is designing a 60 passenger vehicle capable of speeds of 150 mph, under contract to the US Department of Transportation's Urban Mass Transport administration. LML will carry out engineering design and development work on the Rohr project involving the linear induction motor and the power collection and transforming equipment required by the linear motor.

LML has one of its motors installed in an air cushion tracked vehicle for suburban use which has operated at 115 mph on a track near Paris.

It is also providing the linear motors to Krauss-Maffei of West Germany which is developing a vehicle that 'floats' on a magnetic repulsion principle. Both these linear motors are the dual sided affairs, unlike the British AEI-GEC design which is a unique single sided linear motor.

V4281

PIONEER® adds the 4th dimension— *Quadraphonic Sound*

Pioneer QA 800 the first completely integrated pre-main 4-channel amplifier with *'quadralizer'* circuitry. Far more than just a synthesiser, the **QA 800** can be driven by any 2 channel or 4 channel stereo source including: **Pioneer QT 6600** 4 channel open reel tape deck or **QT 2100** 4 channel, 8 track stereo tape cartridge deck.

ADDITIONAL PIONEER QUADRAPHONIC SOUND EQUIPMENT.

QL 600, *'quadralizer'* with 2 channel stereo amplifier. Added to existing stereo systems it needs only 2 more speakers to make a full quadraphonic sound system.

QC 800 4 channel pre-amplifier with *'quadralizer'*.

QM 800 4 channel power amplifier.

QX 8000 quadraphonic receiver/amplifier which combines all possible combinations from source to quadraphonic output.

news digest

NO NEW COMPUTERS?

Soon users will take over leadership of the computer industry from manufacturers.

This is predicted in a report published by Infotech, the British-based computer information and education organisation.

The report says the computer industry has reached the state of investment where total replacement of one complete generation of machines by another is no longer practical.

And so the "revolutionary progress" which has characterised the industry in the past, will be replaced over the next seven years by a series of significant advances being achieved on current machines.

"During this period of comparative stabilisation, the major advances will be made by the user," forecast the experts contributing to the report.

"With a resulting new-found ability to exploit current systems to their limits, the user will find his role dramatically reversed and himself in a position to lead the industry for the first time since its inception."

This welcome pause in the launching of ever more advanced generations of computer has been largely caused by world manufacturers being hit by a cash-flow problem. They are faced with very high development costs before they can earn any income from sales. Thus new developments will in future have to be spread over a longer period in order to smooth out the cash flow.

This will give the user badly needed time to catch up with the ability of his computer. At the moment computer technology has outstripped the operator's expertise in programming and and exploiting the latest machine.

Mr. I.M. Barron, managing director of Britain's Computer Technology, says new computers will emerge from time to time over the next few years but these will be to replace machines that have been taken to their limits.

At the end of the period of pause, the user should have obtained experience in working particular machines over a long period. In the course of this he should have achieved progressively better performance at lower cost.

By then the user would be in a position to take the lead and dictate the pattern of future developments based on his increased expertise.

OMEGA TRANSMITTERS

Litton Industries has delivered to the US Navy the first of eight OMEGA radio transmitters.

These very low frequency transmitters are being produced by the company's Litcom division in Melville, N.Y.

The first OMEGA transmitter will be installed by the US Navy at LaMoure, N.D. Litton state that additional stations using these transmitters will be established in Hawaii, Trinidad, Norway, Japan, Australia, Argentina and the Reunion — a French island possession off the East Coast of Madagascar.

The US Government will provide the electronic equipment for all OMEGA stations. The stations will be operated by the governments in the countries in which they are installed.

Litton is producing two 150 kilowatt transmitters for each of the eight stations along with the associated OMEGA timing and control devices that closely control the very low frequency radio signals. The Company's Litcom division has also developed the only fully automatic, synchronized OMEGA (ORN-101) receiver for ships which will automatically receive and process the synchronized navigational radio signals. In addition, the ORN-101 also features a highly accurate time standard not found in other OMEGA receivers.

NOISE DETECTOR

A new portable, transistorized vhf interference and noise measuring set, has been engineered by Britain's Eddystone Radio.

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RTV.31

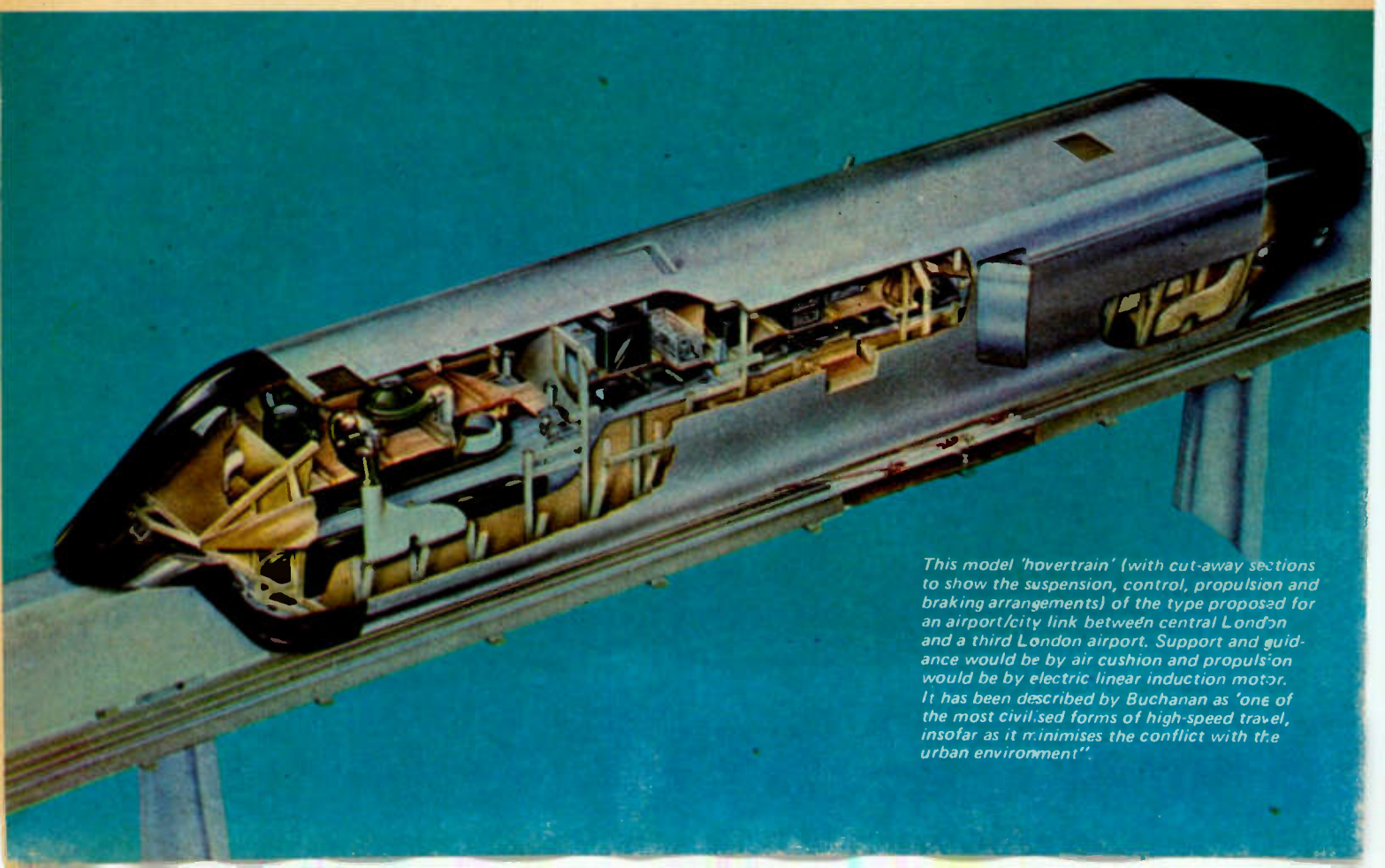
LINEAR

SUSPENSION

COMMUNICATIONS & CONTROL

PROPULSION & BRAKING

The experimental tracked air cushion vehicle, which Tracked Hovercraft Limited aims to have under full-scale test this year is shown cut-away to indicate the amidships positioning of the 6,500 lb thrust single-sided linear motor used for propulsion, and the hoverpads used for support and guidance. The vehicle is designed to reach 300 mph, towards the end of 1972, when the test track at Earith, in England is extended to eight miles in length.



This model 'hovertrain' (with cut-away sections to show the suspension, control, propulsion and braking arrangements) of the type proposed for an airport/city link between central London and a third London airport. Support and guidance would be by air cushion and propulsion would be by electric linear induction motor. It has been described by Buchanan as 'one of the most civilised forms of high-speed travel, insofar as it minimises the conflict with the urban environment".

PROPULSION HOVERTRAIN

The linear induction motor has been combined with the hovercraft to produce a 300 mph train. Harold Dvoretsky reports from London.

AIR traffic congestion is becoming an increasingly serious problem – especially in the USA and Britain where inter-city flights are the greater part of the traffic.

Yet a train capable of 200 mph can provide a faster service from one city centre to another in less time than a 600 mph plane – if the centres are less than 300 miles apart. If the train can achieve 300 mph, then it has the advantage over distances up to 600 miles.

And a surprisingly large number of the world's busiest inter-city transport routes are between 300 and 600 miles in length.

Hence the increasingly growing interest in high speed rail transport.

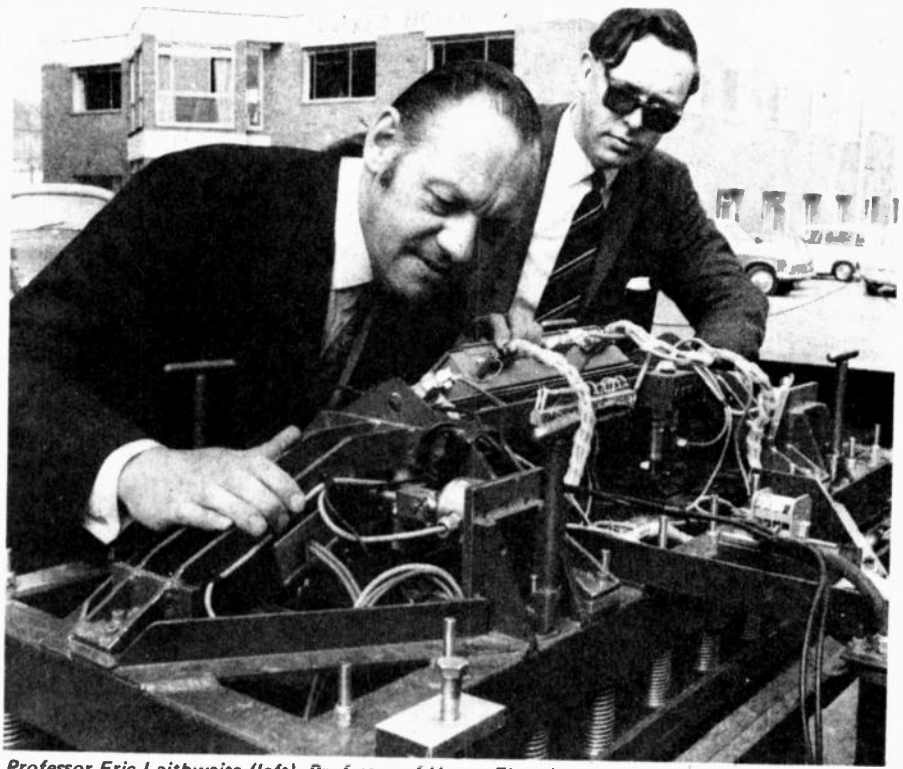
British Railways have already developed an advanced passenger train capable of 155 mph on existing track, and probably a lot more if the curves and bumps were taken out of Britain's antiquated lines.

But it doesn't need a computer to calculate the gigantic forces involved in a 250 mph railway accident. At that sort of speed the MV^2 becomes quite something.

And the realisation of this is causing railway engineers to think very hard indeed about more positive methods of propelling and guiding high speed tracked vehicles.

The tracked hovertrain is one result.

In this system the train, which straddles a box section beam, is supported by an air cushion, and is propelled by a linear induction motor. Deep flanges projecting down from the train – on either side of the beam – ensures that derailment is most unlikely.



Professor Eric Laithwaite (left), Professor of Heavy Electrical Engineering at Imperial College – who is consultant to Tracked Hovercraft Limited on the design of linear induction motors – inspecting the single-sided motor test rig and track at the company's scientific headquarters in Cambridge.

TESTING STARTS SOON

One of the world's first tracked hovertrains built by Britain's Tracked Hovercraft Ltd., is expected to start full-scale testing late in August.

The fuselage (for it has been built in an airframe factory on aircraft principles) was delivered to the Earith, Hunts. testing site a few weeks ago. There the single sided 6500 lbs thrust AEI/GEC linear induction motor of special design was installed ready for estimated speed tests of 150 mph.

This first test vehicle, known as RTV 31, has a design potential of 300 mph. But for a start the 72½ ft long 13¼ ft wide and 12¼ ft high vehicle will be restricted to only three miles of the eight miles of box sectioned concrete test track that has yet to be completed.

In early trials the vehicle will be remotely controlled – instrumentation taking the place of driver or passengers. But later, scientists may convert this vehicle to carry one or two passengers for demonstration purposes.

LINEAR PROPULSION HOVERTRAIN

More than a mile of the initial three miles of full-scale test track has been completed by Tracked Hovercraft Limited at the British Company's test facility site at Earith, Hunts, north of Cambridge. It is expected that the first full-size research tracked air cushion vehicles will start initial track tests early in 1971. One of the test track reinforced concrete 'box' beam sections, being lowered into position, showing the completed track stretching away into the distance. The recess seen in the track surface is to accommodate the linear motor reaction rail.

While the British effort lags behind the French by about a year (as far as prototype testing is concerned) Tracked Hovercraft Ltd. are still believed to be world leaders in the greatly secret linear induction motor, the hoverpads and in particular, the box section 'line'.

This beam track is not only considered cheaper than the inverted Tee shape track used by the French, and the channel section used in the USA, but it is also regarded as far safer from an operational point of view.

A recent report commissioned by the United States Department of Transportation compared the three different types of track and indicated that the box sectioned British design is the most economical of the three. And since the track cost is a major factor in the overall economics of a hovertrain system, the conclusion is significant.

THE LINEAR INDUCTION MOTOR

The single sided linear motor, the brainchild of Professor Eric Laithwaite of Imperial College, London, who is design consultant to Tracked Hovercraft Ltd., is also expected to be ahead of its competition.

Professor Laithwaite has been testing the first of the three test vehicles – the RTV 41 – which was designed to test out a model linear motor system on a 300 ft special track alongside the company headquarters at Fen Ditton near Cambridge since early in the year.

The second test vehicle, the RTV 22, now under construction at Rubery Owen Ltd., will be used for full power operation and control of the single aided linear motor.

Tracked Hovercraft Ltd. decided on the single sided linear motor, rather than the 'conventional' double sided unit, because it offered easier and safer track construction and operation. Retraction of a double sided motor, in the event of failure, would be difficult.

The single sided motor requires only a one element track (see insert for technical description of how a linear motor works) and this presents no problems for switching, or when the train is negotiating curves at high speed.

The motor operates with a reaction plate set flush with the track surface, but most other linear systems currently under development use a vertical reaction plate made of aluminium.

Early theories of linear motor operation suggested that a high frequency power supply would be necessary (and in fact this form of supply is being used by rival systems) but Professor Laithwaite's testing has shown that speeds of at least 150 mph can be obtained with a 50 Hz supply – and it is believed that even higher speeds will be possible using the same frequency.

Another fear was that one-sided linear motors might induce high attraction forces and thus negate the air support system. But this fear too, seems to have been exaggerated, and it is only at synchronous speeds that there is any problem. Even this does not present any severe limitations at operational speeds.

The linear induction motor that powers this first full sized prototype has been designed to develop a thrust of between 6000 and 6500 lbs – and weighs only two tons. It is in fact smaller than a jet engine of equivalent thrust.

The motor draws 6.6 kV three-phase power from three trackside rails using a shoe contact system, (power factor is expected to be as high as 0.6).

The power for the hoverpad lifting fans will be fed from a trackside 1500 V dc supply.

The linear motor itself is independently floated using a servo hydraulic system. This enables the gap between the motor and the rail reaction pad to be kept as small as possible, somewhere between half an inch to one inch. This is necessary for efficient operation.

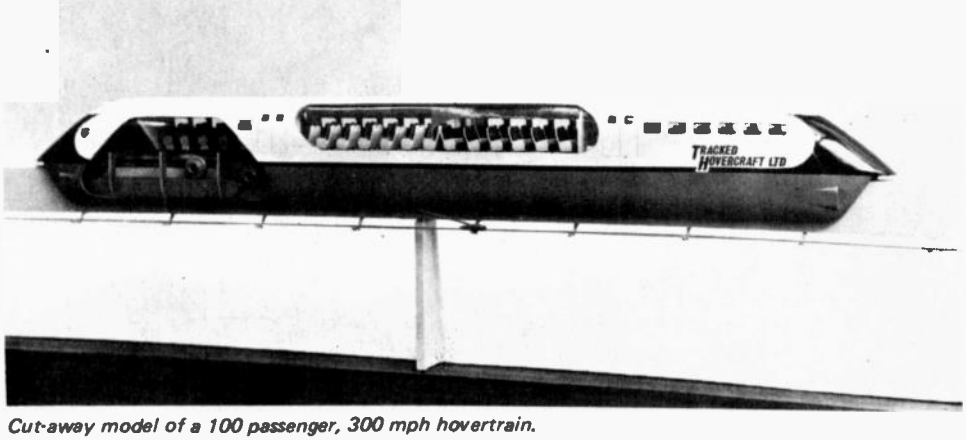
BUILT LIKE AN AIRCRAFT

The prototype vehicle has been built to extremely close tolerances and is designed to withstand the high stresses more normally associated with aircraft. To meet these stresses the hovertrain is built up from a series of steel frames at 40 inch intervals. These frames are then covered by aluminium sheets to form a stressed outer skin. The inner skin, or tunnel, which will straddle the concrete beam track, is formed from steel sheet.

Both RTV 22 and RTV 31 will be fitted with highly sophisticated instrumentation that forms part of the advanced data handling system being built by the Electronics and Space Division of British Aircraft Corporation.

The system is much the same as that used in the SST Concorde development programme.

The streams of digital information will be transmitted from the research vehicle to base, at Earith, on a narrow beam UHF radio link at a rate approaching one million bits a second. This data will be fed into a computer for processing.



Cut-away model of a 100 passenger, 300 mph hovertrain.

By using these methods the design engineers hope to get the results of trial runs almost immediately, thus cutting development time considerably.

A major facility in the development programme is a full size dynamic 'heave' table that simulates all the relative movements of track to vehicle. This can be raised and lowered under computer control to simulate variations in the track. Pressure transducers attached to the stationery part of the rig measure the reaction on the pad and in this way the stresses that would occur in a real vehicle can be predicted.

In the beginning the hovertrain will float on air cushions produced by simple peripheral curtain jets of classic Cockerell design. Secondary suspension will be provided by a mechanical spring system working in conjunction with air cushions.

The design assumption behind the prototypes is for a 100 passenger vehicle operating at 250 mph on an elevated guideway and capable of operating in crosswiinds of 45 mph and 60 mph. The hovertrain has been designed to operate in either direction of travel.

The eight mile test track at Earith ranges from ten feet to thirty three feet above ground. The box beams are six feet four inches deep, four feet six inches wide and seventy five feet in length. Each weighs 52 tons.

Only highway shipment limits the lengths of the sections, and by the time that the first operational track is built, sections double this length are envisaged.

THE ECONOMICS INVOLVED

A recent report concludes that the breakeven costs per passenger mile on a route in the USA carrying five million passengers, a year would be 8.7 cents, 7.1 cents, and 6.1 cents for the channel, inverted Tee and the British box design respectively. In Britain the cost is calculated to be only 5.2 cents per passenger mile.

Tracked Hovercraft point out however that these costs are based on suspension power requirements calculated on the simplest form of peripheral jet system. Developments during the next year or two should substantially reduce the figures given.

Hovertrain protagonists see this new transport development as part of a future integrated system in which roads cater for short journeys, hovertrains. System cater for routes between 50 and 600 miles, and aircraft are used primarily for long distance flights.

But whatever the prospects are for the hovertrain principle, there must surely be international agreement on the best engineering configuration for both vehicle and track systems. ●

The RTV 31 hovertrain on its way to the testing site in Hunts.

HOW THE LINEAR INDUCTION MOTOR WORKS

The action of an induction motor is like artificial gravity. We manage to cause one object to produce a force on another which is completely separated from it. A ring of coils, for example, as shown in fig. 1, can be fed with electric current in such a way that the copper cylinder in the centre is rotated, as if it were being dragged around by some swirling fluid. We call this imaginary fluid a "rotating magnetic field". A linear induction motor is effectively this same machine which has been cut open and unrolled, as shown in fig. 2. The rotating magnetic field now becomes a field which travels along with it. (Fig. 3). Each coil is fed with alternating current and the whole array will propel a piece of aluminium sheet placed over the coil ends.

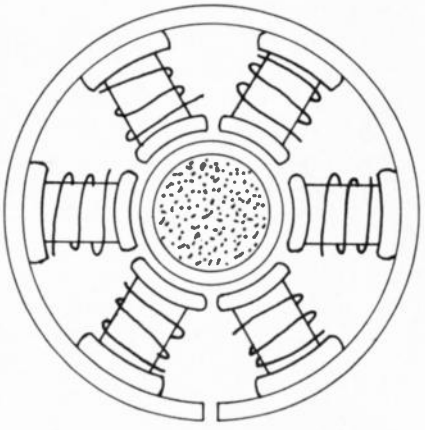


Fig. 1. A ring of coils can produce a rotating magnetic field.

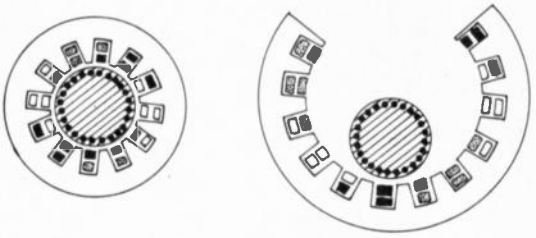


Fig. 2. Imaginary process of unrolling a conventional motor to obtain a linear induction motor.

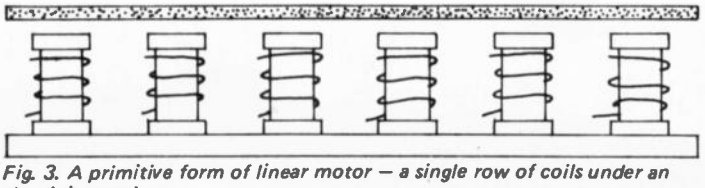


Fig. 3. A primitive form of linear motor — a single row of coils under an aluminium strip.

POWER SUPPLIES

This series of articles by B. Doherty outlines the operation, performance, limitations and design aspects of the modern dc power supply.

THE usual first stage in a dc power supply is the transformer which converts the ac at mains voltage to the (usually) lower voltage required for semi-conductor circuits. The transformer also isolates the circuit from the ac mains (Fig. 1).

The output of the transformer is still ac, so a rectifier is required to convert this to dc. (Fig. 2).

The dc output is, however, a fluctuating direct current, so a smoothing, or filter, circuit is required. (Fig. 3).

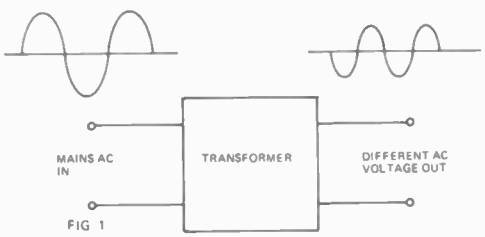


FIG 1

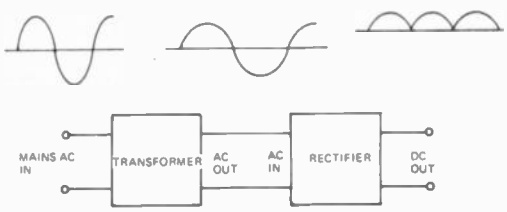


FIG. 2

This provides an almost steady dc, there remaining only the problem of being sure that the supply maintains a steady flow of power and does not allow fluctuations. For this, a control circuit is added to counteract fluctuations in supply or load.

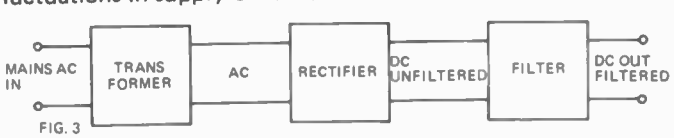


FIG. 3

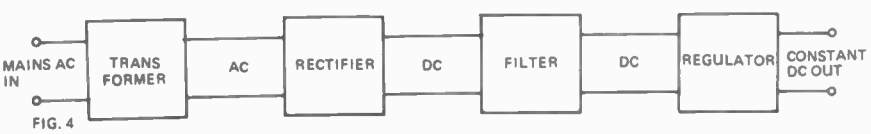


FIG. 4

This low cost supply is continuously adjustable from 0-20 volts.

The block schematic of a complete power supply is shown in Fig. 4.

Power supplies may be required to supply either constant voltage or constant current.

A constant voltage power supply acts to maintain its output voltage constant, in spite of changes in load, line, temperature, etc. Thus for a change in load resistance, the output voltage of this type of supply remains constant while the output current changes by whatever amount is necessary to accomplish this.

A constant current power supply on the other hand, acts to maintain its output current constant in spite of changes in load, line and temperature. And thus for a change in load resistance, the output current remains constant while the output voltage changes by whatever amount is necessary to accomplish this.

The differences between the two types of power unit are shown graphically in Figs. 5 and 6.

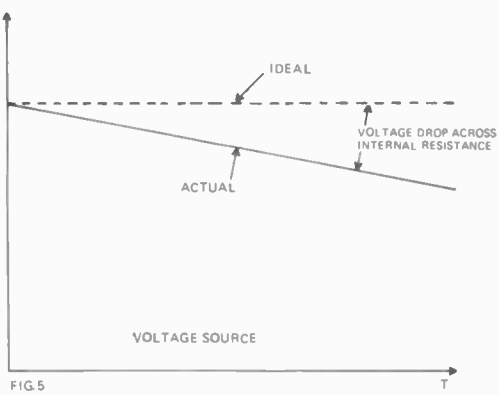


FIG.5

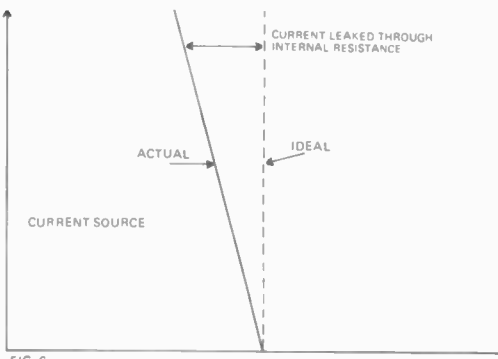


FIG. 6

The internal resistance of an ideal voltage source will be zero, so that there is no voltage drop across the internal resistance, and the internal resistance of an ideal current generator will be infinite, so that there is no current lost internally. This is perhaps clearer if we look at the circuit of practical voltage and current generators (Figs. 7 and 8).

In both cases the actual source consists of an ideal source (Fig. 7) with an internal resistor connected so as to introduce an imperfection before the terminals (Fig. 8).

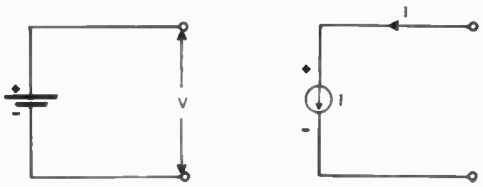


FIG. 7

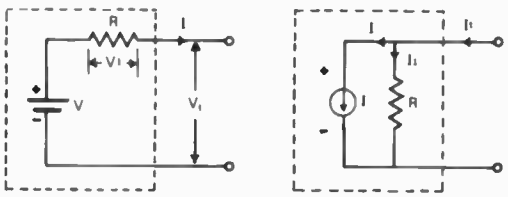


FIG. 8

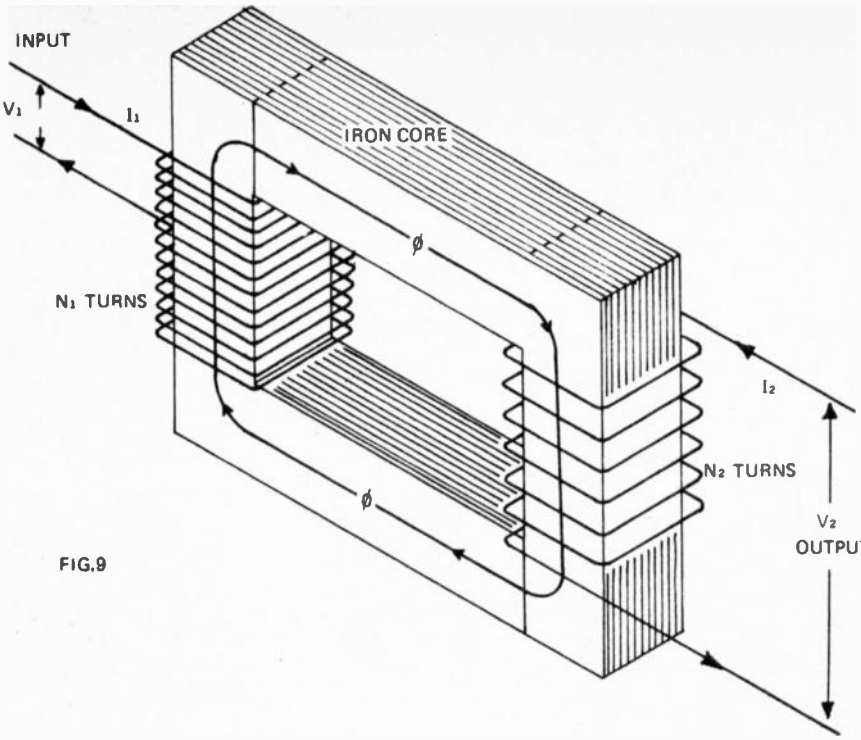


FIG.9

THE TRANSFORMER

The transformer (Fig. 9) operates by creating a magnetic flux (ϕ) in the iron core by passing a current into the primary, then the passage of the magnetic flux through the secondary generates a voltage in the secondary (Faraday's law).

Note that the coupling between the primary and the secondary is magnetic only — there is no electrical coupling.

The ratio of primary and secondary quantities is determined by the turns ratio. Thus

$$\frac{V_2}{V_1} = \frac{N_2}{N_1}$$

$$\frac{I_2}{I_1} = \frac{N_1}{N_2}$$

Theoretically there is no power loss in the transformer, so the principle of conservation of energy, requires that the input power is equal to the output power

so $P_1 = P_2$

i.e. $V_1 I_1 = V_2 I_2$

It is from this product of $V_1 I_2 (= V_2 I_1)$ that the volts/amps of a transformer is derived.

In practice of course, there are losses in the transformer which mean that the power in the secondary is less than the power in the primary.

The relation between primary current and magnetic flux is as shown in Fig. 10.

Note that the relation is linear from 0 to A, but after A no matter how much the current is increased the flux remains approximately the same. This phenomenon is called *saturation* (of the iron core) and occurs when the great majority of the magnetic dipoles in the iron have been aligned with the flux.

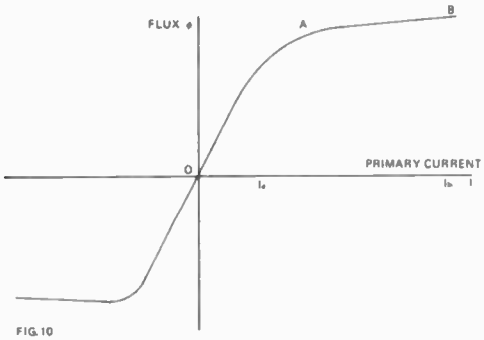


FIG.10

The segment AB is called the saturation region.

If the primary current is derived from the ac mains it will have a sinusoidal waveform. If the peak of the sinusoid is less than I_A, the flux produced will be an exact replica of the input current, because as current goes up, flux goes up and vice versa.

The secondary voltage will be approximately proportional to the flux, and will therefore also be sinusoidal.

There is however a renewal of interest in the type of transformer where the peak of the primary current moves well into the saturation region. In this type of transformer the peak primary current is I_B. The flux varies directly with primary current until A is reached, then it remains approximately constant over AB as the sinusoid rises to a peak then falls.

This regulated power supply, designed and made in Australia, provides outputs adjustable from 9 to 16 volts at currents of up to 15 amps.

POWER SUPPLIES

When the primary current falls below A, the flux once again varies directly with primary current. The flux waveform is then as shown in Fig. 11, and since the secondary voltage is roughly proportional to the flux, the secondary voltage is as illustrated in Fig. 12.

(Note that transformers must be specially designed to operate in this mode.)

DIODES

The voltage/current graph for a typical diode is shown in Fig. 13. When a positive voltage is applied, the current is high and the forward voltage drop is less than 1 volt. When a negative voltage is applied, a negligible current flows.

The diode is eminently suitable for use as a rectifier because of its ability to pass current only in one direction.

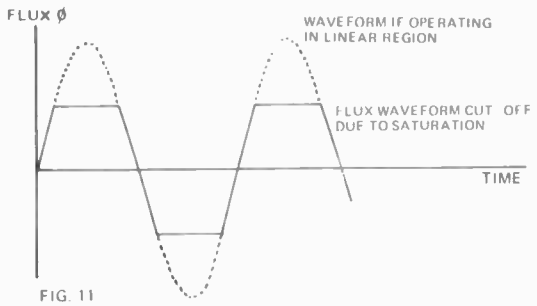


FIG. 11

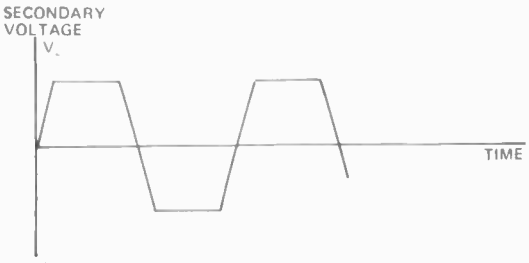


FIG 12

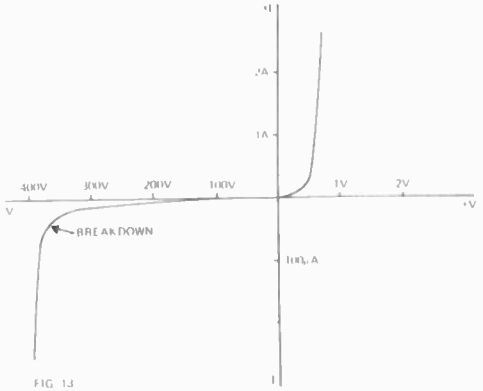


FIG 13

BASIC RECTIFIER CIRCUITS

The simplest possible rectifier circuit is shown in Fig. 14.

The diode will pass only the positive half cycle of the secondary ac voltage, so the voltage across the load is as shown in Fig. 15. The output is a fluctuating direct current (since it moves always in the positive direction).

The circuit shown in Fig. 14 is a half-wave rectifier. As a source of direct current it is not very effective because of the large voltage fluctuations. The full-wave rectifier is a substantial improvement.

The two most common types of full-wave rectifier are the centre tapped (Fig. 16) and the bridge (Fig. 18) configurations.

The full-wave centre tapped secondary configuration is shown in Figs. 16 and 16a. On the positive half-cycle A is at +V, B at 0V, and C is at -V. Thus A is more positive than B, and diode D1 conducts via the load in the direction shown. Diode D2 has a negative voltage across it and does not conduct.

On the negative half-cycle, A is at -V, B is at 0V, and C at +V. Thus C is more positive than B_1, so diode D_2 conducts via the load in the direction shown. Note that it conducts in the same direction as did D_1. Diode D_1 now has a negative voltage across it and does not conduct.

The voltage applied to the load is therefore as shown in Fig. 17. The fluctuation is much less with this waveform. (Half as much as with the half-wave configuration.)

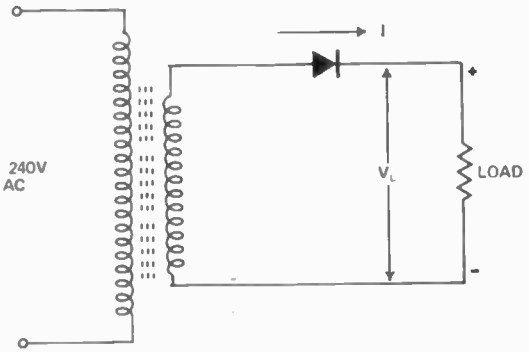


FIG. 14

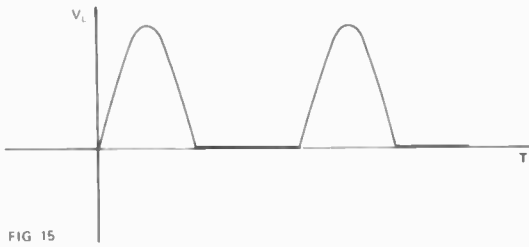


FIG 15

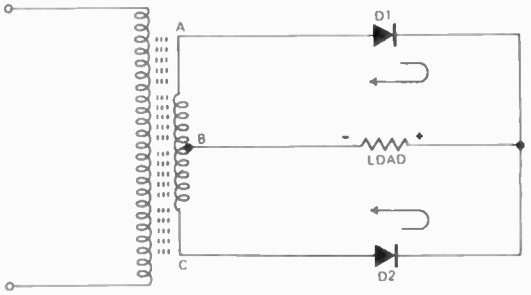


FIG. 16

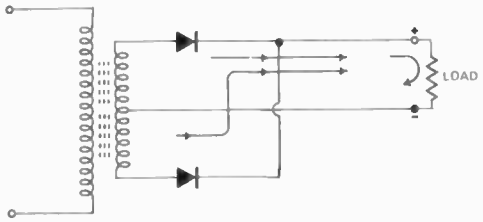


FIG.16A

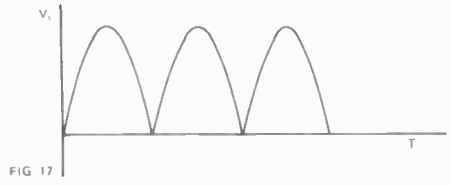


FIG 17

THE BRIDGE RECTIFIER

The second common type of rectifier is the bridge rectifier. (Fig. 18).

During the positive half-cycle, current flows from A to B through D1, through the load, and through D3. During the negative half-cycle, current flows from B to A through D2, *through the load in the same direction as before* and through D4.

The voltage applied to the load is, therefore, the same as in the centre-tapped circuit shown in Fig. 16 above.

VOLTAGE DOUBLERS

Another type of rectifier-filter commonly used in low power applications where the load is relatively constant is the voltage doubler (Fig. 19).

When A is at +V and B is at 0V, diode D1 conducts and charges C1 up to the peak of the ac voltage. Diode D2 has a negative voltage across it and does not conduct. When A is at -V and B is at 0V, diode D2 conducts and charges C2 to -V peak. Diode D1 has negative voltage across it and does not conduct.

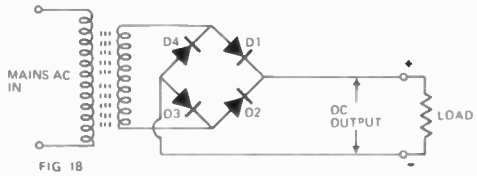


FIG 18

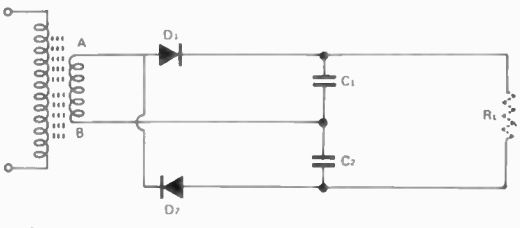


FIG.19

Since capacitors C1 and C2 are in series, the voltage across them (off load) is twice the total peak ac voltage, hence the term voltage doubler.

When a load is applied to the voltage doubler circuit, the output voltage will be less than twice the peak voltage. The actual voltage will depend on the value of the capacitor and the load current drawn from the circuit.

VOLTAGE MULTIPLIERS

The voltage multiplier shown in Fig. 20 produces high voltage at lower power levels.

Off load, the output voltage of this configuration is twice the peak ac voltage multiplied by the number of stages used. Both diodes and capacitors must be rated as twice the peak ac input voltage.

DIODE SELECTION

The important factors in selecting suitable diodes are the current they must carry, both peak and average,

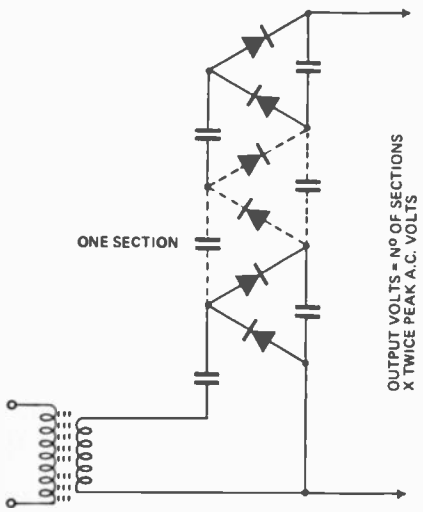


FIG.20 VOLTAGE MULTIPLIER

and the negative voltage which will appear across them when they are non-conducting. If the permissible maximum currents (as determined from the manufacturers' specifications) are exceeded for even a short time the diode will be destroyed, and if the negative voltage exceeds the Peak Inverse Voltage (P.I.V. – once again found from manufacturers' specifications) the diode will probably be destroyed by avalanche breakdown.

In the half-wave circuit the single diode must carry the full current and the full secondary voltage (the *peak*, not the rms which is normally specified at the secondary). For a sinusoid, the peak voltage = rms voltage x $\sqrt{2}$. If capacitors are used to filter the output, the diodes must be rated at twice peak voltage.

In the centre-tapped secondary or circuit, the voltage of the transformer is usually quoted as half the total voltage – 0 – half the total voltage; thus if the total output voltage is 650V, the transformer specification will be 825-0-325 volts.

The diodes must be rated for the peak of the *total* output voltage, and half the output current.

In the bridge rectifier the diodes are rated for the peak of the ac voltage and half of the full amount.

FILTER CIRCUITS FOR POWER SUPPLIES

A full-wave rectifier output may be shown to be equal to a constant voltage *plus* an alternating voltage, by the use of a Fourier series. Thus the output voltage is expressed by

$$V_o = \frac{2}{\pi} V_m + \frac{4}{3\pi} \cos 2\,wt + \text{negligible terms}$$

where vo is the rectifier output voltage

V_m is the peak rectifier output voltage

$w = 2\pi f = 2\pi \times 50$ Hz is the supply frequency in radian/sec.

The purpose of the filter circuit is to remove the ac component of the rectifier output but allow the dc component to pass through. The ac component is termed "ripple" (and in audio work "hum", from the 100 Hz signal produced in the speakers by the ripple voltage).

The ripple will be an important factor in deciding the performance of a power supply, so we must establish an accurate means of measuring and recording it. For this purpose we introduce the "ripple factor", which is defined by —

$$\text{ripple factor, r equals } \frac{\text{rms value of alternating components of output}}{\text{dc value of output}}$$

For a good power supply the alternating component is small in relation to the dc component, so the ripple factor will be small.

The dc and ac components may be measured quite readily using a dc reading meter for the dc component, and an rms reading meter (with a capacitor in series) for the ac component.

With a sinusoidal input, the ripple factor of a half-wave rectifier is 1.21, and for a full wave rectifier it is 0.482. In other words for a half-wave circuit the ac component is larger than the dc component by about 20%, while for a full-wave circuit the ac component is less than half the dc component. Thus full wave rectification clearly provides a substantial improvement in ripple factor, and hence it is almost always used where the quality of the dc supply is in any way important.

The simplest filter circuit is a choke or inductance connected in series with the output. The reactance of the choke is $2\pi fL$, where f is frequency (in Hz), and L the inductance of the choke (in Henrys). The ac component of the waveform sees this as a high impedance, but the dc component, having zero frequency, sees no impedance. Thus a high impedance is inserted for the ac component, but has no effect on the dc component. (In practice there will be a small dc resistance due to the copper wire used to wind the choke).

A typical circuit arrangement is shown in Fig. 21.

The ripple factor with a choke filter is approximately

$$r = \frac{1}{3\sqrt{2}} \cdot \frac{R_L}{2\pi fL}$$

Thus ripple is increased as the load increases and as the current falls (Ohm's Law), i.e., low ripple at high currents.

A substantial improvement is obtained with the capacitor filter (Fig. 22). The capacitor value must be large

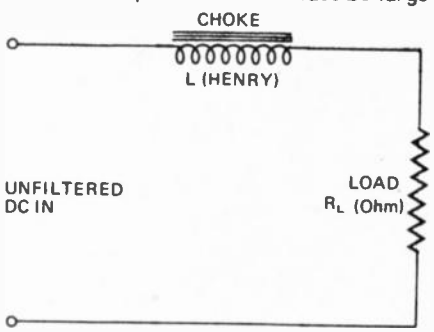


FIG. 21

to provide as low an impedance path around the load as is possible for the ac components. Of course, no dc passes through the capacitor.

The capacitor charges up to the peak of the unfiltered dc output, and when the output voltage falls, the capacitor discharges through the load, thus

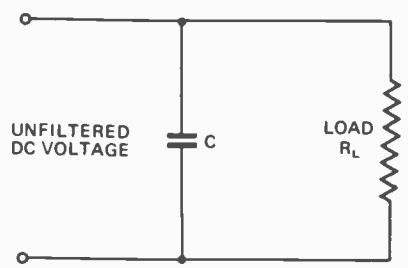


FIG. 22

tending to keep the voltage across the load up to its peak value.

The major drawback of the capacitor filter is that with each peak it recovers the lost energy, and this results in a high current inrush as the capacitor starts charging (Fig. 23). Because of the voltage stored on the capacitor the diode has only a positive voltage across it for the time periods shown in Fig. 23.

The peak diode current is

$$I_{peak} = V_m \sqrt{(2\pi f)^2 C^2 + \frac{1}{R_L{}^2}}$$

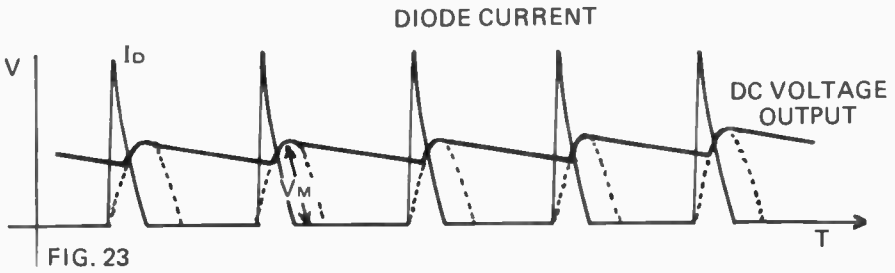


FIG. 23

This is the peak current which the diode will conduct on each fluctuation, The diode peak current rating must, therefore, be in excess of the value which is calculated from the above.

For a single capacitor filter the ripple factor is given by

$$r = \frac{I_{DC}}{4\sqrt{3}\ f\ C\ V_{DC}} = \frac{1}{4\sqrt{3}\ f\ C\ R_L}$$

A substantial improvement is obtained with one of the more commonly used circuits, the pi-section filter (Fig. 24).

The ripple factor for this circuit is

$$r = \sqrt{2}\ \frac{Xc}{R_L}\quad\frac{Xc1}{X_L1}$$

It is possible to replace the inductor with a low value resistor (with a sufficiently high wattage to allow it to carry the full load current).

The ripple factor is then

$$r = \sqrt{2}\ \frac{Xc}{R_L}\quad\frac{Xc1}{R}$$

The use of the resistor in place of the choke is quite common because of the expense, weight, and bulk of the choke.

VOLTAGE STABILIZATION

There are three main factors which may cause the output voltage to vary. The ac supply may fluctuate by up to ± 10%, the load current may range from zero to the full load current, and the temperature may have a further effect, particularly with semi-conductor devices.

The main source of variation in output voltage is the variation with load current. This is because the resistance of the copper wire used in the transformer, the forward resistance of the diode, filter resistance, and the like, cause a voltage drop which is proportional to the load current.

It is possible to represent a voltage source by an ideal voltage source in series with the internal resistance (indicated above) as shown in Fig. 25. The voltage appearing across the load is then the voltage of the ideal voltage source *less* the voltage drop across the internal resistance.

i.e. $V = E - I\,Ri$

So as I increases, V falls.

The measure of the stability of the output voltage is the *regulation*, defined as

$$\text{per cent regulation} = \frac{\text{no load voltage} - \text{full load voltage}}{\text{no load voltage}} \times 100$$

Devices which stabilize the output voltage are, therefore, frequently called regulators.

Regulators fall into two categories. These are the shunt regulator (Fig. 26) and the series regulator (Fig. 27).

Both type utilize the fact that Vo = Vi = Vf. If Vi alters and Vf can be made to alter by an equal amount, then their difference (i.e. Vo) will be unchanged.

With the shunt regulator the output voltage is compared with a fixed reference voltage V_R, and a greater or lesser current is drawn by the regulator in proportion to the difference.

This either increases or decreases V_f depending on whether Vo has increased or decreased.

The series regulator has V_f dropped over the regulator itself and the voltage-drop over the regulator is made inversely proportional to current by comparison of Vo and V_R.

The second part of this article which will be published next month considers actual regulator circuits, protection, transients, saturating core transformers, control of power flow, output voltage control, and cooling. ●

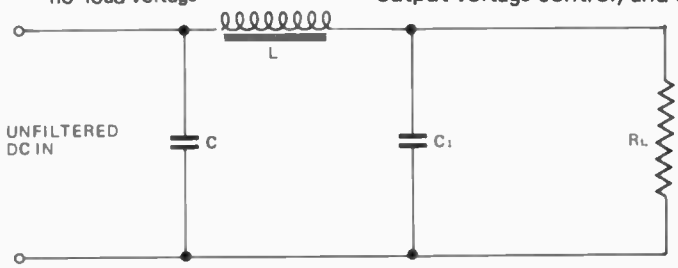


FIG. 24

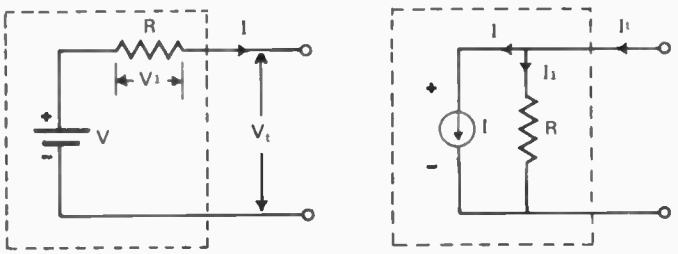


FIG. 25

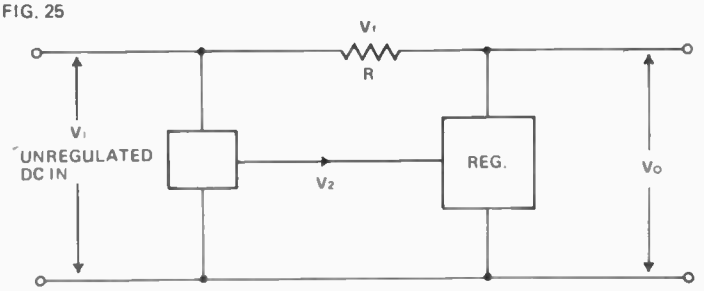


FIG. 26

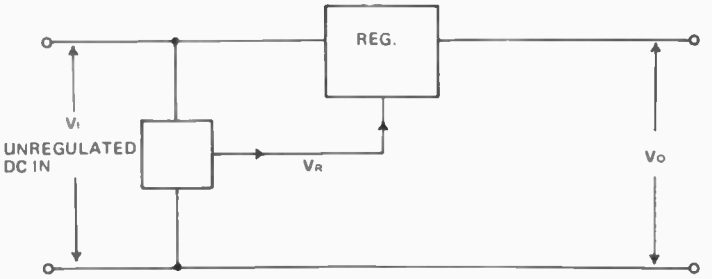
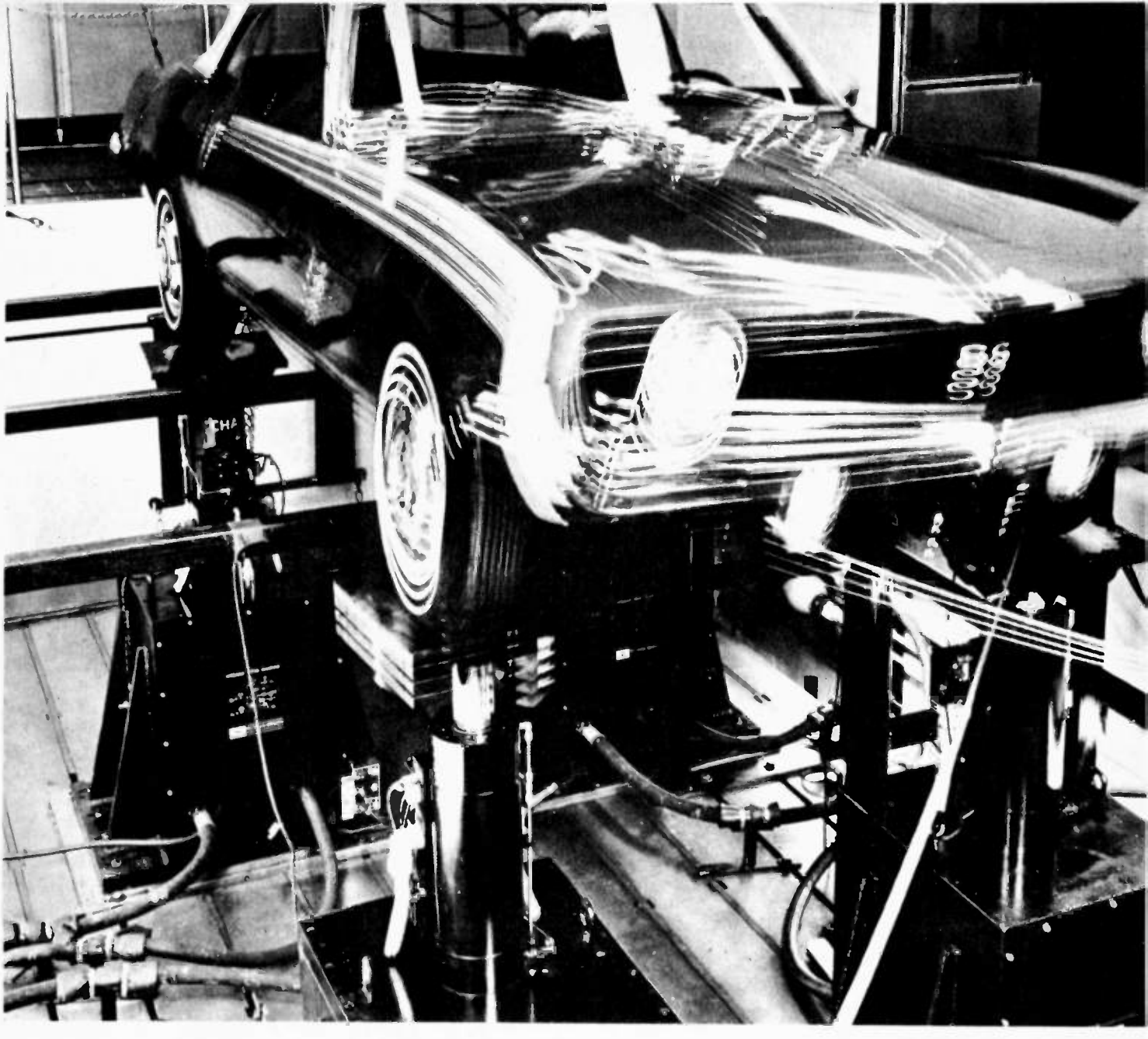


FIG. 27



SHAKE, RATTLE AND ROLL

Latest development in automobile research enables one hundred hours of laboratory testing to equal 25,000 miles on the road.

Vehicle proving grounds are great for publicity. Standard sedans and trucks thrashing around a quarter mile loop of simulated Belgian cobblestones rarely fail to impress — especially if one is inside them.

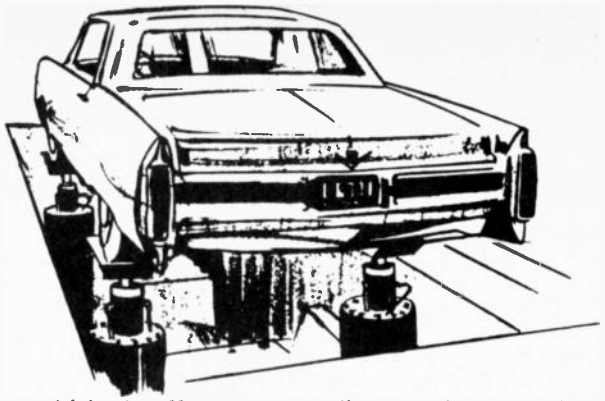
But proving grounds have a tendency to breed vehicles that can thrash around on Belgian cobblestones (simulated or otherwise) until wheels go out of fashion, yet fall to bits on African or Australian dirt roads within a year.

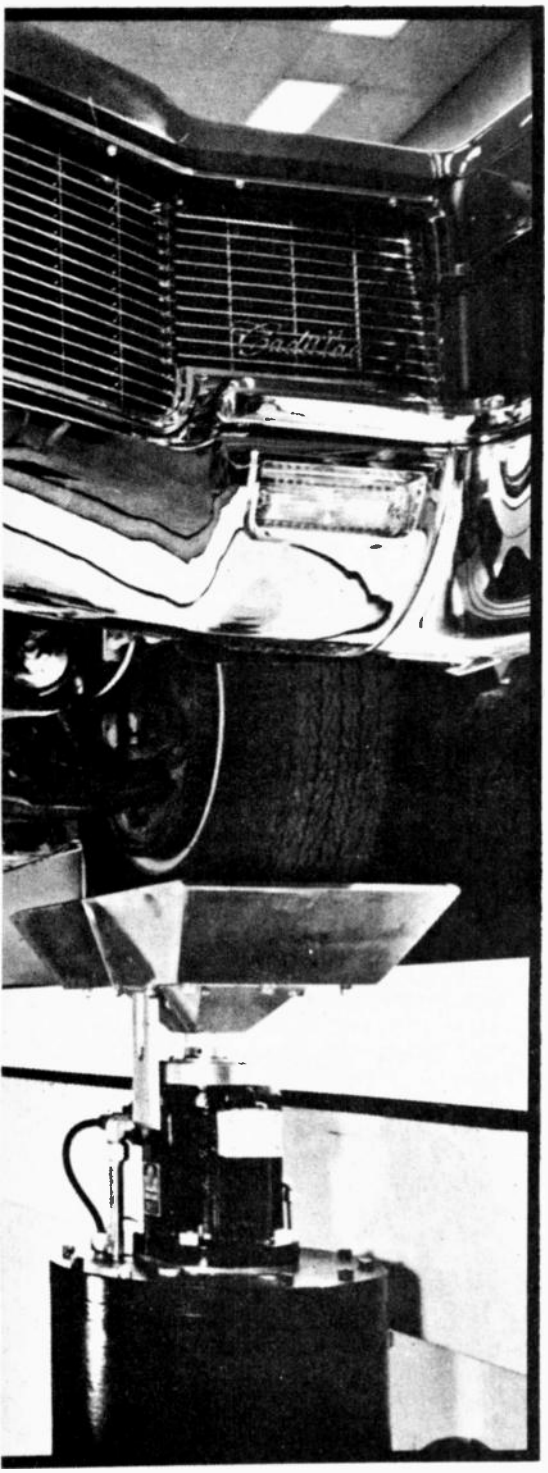
Given enough road surfaces and conditions, and experienced test drivers willing to go nowhere at an almost continuous 2 to 3G, proving ground evaluation has some merit.

But its drawbacks are only too well known to the automotive research engineer.

An alternative and possibly better method is to recreate actual road 'patterns' at each wheel of a stationary

SHAKE, RATTLE AND ROLL





Detail view of electro-hydraulic actuator, hydraulically operated floor is raised when car is driven onto the simulator, then lowered to allow access to all parts of the car during test.

vehicle. In effect tape recording a road and then playing it back to the vehicle.

Apart from the saving in operating and capital cost, the in-plant testing facility can be constructed to provide accessibility to all parts of the vehicle while the test is running. Better control and repeatability of input conditions are possible with this method.

The method can be used to test either complete vehicles, or merely sub-assemblies – such as the complete front or rear suspension.

Nevertheless the reproduction of dynamic conditions to which the vehicle is normally subjected is still quite an engineering challenge.

SUSPENSION LOADS

The front suspension members for example are subjected to a large number of different situations, leading to an enormous variety of relationships among all external forces acting upon them.

These external forces vary not only in magnitude but have different directions depending upon their origin. Therefore the magnitude and direction of the vector sum of the forces will vary accordingly.

The main force components acting on a load carrying ball joint are shown in Fig.1. These forces act at the points where the tyres make contact with the road:–

1. Dynamic force (P) acts in the vertical direction due to the combination of vehicle speed and road surfaces.

2. Centrifugal force (C) acts in the transverse direction due to the combination of vehicle speed and turning.

3 Deceleration force (B) acts in the longitudinal direction due to braking.

Each of these forces will produce at least two force components at any of the front-end members because of the geometry of the suspension system.

For example, on a load carrying ball joint, the vertical dynamic force (P) will produce vertical and transverse force components; the transverse centrifugal force (C) will produce transverse and vertical force components; and the longitudinal deceleration force (B) will produce longitudinal and vertical force components.

And as the forces involved are multi-directional, the road simulator must be able to create adequate forces simultaneously in three directions.

These required forces are generated either electrically or electro-hydraulically.

In the purely electrical system, the actuator looks like the world's biggest loudspeaker, with the exception that a longitudinal thrust rod replaces the loudspeaker cone. When a voltage is applied to the 'voice coil' – the rod produces the mechanical analogue of the input voltage.

The power required to drive these vibrators is large and inputs of up to 100 kW are common.

The electrical vibrator has a relatively fast response time, and by using suitable transducers, overall motional feedback can be applied around the complete loop.

ELECTRO-HYDRAULIC ACTUATORS

The electro-hydraulic actuators, on the other hand, consist of linear hydraulic rams controlled by servo-valves governed by an electrical signal. The forces generated by such actuators are so accurately controlled, that within their designed working load, they can provide a waveform deviation of less than 0.001 inch from a true sinusoidal input. Yet the maximum force obtainable may exceed 1,000,000 pounds.

Closed-loop control can also be obtained with electro-hydraulic systems. A transducer mounted directly on the specimen, measures actual forces or displacements on the specimen, and outputs an electronic feedback signal that represents actual forces or displacements. The servo controller compares the feedback signal with the programme input signal. Any difference between the two signals automatically boosts or reduces the signal to the servo valve, thus changing the forces on the specimen, until both signals are substantially equal.

The necessary road condition data is obtained by equipping a representative test vehicle with transducers that monitor and translate speed, torque, tyre deflection, axle displacement, body acceleration, cornering force, diagonal strain etc.

The vehicle is then driven, with various loadings, over terrain similar to that for which the vehicle was designed.

The data from the various transducers is recorded onto magnetic tape by using an FM recording technique similar to that described on page 32 of this issue.

The taped signals, after suitable editing, are then reproduced to programme the test. Further transducers fitted to the vehicle under test, produce a second set of data that is compared with the original data to check the accuracy of the overall loop.

RESULTS OBTAINED

The results so far have been very worthwhile, especially for sub-assembly testing. An excellent correlation of wear patterns has been obtained between assemblies tested on a simulator, and those tested under actual road conditions.

In addition to accuracy, the laboratory system has proved to be less costly and time consuming. For comparison, 100 hours of simulated running is the proving ground equivalent of 5,000 miles which in turn represents at least 25,000 miles of 'normal use'.

But let us hope that the concept will be applied to making vehicles last longer — rather than as one fears — ensuring that no one component goes on for more than 25,000 miles! ●

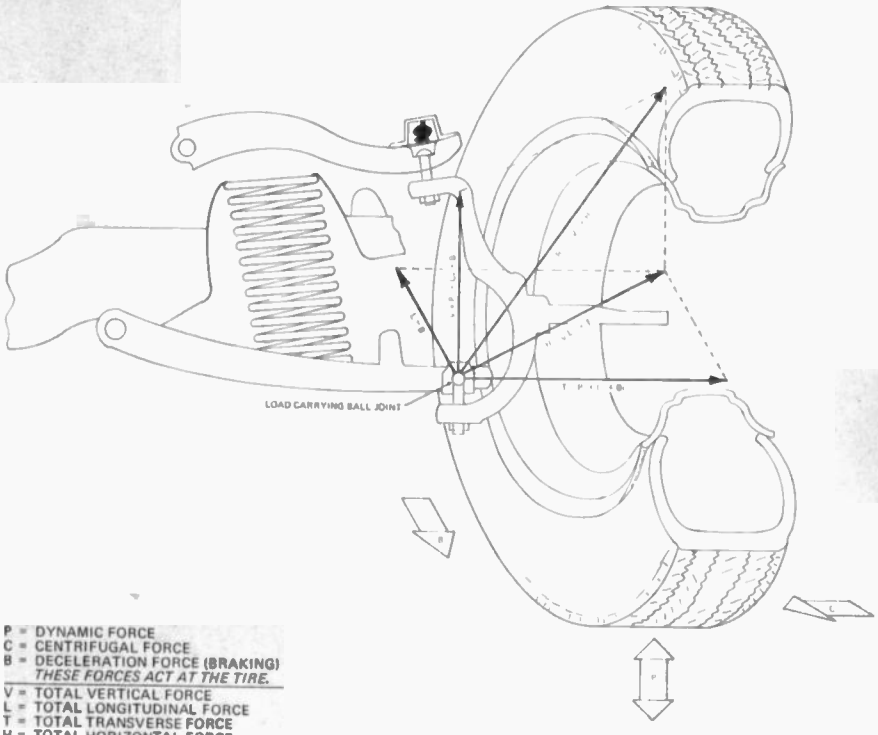


Fig. 1. Force components produced on a load-carrying ball joint.

THE 3-D LASER MICROSCOPE

A British physicist, Dr Robin Smith of Imperial College, London, has built a remarkable optical microscope based on a new principle which can provide completely undistorted three-dimensional viewing and recording of such vital events as the way in which human blood cells devour bacteria, or what happens when living cells divide.

Dr. Smith's microscope uses two exciting developments of recent years, the laser and the hologram. The laser produces an extremely intense beam of light on a single wavelength. The hologram is really a remarkable kind of photograph which, when illuminated with light from a laser, provides the human eye with a perfect three-dimensional image of the subject of the photograph.

The microscope works like this. The object under examination is mounted on a slide and positioned on the microscope stage in the usual way. But in place of the usual mirror beneath the microscope, normally put there to reflect light up through the object, there is a photographic plate. Instead of being illuminated from below the slide is illuminated from above, by a laser which shines its beam down the barrel of the microscope.

When the laser is switched on it takes a photograph of the object on the photographic plate. This photograph is a hologram. When the slide with the object under examination is removed and replaced by an empty slide, with the photographic plate still in position beneath, then if the observer looks down the barrel of the microscope it will appear as though the object is still there. It is an uncanny experience to see a perfect three-dimensional replica of the object materialise upon the empty slide. If the photographic plate is replaced by a moving film then this can provide a complete three-dimensional reconstruction of a complete event like cell division.

Perhaps the cleverest thing about this ingenious invention is that there is absolutely no distortion in the three-dimensional image created. This is because any distortions which are caused while the laser beam is taking a photograph are cancelled out when the beam is used again to illuminate the hologram and create the image.

The microscope is the first of its kind in the world and biologists and metallurgists are particularly interested in seeing it developed commercially. It is too early yet to say what a production model will cost but it should be within the reach of most laboratories since the only expensive item is the cost of the cheapest form of laser — perhaps two or three hundred pounds. ●

A TILT IN THE KILT

by Professor R.V. Jones,
Dept. of Natural Philosophy, Aberdeen University.

The whole Eastern region of Scotland tilts by one part in a million at high tide. Detection of small movements such as this is fundamental to many forms of physical measurement; and for this reason scientists are studying ways in which small movements can be magnified.

Magnification by itself, however, is not enough – as anyone will know who has tried to use high-powered fieldglasses; the magnification can only be used effectively if the glasses can be rested against a firm support. In developing sensitive instruments it is therefore necessary to make sure that they are well supported and especially to ensure that their various components are maintained in the desired geometrical relationship to one another.

The methods of magnification which we have developed at Aberdeen have been principally the optical lever and the capacitance micrometer. In the former, the rotation of a small mirror is made to turn a light beam reflected from its surface and the movement of the beam is then detected by photocells. With its aid we have performed such experiments as operating galvanometers at the limit of sensitivity imposed by the Brownian movement generated as the galvanometer coil jumps about under the bombardment of the molecules in the air that surrounds it, and as observing the change of momentum when a light beam enters an optically denser medium. Currently we are using a rather similar technique to observe the effect predicted by Fresnel in 1818, but never before directly observed, of the transverse movement of a light beam when it passes through a denser medium, such as glass, that is in motion at right angles to the direction of the beam.

The foregoing optical techniques are very good for observing small movements (in the range of 10^{-11} centimetres upwards) when these movements occur relatively quickly, say within a few seconds. But they are not so good if the movements are slow, because sources of light such as tungsten filaments are insufficiently stable.

We have therefore turned to capacitance micrometry for work involving long-term stability, because this method depends on measuring small displacements of one plate of an electrical capacitance relative to another, and all the components are simple and fairly stable – at least they do not deteriorate as does a lamp filament, nor do they heat and distort one another.

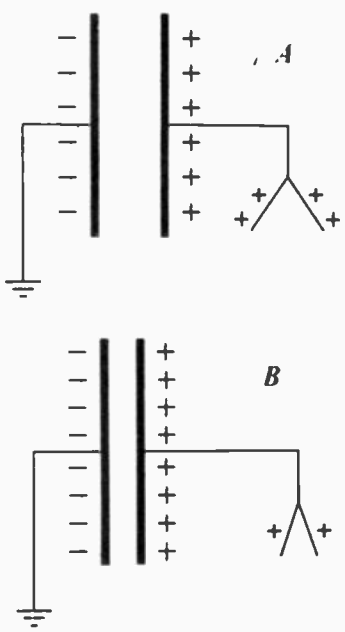


Fig. 1. Principle of the capacitance micrometer.

CAPACITANCE MICROMETRY

The first suggestion for a capacitance micrometer seems to have been made by Villey in 1910. His system consisted of a parallel plate condenser with one plate connected to earth and the other insulated from earth and connected to a gold leaf electroscope. If the plates are widely separated (Fig. 1A) and a positive charge is given to the insulated plate, two things occur. First, some of the positive charge flows to the electroscope and makes its leaves diverge. Secondly, the charge that is left on the plate induces a charge of opposite sign (negative) on the earthed plate. A state of equilibrium is reached where the positive charges on the electroscope are repelled by those on the insulated plate but where this repulsion is to some extent offset by the attraction of the negative charges on the earthed plate. If the latter is now brought closer to the insulated plate (Fig. 1B), its negative charges are able to exert a greater attraction on the positive charges on the electroscope and so some of these charges are pulled out of the electroscope towards the plate; these in turn draw up further negative charges onto the earthed plate. A new state of equilibrium is reached in which the electroscope leaves diverge less than they did before. It is possible to devise such a system in which the movement of the leaves is greater than that of the earthed plate which caused the change in equilibrium.

Villey reported that he had achieved a magnification of more than a million and that his sensitivity surpassed that which could be attained even by optical interferometry. In 1920 Professor R. Whiddington showed that the device could be converted into a practical instrument by using thermionic valve technology in place of the electroscope; and in the last ten years my colleague Dr. J. C. S. Richards has developed solid state circuitry of high stability and reliability, so that the limitation on the method is now much more often set by the mechanical stability of the capacitance rather than by the electronics. In our most usual arrangement, two capacitances are constructed as similarly as possible and connected into a transformer ratio bridge operating at 16 kHz. If possible, the body whose displacement is to be measured, is mechanically connected to the capacitances so that the displacement increases one of these capacitances and decreases the other, by the movement of their plates.

SOURCES OF INSTABILITY

Before the system is used in practical instruments, it has been necessary to study many of the ways in which the

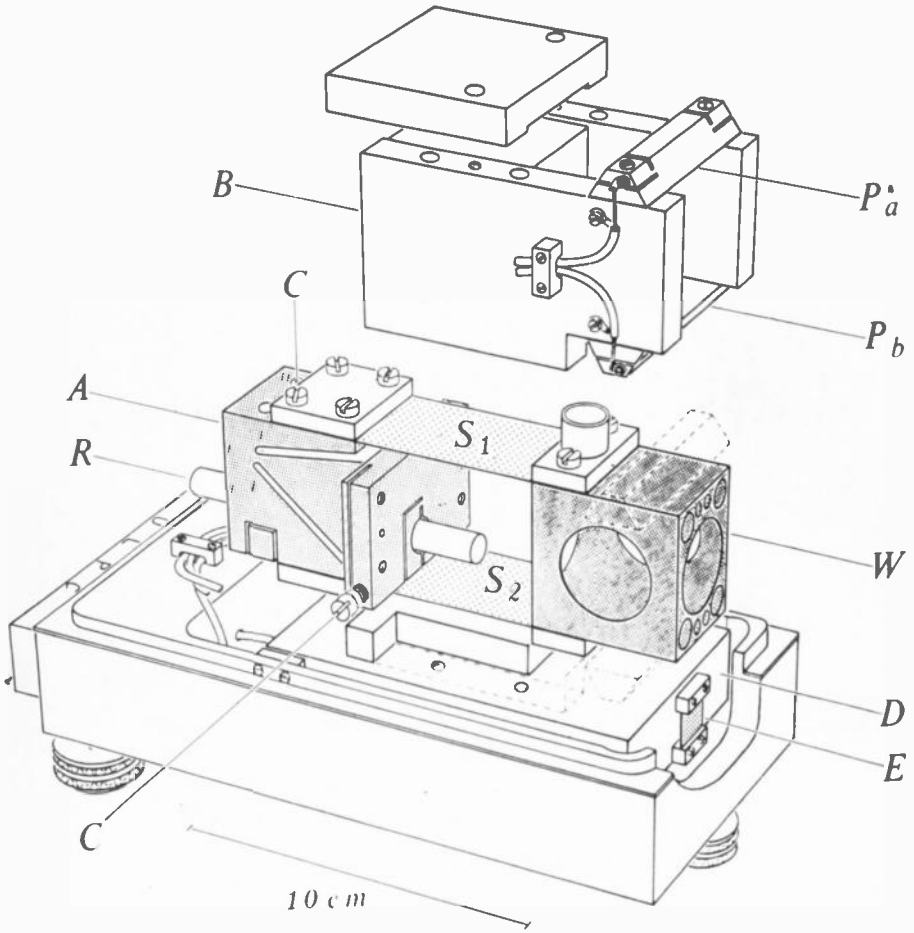


Fig. 2. Gravimeter, in which suspended weight W is held by cantilever springs S_1 and S_2, which deflect vertically by about 5mm because of the gravitational pull on W. Small changes in the position of W, due to changes in 'g' are recorded by the disturbance of the bridge formed by W, P_a, and P_b.

value of the capacitances may change, as it were, spontaneously. A change in temperature, for example, will cause the physical dimensions of the capacitance to change; so will a variation in atmospheric pressure, if the capacitance is not kept in a sealed box. At the sensitivity that we have available it would be possible to detect the expansion and contraction of the brass capacitance plates as they are subjected to the pressure fluctuations due to quite small gusts of wind outside the building. Another source of variation is the change in dimensions of both metal components and insulators as they "age". It is difficult, for example, to make even as simple a component as a gauge block that will maintain its dimensions to better than one part in ten million per annum, because of the internal atomic rearrangements that may take place continually if the material of the gauge is in a state of strain. Obviously, some of the causes of trouble, such as temperature and pressure fluctuations, can be much reduced by taking suitable precautions; but other troubles, particularly those resulting from strain in some of the components, are difficult to counter. Almost every method of holding components together, such as screws or adhesives, automatically involve strain, and the best method of joining components is that which results in the inevitable strain having a minimum effect.

Taking the best precautions we can, we find that it is not easy to maintain a stability of much better than one part in a 1000 million per day, so that with components of the order of one centimetre in size, it is difficult to be sure of a measurement that involves a change of less than 10^{-9} centimetres per day. Useful short-term sensitivity can, of course, be considerably higher. Here the main sources of disturbances are "noise" in the electronic system and (more usually) mechanical vibration. A movement of 10^{-11} centimetres is detectable; and, with due precautions, an equivalent "noise" of better than 10^{-12} centimetres can be achieved for a bandwidth of 1 Hz.

TILTMETERS

The first instrument to which we applied capacitance micrometry was a microbarograph for investigating pressure waves of small amplitude in the atmosphere. It has proved useful in the detection of disturbances such as those due to meteorite impacts, nuclear explosions, and (occasionally) the launching of large rockets. We also developed a tiltmeter for observing small local changes in the tilt of the Earth's surface. The instrument is effectively an electronic plumb line, where the "bob" is a small slab of metal about 30 millimetres long, and capacitance plates are situated on either side of it; if the instrument is placed on an initially level surface, the bob hangs equidistant from either plate and the electronic bridge is balanced. If the surface of the Earth below the instrument then tilts, one plate is now nearer to the bob than the other and the amount of tilt is recorded by the amount that the balance of the bridge has been altered. Such an instrument will detect changes in tilt of one part in 1000 million, but it cannot be used at this sensitivity because the Earth's surface is continually in motion owing to microseismic waves that are generated on the beds of the ocean by standing waves excited by atmospheric storms.

Even at considerably lower sensitivities, there are obvious effects due to the change in local tilt of Aberdeen, for example, caused by the extra weight of water in the North Sea at high tide. The sea-bed compresses elastically under the extra weight, and draws downwards with it the eastern part of Scotland, so that this region tilts eastwards by an angle of about one part in one million at high tide. There is also a long-term increasing tilt eastwards over the whole of Great Britain which is thought to be due to the eastward drift of the whole area caused by the flow of the solid ocean-bed eastwards from the mid-Atlantic ridge. The evidence for this, however, does not come from our instruments but from observations of the change in shore levels of the British coasts over the last thousand years or so. In other parts of the world these tilting effects are more pronounced, and can result in the build-up of such stresses that they can be released only by the violent movements of earthquakes; and it is possible that tiltmeters may be of some use in predicting earthquakes by observing the build-up of strains that show themselves by local changes in tilt.

EARTH TIDES

Our most recent instrument using capacitance micrometry is a gravimeter. Basically, this measures small changes in the pull of gravity by suspending a mass on a spring; any change in gravity causes a

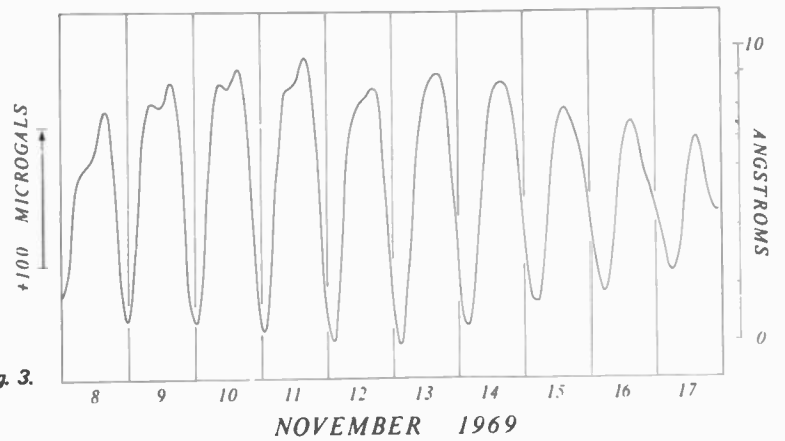


Fig. 3.

Fig. 3. Gravimeter record, showing variation of 'g' over a period of ten days. Arrow at left indicates magnitude of an acceleration of 10^{-4}cm/s^2. Scale at right is variation in position of weight, in units of 10^{-8}cm.

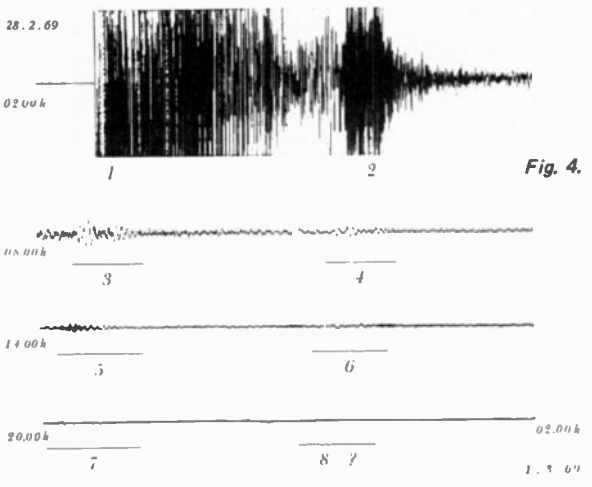


Fig. 4.

Fig. 4. Record of disturbance of the Earth's surface after the earthquake (magnitude 8) in the Atlantic Ocean off Portugal on 28.2.69. The trace starts at 02.00h GMT, each section is 6h long. The wave trains from number 2 onwards are due to Rayleigh waves that have successively circled the Earth.

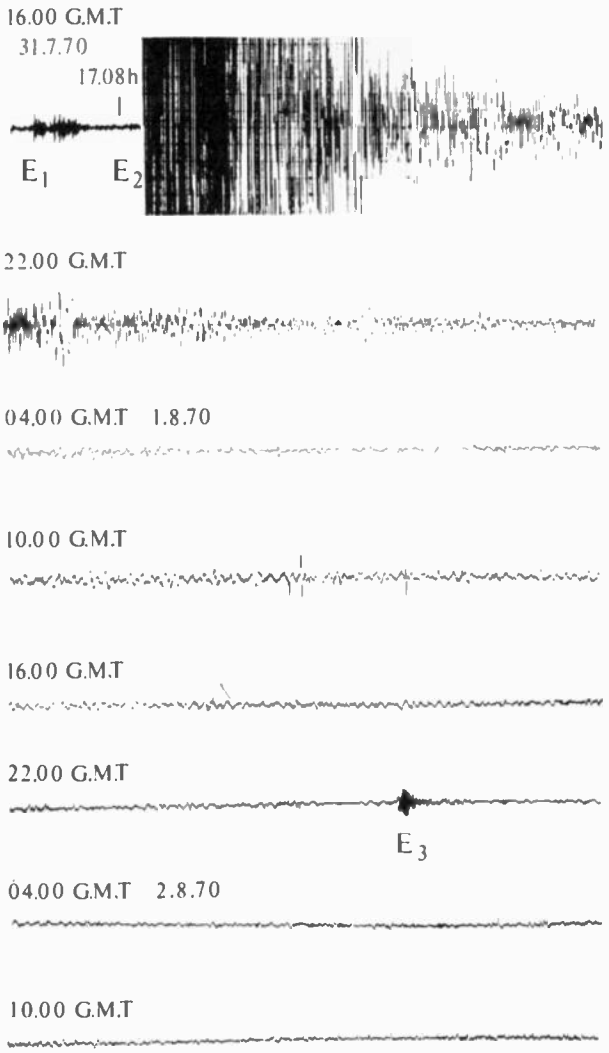


Fig. 5. Record of the Earth's surface ringing like a bell after the Peru/Columbia earthquake (E2) of 17.08h GMT of 31.7.70. The interval between the time of the earthquake (which was of magnitude 7) and its arrival in Aberdeen is about ten minutes. Each section of trace lasts six hours, the sensitivity being doubled from 10.00h 1.8.70 onwards.

A TILT IN THE KILT

corresponding change in the weight of the mass and this in turn causes the spring to be deflected to a greater or lesser extent. Gravimeters have been intensively developed because they have been useful in detecting changes in gravity from one place to another on the Earth's surface and especially those changes in the local pull of gravity that are due to denser or lighter minerals under the surface. Gravimeters have thus been important tools in geophysical prospecting for such mineral resources as oil. At the same time, if they can be made sensitive enough, they can provide useful data on the physics of the Earth itself. This possibility arises partly from the fact that the solid Earth does not maintain its shape with infinite rigidity, but has to give way elastically to the tidal forces created by the Sun and Moon. We are, of course, well accustomed to tides in the oceans, and the same forces that raise these latter tides also raise tides, of a lower amplitude, in the solid Earth. Typically in medium latitudes, the maximum amplitude of Earth tide is about 40 centimetres.

A gravimeter will observe Earth tides partly because the rising and falling of the Earth's surface will move the gravimeter away from or closer to the gravitational centre of the Earth, and this will give a small change in the local pull of gravity, which is proportional to the inverse square of the distance of the gravimeter from the gravitational centre. In addition, the mass in the gravimeter will itself be subject to the same pulls of Sun and Moon that are causing the tides in the Earth, and so it will respond to the resultant pull of Sun, Moon and Earth taken together. This effect probably accounts for about four-fifths of the total variation in pull observed by the gravimeter, the remaining fifth being due to the change of distance of the gravimeter from the Earth's centre. The total change is, of course, very small: the maximum difference between "high" and "low" Earth tides is about two parts in ten million.

GRAVIMETERS

One type of gravimeter that we have built at Aberdeen is shown in Fig. 2. The weight W is cantilevered by two pre-stressed parallel springs S_1 and S_2, so that under the deflection (about 5 millimetres) due to the weight they become horizontal. W is made the moving electrode between two others P_a and P_b, so constituting two capacitances that together form the capacitance micrometer bridge.

The tidal changes in the pull of gravity will cause the weight W to rise and fall during the day by about one millionth of a millimetre. If we are to detect his movement reliably, the instrument must remain stable to about one hundred millionth of a millimetre (less than an atomic diameter) over a period of days. The principal difficulty is that of finding a material for the springs that has an elasticity that is sufficiently independent of temperature, and which does not gradually give way (or "creep") under the control force exerted by the weight. It is an appreciable defect if the springs sag at a weight of one thousandth of an inch per thousand years. When the difficulties have been sufficiently overcome, the pattern of the Earth tides can be seen. Fig. 3 shows how they vary over a period of ten days.

(Continued on page 118)

THE BRUEL AND KJAER TYPE 7001 FM TAPE RECORDER

MAGNETIC tape recording has proved to be of immense value in modern life. From the early beginning in 1898, when the Danish scientist and inventor Valdemar Poulsen demonstrated his first "telegraphone", and up to modern instrumentation tape devices, a tremendous amount of scientific effort and ingenuity has been laid down in modifying and improving the magnetic recording and reproducing technique.

Even though there are many limiting factors in modern tape recording the ability of such systems to store information for later analysis, to expand and compress time scales, and by multichannel recording technique to preserve time coincidence between events, has made the magnetic tape recorder a key instrument in today's instrumentation systems.

The continuous improvement of magnetic recording technique over the last decade has resulted in the development of various recording principles, such as direct recording, frequency modulation, pulse coding, pulse width modulation, amplitude modulation, etc.

All of these types of recording techniques have their advantages and disadvantages, but the most widespread recording principles used for general purposes and analogue measurements today seem to be direct recording (with high frequency bias) and frequency modulation. If the recorded (analogue) data are to be stored for later spectrum analysis of single samples the direct recording technique is the simplest and most economical way of data preservation.

On the other hand, if very high amplitude stability is required, or if the stored data are very low frequency vibrations or contain necessary dc (static) information, the frequency modulation technique is far superior to direct recording.

The ability of FM recording to record highly stable analogue signals has resulted in several high quality FM recorders being released in recent years. These machines are finding their way into most fields of scientific research, particularly those where analogue processing of the signals is required at a later date. Typical applications for this type of recorder would be to record vibration measurements from bridges, aircraft, oil refinery stacks, etc.

The Bruel & Kjaer company – who manufacturer the Model 7001 recorder which is the subject of this review – produce more precision acoustical and audio frequency measurement equipment than nearly all the other manufacturers of similar equipment combined.

Their Model 7001 recorder is basically a two-channel FM four-speed machine which also has a third channel for speech and control purposes.

In view of the wide range of potential users and applications this test examines both the practical and theoretical aspects of the machine.

Precision laboratory tape recorder from Denmark has frequency response from dc to 20kHz. A full report by Murray Wood, BE, BSc, ME. and Louis Challis BE.

FM RECORDING – THE THEORY

Almost any practical ac signal can be interpreted as a sum of simple sinusoidal and cosinusoidal waves. For a basic understanding of, for instance, a modulation process, it is thus often sufficient to consider just one cosinusoidal signal.

$$a = A_o \cos\phi \quad (1)$$

where A_o is the maximum amplitude of the signal and ϕ is a continuously varying, generalized angle. For a constant frequency signal of frequency f ,ϕ can be written

$$\phi = \int 2\pi f \, dt = 2\pi ft + \Phi = \omega t + \Phi$$

where $\omega = 2\pi f$ angular frequency. If the signal frequency is not constant it is useful to define an instantaneous angular frequency

$$\frac{d\phi}{dt} = 2\pi f = \omega \quad (2)$$

In frequency modulated systems the amplitude factor A_o in equation (1) is kept constant while the instantaneous frequency is varied according to some function determined by the modulating signal. Using a simple cosine representation of the modulating signal the instantaneous frequency is given by

$$f = f_o + \Delta f \cos(\omega_1 t) \quad (3)$$

Here f_o is the carrier frequency around which the modulating signal varies with a frequency $f_1 = \frac{\omega_1}{2\pi}$ and a maximum frequency deviation of Δf.

Multiplying equation (3) by 2π and utilizing equation (2) the angle ϕ in equation (1) can be determined:

$$\phi = \int [2\pi f_o + 2\pi \Delta f \cos(\omega_1 t)] \, dt$$

$$= \omega o \, t + \frac{\Delta\omega}{\omega_1} \sin(\omega_1 t) + \Phi_o \quad (4)$$

where ϕ_o is a constant, time independent angle (phase angle). An expression for the complete frequency modulated signal is thus:

$$a = A_o \, X \cos\left(\omega_o t + \frac{\Delta f}{f_1} \sin(\omega_1 t) + \Phi_o\right) \quad (5)$$

It can be shown if ϕ_o is assumed to be 0 the expression given by equation (5) can be mathematically transformed into the following formula:

$$a = A_o [J_o(\beta) \cos(\omega_o t) + J_1(\beta) \cos(\omega_o + \omega_1)t - J_1(\beta) \cos(\omega_o - \omega_1)t + J_2(\beta) \cos(\omega_o + 2\omega_1)t + J_2(\beta) \cos(\omega_o - 2\omega_1)t + J_3(\beta) \cos(\omega_o + 3\omega_1)t - J_3(\beta) \cos(\omega_o - 3\omega_1)t + \text{----------}] \quad (6)$$

where $J_o(\beta)$ is the Bessel function of the first kind with argument β and order n, n being an integer. $\beta = \frac{\Delta f}{f_1}$ is a kind of modulation "index" and depends, as can be seen, not only upon the maximum frequency deviation frequency "swing", Δf, but also upon the frequency of the modulating signal itself, f_1. This is due to the dependency of the actual modulating phase angle upon the instantaneous frequency see equation (2).

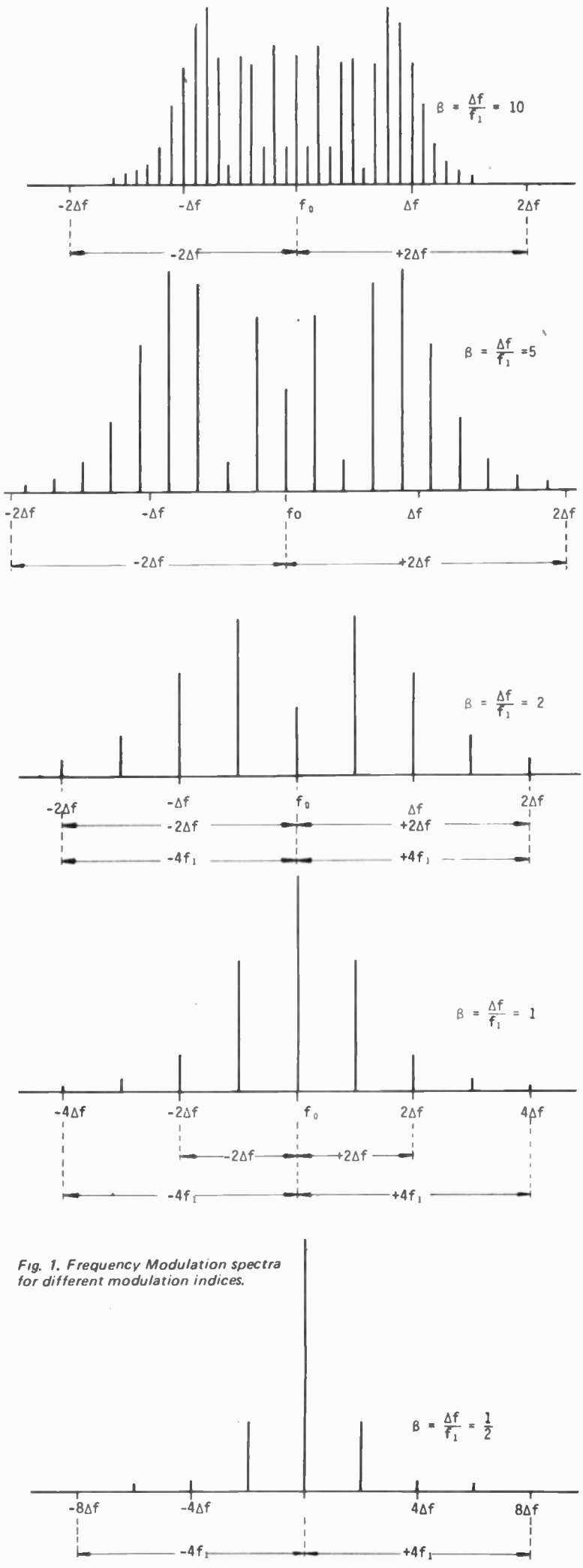


Fig. 1. Frequency Modulation spectra for different modulation indices.

The ratio $\Delta f/f_1$ max. is commonly called *deviation ratio* and in wide-band FM magnetic recording is in the order of 1:2 or greater.

Equation (6) describes the frequency modulated signal in terms of *sidebands* with frequencies $\omega_o \pm \omega_1$; $\omega_o \pm 2\omega_1$; $\omega_o \pm 3\omega_1$ etc.

It is necessary to establish the number of sidebands that must be correctly handled by the measurement system to reproduce the original modulating signal with negligibly small errors.

Fig. 1 shows modulation spectra of a frequency modulated signal of the kind discussed above for various values of the modulation index. It is seen that as long as $\Delta f/f_1$ is great then a great number of sidebands are necessary for a complete description. However, most of the important sidebands are found within the limits $\pm 2\Delta f$, the spacing between the sidebands being f_1.

On the other hand if $\Delta f/f_1$ is small only one (or two) sidebands are present and a general bandwidth requirement for FM-systems would thus be $4\Delta f$ or $8\ f_1$ (whichever is the greater), a requirement which is practically always fulfilled in FM magnetic tape recording.

In practical FM magnetic tape recording systems the input signal frequency modulates a carrier frequency oscillator of frequency f_o to a maximum frequency deviation, Δf, (frequency "swing") of ±40% of the carrier. Furthermore, to obtain a reasonably large dynamic range, even at the highest modulating frequency fmax this is normally chosen to be approximately ¼ of the total frequency deviation (i.e. 20% of the carrier). All the sidebands necessary for a faithful reproduction of the input signal will then be recorded.

The actual carrier frequency chosen, depends basically upon the tape speed and the characteristics of the magnetic head. In the Tape Recorder Type 7001 the highest carrier frequency used is 108 kHz and consequently the highest input signal frequency component that can be recorded with full dynamic range is approximately 20 kHz.

A maximum tape speed of 60 inches per second is used. The choice of carrier frequency, tape speed and input signal frequency range might be regarded as the basic factors in the design of an FM magnetic tape recorder. These factors, and a careful development of the tape transport mechanism as well as the circuitry used in the recording and reproducing electronics, determines the optimum achieveable dynamic range.

The upper limit of this range is set by the so-called deviation ratio and the phase non-linearity in the circuitry, while the lower limit is normally determined by the wow and flutter of the tape transport, as well as spurious (random) noises inherent in the recorder.

The characteristics of the reproducing process cause the amplitude to vary considerably with frequency. This would be disastrous in direct recording/reproducing systems but in the case of frequency modulation systems, it is of practically no importance because the amplitude is limited (clipped) before detection of the modulating signal takes place and the recording tape can be magnetically saturated.

The amplitude vs. frequency non-linearity produced by the tape itself due to demagnetizing effects of neighbouring magnetic areas is unimportant in FM systems for the same reason. But as stated above, phase non-linearities are very important and great care must be taken to minimize and/or compensate for their existence.

In single track recording systems, the lower limit of the dynamic range is normally determined by wow, flutter and spurious noises.

In multi-track recording systems, on the other hand, crosstalk between channels, and a further effect commonly called skew or yaw also enters the picture.

Wow and flutter are caused by many factors. These include small eccentricities in the capstan or pinch rollers, tension variations in the tape, variations in power supply frequency and phase, mechanical vibrations in the recorder, friction effects, and tape roughness.

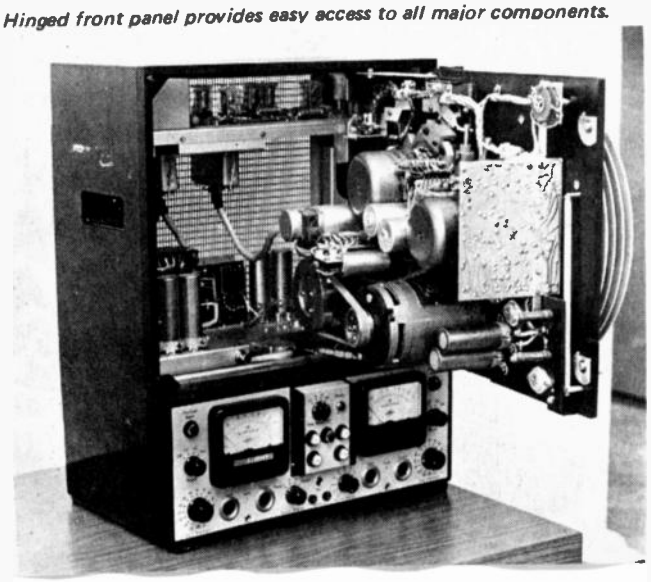
Some of these factors cause periodic flutter components while other factors are of a more random nature. If the flutter is completely random and no resonance effects are present in the tape system, a more or less white, inherent noise would be expected. The output voltage caused by such a noise would increase with the square root of the measurement bandwidth.

Crosstalk between channels is mainly determined by the shielding and separation distance between the sections of the magnetic heads belonging to different channels. As the crosstalk process is basically different for FM and direct recording systems, the two FM channels in the Tape Recorder Type 7001 have been separated on the tape by a direct recording track. The direct recording channel is, however, only meant as a voice channel for marking and identification of special parts of the tape when desired, and is not intended to be used for measurement purposes.

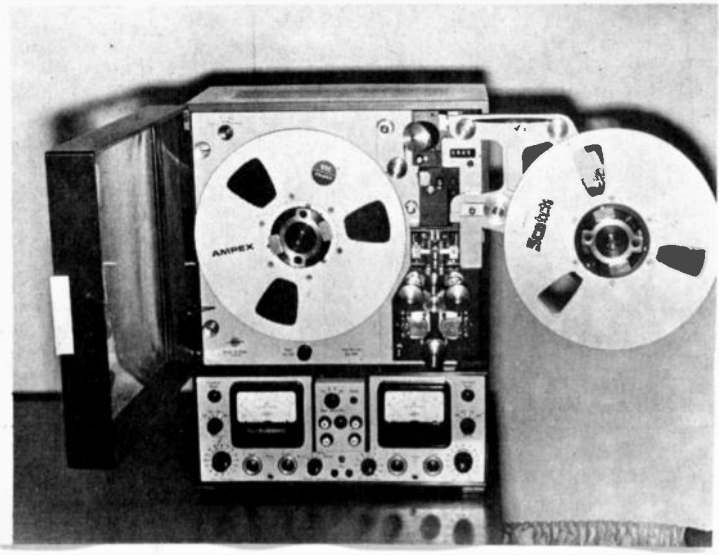
MECHANICAL CONSTRUCTION

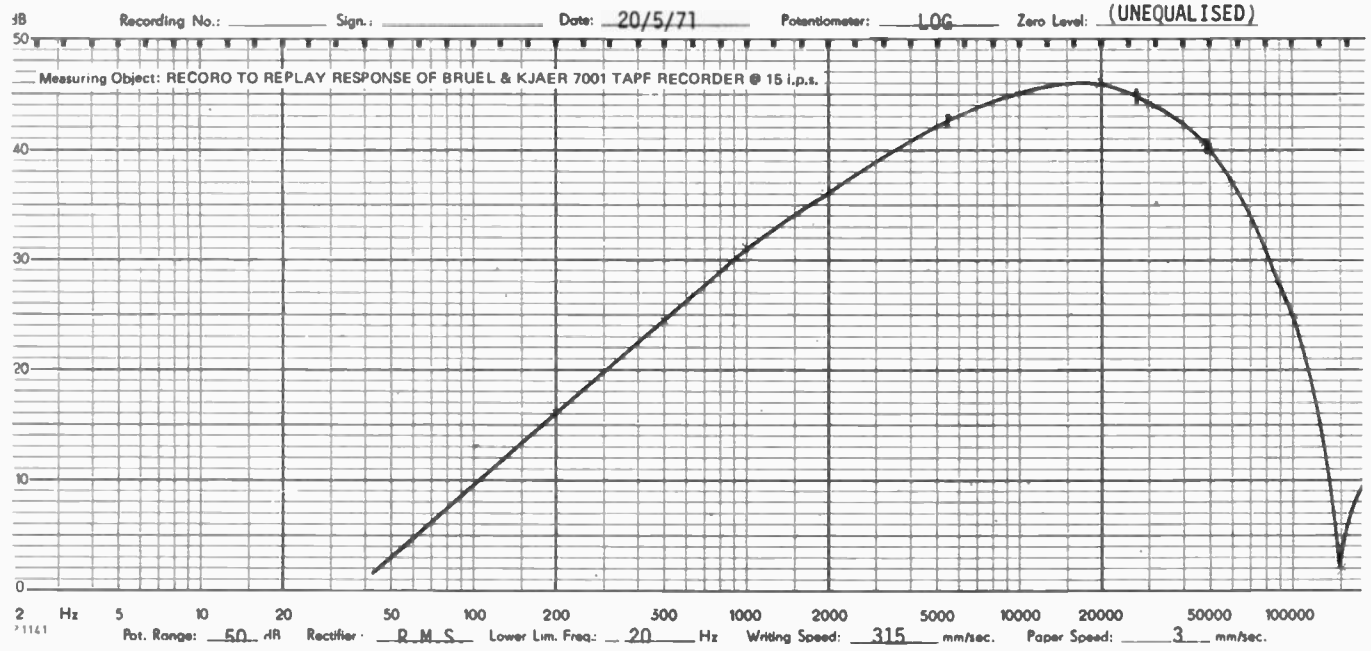
The mechanical side of the Bruel and Kjaer recorder is particularly well made and quite complex in its operation. There are four speeds available. These are 1½, 6, 15 and 60 inches per second. These are obtained by using a 4:1 speed ratio from the capstan motor by pole changing and a 10:1 speed ratio from a gear box. The motor is converted from a two-pole synchronous motor to an eight-pole synchronous motor by electrical switching. On a 50 Hz power supply, this would provide motor speeds of 3000 rpm and 750 rpm. But being a synchronous motor, the speed is only as accurate as the frequency of the electrical supply driving the motor, and so for high precision use the capstan motor can be driven from a special regulated frequency supply. Normally, however, the mains supply

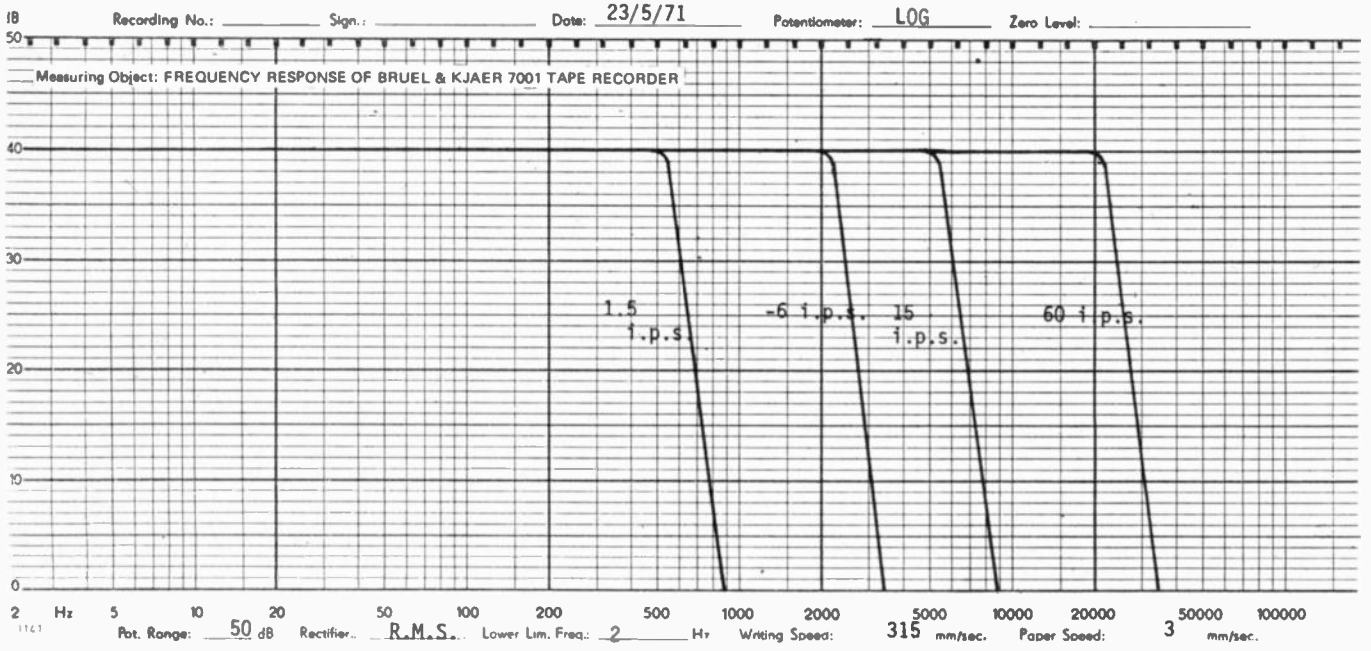
Hinged front panel provides easy access to all maior components.



The concentrically mounted tape reels swing apart for easy tape loading.







would be adequate. The selection of the gear box reduction is performed by a solenoid operated clutch and the speed control is therefore entirely governed by electrical switching.

One of the problems associated with high speed tape transport systems is the physical difficulty of accelerating the reels and tape to the required speed. The method used by Bruel and Kjaer is very ingenious and while it would not be satisfactory for frequent stopping and starting, it is adequate for the type of usage envisaged by the designers of the machine.

The spool motors are controlled by servo amplifiers which derive a signal related to tape tension photo-electrically. When the play button is pushed, the tape is moved only by the spools until the speed (as measured by a photo cell on a serrated wheel) is close to the desired operating speed.

When the speed is approached, a solenoid releases the pinch wheels which then press the tape against the capstan both on the feed side and take up side of the heads. This ensures that tension is never high enough to stretch the tape.

At 60 inches per second it takes about two seconds to engage the tape, while at 1½" per second engagement is virtually instantaneous. There are two additional photo-sensors. One is used in conjunction with the controls when changing between fast forward or rewind, or play or record. It insures that the tape is stationary before changing function and thus further protects the tape from high stresses. The other stops the drive motors if the tape breaks at any time.

The actual deck arrangement is unusual in that the supply and take up spools are concentrically positioned so that whilst the recorder takes 10 inch diameter spools the deck is only 15 ' x 13".

ELECTRONIC CIRCUITRY

The record and playback circuitry of the 7001 Recorder is rather complicated. It consists of two frequency modulators, two frequency demodulators and conventional record amplifier, and a playback amplifier and erase circuit on the voice channel. A full block schematic diagram is shown in Figure 2.

OPERATION

The input signal is fed via an attenuator into a dc amplifier which provides an impedance conversion and a gain of approximately 10 dB. If the output voltage is greater than a preset level, it is clipped thus ensuring that the signal which eventually passes on to tape is within the prescribed limits.

The output from the amplifier is fed into a low pass filter which ensures that the frequency of the signal is

THE BRUEL AND KJAER TYPE 7001 FM TAPE RECORDER

within the frequency range for the selected tape speed.

From the low pass filter, the signal then passes into the FM modulator. This is the stage at which, unless great care is taken to perform the transformation to frequency modulation, the greatest errors are likely to be introduced.

The system used in this recorder consists of a voltage controlled oscillator. Although different carrier frequencies are used for each tape speed, to provide maximum stability, the oscillator frequency is kept at a constant 216kHz. To maintain linearity of the modulator a feedback network is used and this is a demodulator similar to that used in the replay mode. The complex feedback loop compensates for errors both in the modulator and demodulator.

The output from the modulator is fed into a flip-flop type divider chain which divides by 2, 8, 20 or 80 depending upon the choice of tape speed.

The output of the divider is then fed into the glass-bonded ferrite record heads. The level of signal used is far higher than would be used for normal recording since amplitude linearity is not important and it is desirable to saturate the tape.

On replay, the signal from the play back head passes into an amplifier which has a very high gain at low signal levels and unity gain above a preset threshold; this produces a signal which is very severely clipped and almost a perfect square wave. The square wave is used to trigger a monostable multivibrator. This multivibrator is designed so that its output pulse has a constant height and width. When this signal is fed into a very stable low-pass filter, the number of these pulses per second determine the output of the filter.

The output of this filter is fed into one input of a differential dc amplifier, the other input being fed by a constant dc signal which is equal to the output when the filter is fed with the carrier frequency alone.

The degree of sophistication required to produce a good FM tape recorder is far greater than that required for the best of the conventional recorders. This can only be justified if the results are equally spectacular without undue complication in using the machine. In the past, we have used FM recorders which although they gave particularly good results were extremely complex to handle, and hard to calibrate and understand.

However, ergonomic aspects of the Bruel and Kjaer 7001 Recorder seem to be particularly good.

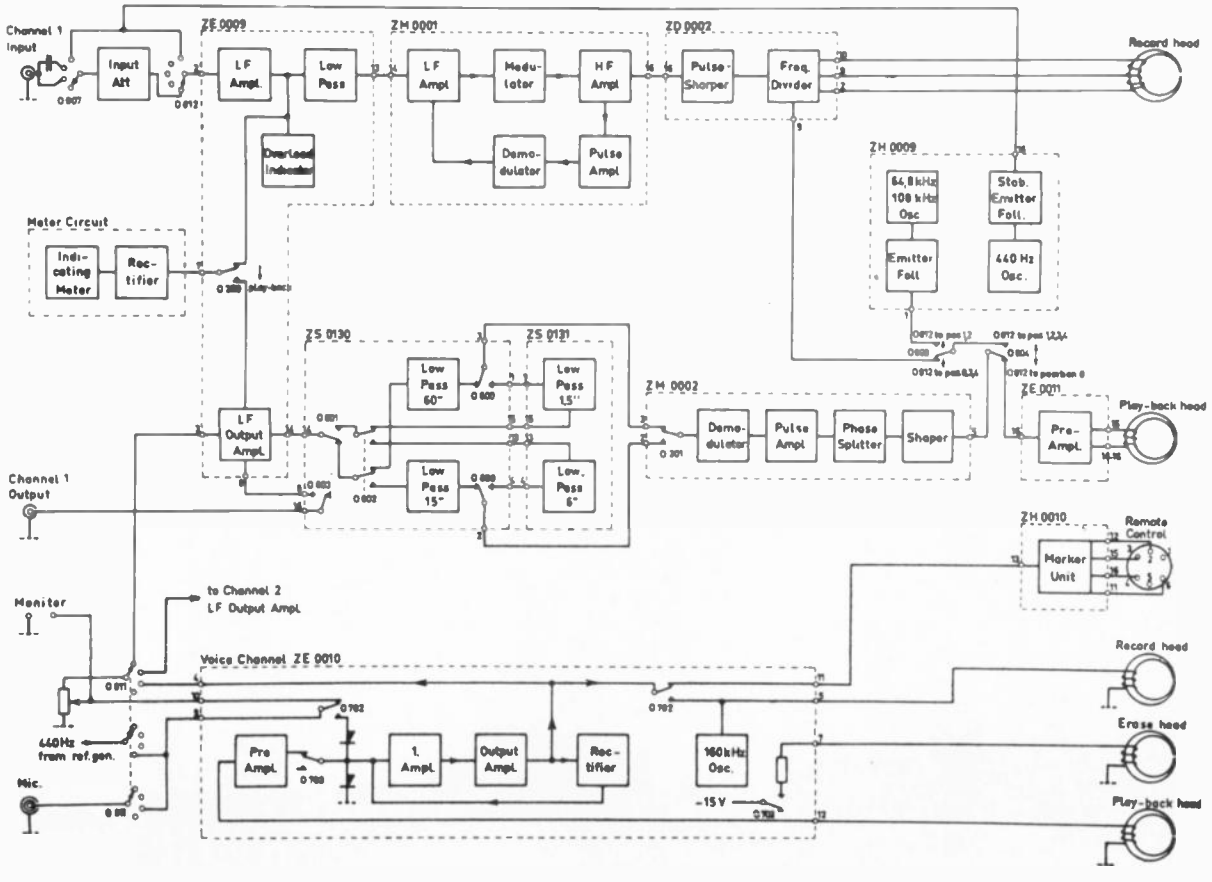
A fairly complex adjustment procedure has been reduced to an almost automatic procedure in which a switch is rotated through four test positions and corresponding screw-driver-adjusted potentiometers set to give meter readings of either zero deflection or 0dB. In the four-week period during which we tested the machine these adjustments only needed to be performed once. If the tape recorder is only going to be used for ac recording (above 4 Hz), these adjustments probably won't need to be performed more than once a year.

One of the more valuable uses of an FM recorder is frequency translation and whilst this can be done in a limited way using an AM tape recorder, there is usually not much advantage to be gained.

However, by using an FM recorder an exact frequency translation can be obtained from dc up to the maximum frequency on record or playback.

Thus by increasing the frequency it

Schematic diagram of the signal converter and amplifier sections.



is possible to look at low frequency phenomena with conventional equipment, while by decreasing the speed, rapidly changing signals can be followed by pen recorders rather than by using ultraviolet recorders or oscilloscopes.

Conventional audio frequency analysing equipment usually covers the frequency range from 20 Hz to 20 kHz. Using the Bruel and Kjaer FM tape recorder, it is possible to extend this range to 0.3 Hz to 20 kHz (or with the newer filters available, down to 0.03 Hz). This frequency range enables the examination of such phenomena as the movement of tall buildings under wind excitation and other effects in larger structures, with conventional analogue equipment. Without the use of such equipment, it is usually necessary to use digital techniques and computer analysis to obtain the same information.

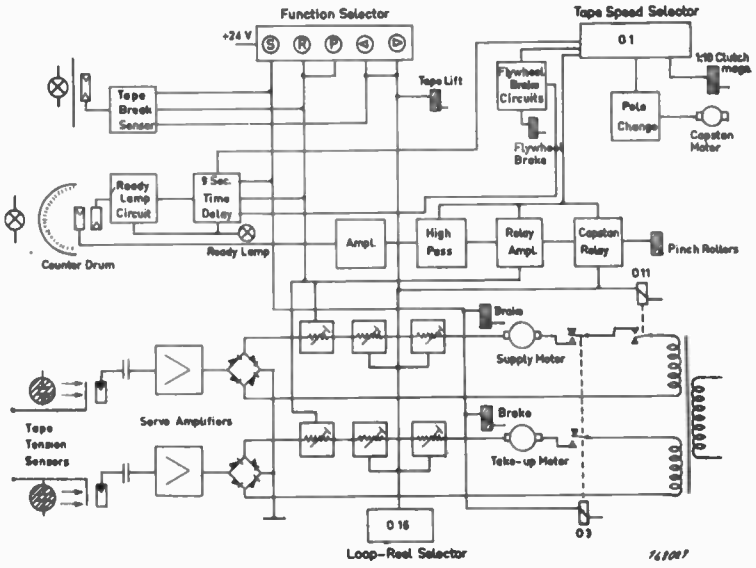
One useful feature is the provision for control and synchronising signals on the tape. These signals may be used with other Bruel and Kjaer analysis equipment to provide automatic starting and stopping of analysis and automatic switching of stepped filters.

This feature is particularly useful for the analysis of single events and does, in fact, enable many of the functions normally performed by real time analyers to be performed on conventional analysis equipment. Using this technique it is possible to examine the spectral content of the noise produced by an accelerating car, the response of a bridge or similar structure to a single impact, and other such phenomena.

For many years, we have used a precision, battery operated conventional tape recorder for storage of data in difficult locations. These locations may be hazardous because of the presence of explosive gases, confined spaces or the difficulty in moving heavy equipment into them. In all these spaces it is desirable to be able to have the minimum of equipment which is preferably battery operated and easy to carry. Unfortunately we feel that the 7001's weight of 85 lbs and its 240 volt 50 Hz power requirement preclude the unit from fulfilling this role.

The only real advantage of the Bruel and Kjaer tape recorder in field measurements is that it provides us with the ability to be able to collect data and subsequently decide which is the best way to process it. Because of its precision, the data is stored with sufficient accuracy for most purposes.

As far as we are concerned, the ideal tape recorder has yet to be developed but the Bruel and Kajer 7001 is a giant step towards it. ●



Schematic drawing of tape transport system.

SUMMARY OF SPECIFICATIONS FOR BRUEL & KJAER 7001 TAPERECORDER

(Obtained using 3M Scotch 991 ¼" instrumentation tape)

ELECTRICAL

Cross Talk:	Better than signal to noise ratio
Distortion:	Less than 1.5% with 1 volt RMS output
Input Level:	± 1.4 volts peak, with attenuator in most sensitive position.
Record Modes:	AC or dc (The lower limiting frequency of the ac input is 4Hz (-3dB)
Input Attenuator:	0-28dB in 2dB steps ± 0.2dB
Input Impedance:	20k ohm in parallel with 100 pF.
Output Level:	1.4 volts peak with no load
Output Impedance	Less than 150 ohm
Heads:	Plug-in ferrite heads
Built-in-Reference. Generator	1 volt ± 1%, 440Hz ± 1% sinewave
Voice Channel:	For marking and identification of the tape. The frequency response is flat to within ± 3dB from 300 Hz to 3kHz and the channel is equipped with AVC.
Tape Speed Accuracy:	± 0.25% ± accuracy of power line frequency
Braking:	Dynamically during motion. Mechanically while stopping and when stopped.
Automatic Stop:	Actuated by photoelectric sensor which stops the tape transport at the end of the tape or in case of tape breakage.
Tape Tension:	100 ± 10 gramme force during record and playback. Automatically controlled from servo amplifiers.
Tape Counter:	4 digit reset counter counts length in feet. Accuracy better than 0.1% during record and playback.
Remote Control:	Control box removable. Extra lengths of cable can be inserted.
Capstan Motor:	Two speed synchronous hysteresis motor
Reel Motors:	AC torque motors
Power Supply:	100 – 115 – 127 – 150 – 220 or 240 volts ac. 100-180W frequency 50 or 60 Hz. Built-in switch allows the capstan motor to be driven from an external precision generator.

Tape Speeds	1.5	6	15	60	ips.
Frequency Ranges ±0.5dB	0-0.5	0-2	0-5	0-20	kHz
S/N Ratio	>44	>48	>48	>48	dB
Carrier Frequency	2.7	10.8	27	108	kHz

IMPROVING ROOM ACOUSTICS

The acoustics of your living room can be dramatically improved, this article by acoustical expert Louis Challis tells how.

Lined woollen curtains can dramatically improve room acoustics.

SOME years ago a well-known Sydney club asked me to cure a severe acoustical problem caused by excessive reverberation. After assessing the problem and making initial proposals, I was asked why I had not considered using a number of wires stretched across the room above head height. Such wires were cheap, whilst what I was proposing would, by comparison, cost a great deal of money.

All I had to do, the club secretary explained, was to be a good fellow and tell him where to buy these wires. He added that a member of the committee, a doctor, had recommended their use as "they are the cheapest form of acoustical treatment available".

Realising that I couldn't offer the club what they wanted – I tactfully suggested that we were both wasting our time – and left.

Two years later I discovered the basis for the doctor's advice. The practice was initiated in the USA about a hundred years ago, when somebody – applying unusual scientific acumen – suggested that 'if the stretched string of a violin, harp or piano can transmit acoustical energy to a sounding board, then the same stretched string should be capable of absorbing acoustical energy from the air!

Apparently the suggestion was taken seriously and installations were made all over the USA, some using over five miles of stretched wire. In a few cases it is clear that simultaneous changes, of form or occupancy, accompanied the installations, and when these occurred, the occasional improvements in acoustics were – erroneously – attributed to the wires.

Thirty years passed before the theory was shown to be false and the practice abandoned.

The study of architectural acoustics goes back many centuries – to Vitruvius in fact – but a few of the

early students had more than a slight understanding of the subject and most early examples of good architectural acoustics were accidents for which neither architects nor builders could take much credit.

In fact some of the early concepts put forward for theatre or concert hall design varied from the extensive use of wooden panelling, to the use of large numbers of empty bottles placed under the stage!

SCIENTIFIC METHOD

In 1895, Clement Walter Sabine, then Professor of Mathematics and Natural Philosophy at Harvard, was asked to 'do something' about the poor acoustics of the new Fogg art museum.

Sabine went beyond the request to 'do something'. He initiated a basic study of room acoustics. This, in effect, started a new science, and

Scientist uses Negretti and Zambra hygrometer whilst testing characteristics of curtain material.

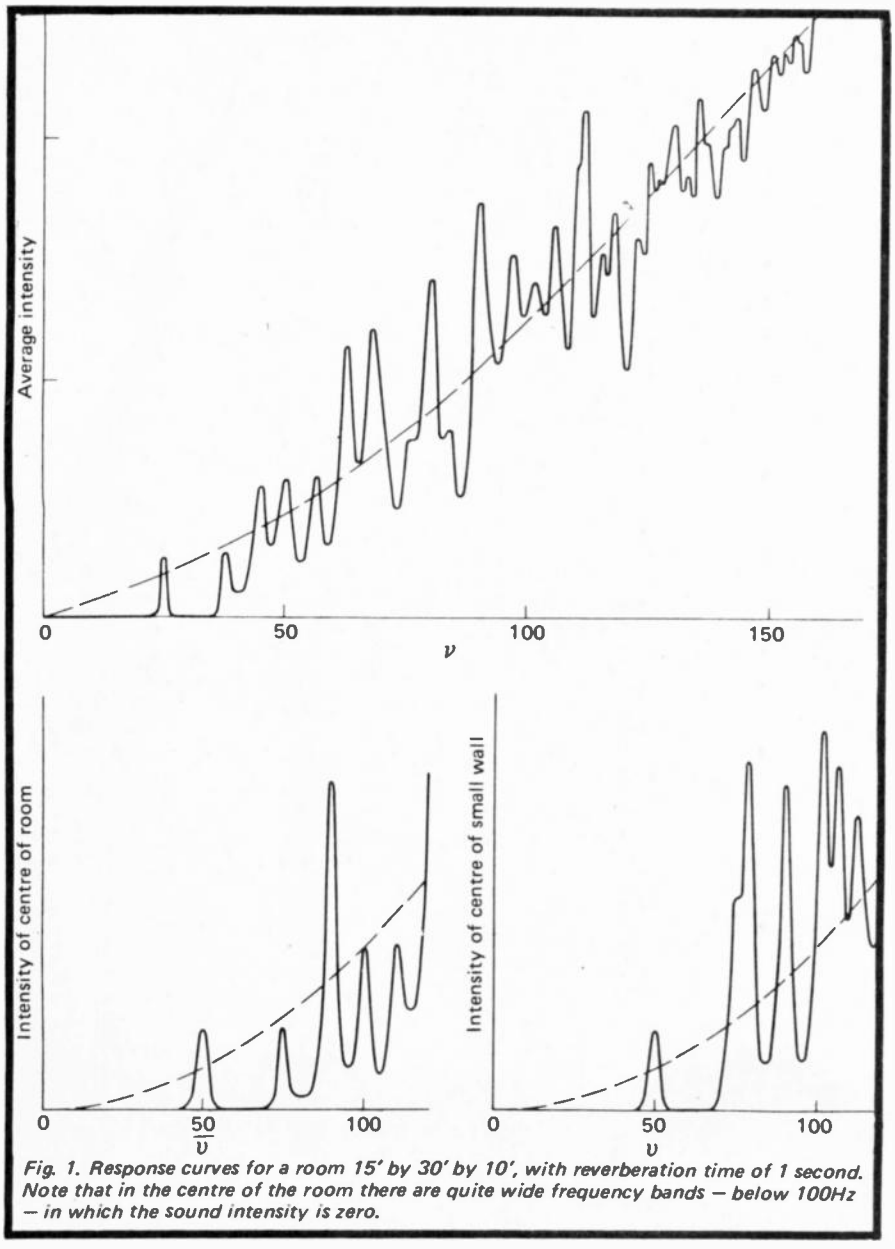


Fig. 1. Response curves for a room 15' by 30' by 10', with reverberation time of 1 second. Note that in the centre of the room there are quite wide frequency bands – below 100Hz – in which the sound intensity is zero.

earned for him the title of 'Father of Modern Acoustics'.

Professor Sabine produced a clear and concise appraisal of room reverberation (the time taken for echoes to die away). To do this, he developed a remarkably accurate measurement system based on electro-pneumatic valve operated organ pipes, a stop watch (later replaced with a chronograph) and his own ears.

When later asked to undertake the acoustical design for the new Boston Symphony Hall, Sabine applied the theoretical knowledge that he had acquired during the previous three years, to initiate the first scientifically designed theatre in the world. When the hall was opened (in 1900) it was acclaimed by musicians and critics alike, and for symphony music at least, it is still one of the best auditoria in the world today.

Sabine's initial work was quaint by modern standards, for his initial investigations were concerned with the evaluation of how the introduction of cushions, curtains, drapes and carpets affected the reverberation time of just one room.

And what he found was appreciated by very few people in his day, and by not so very many more today.

He provided qualitative and quantitative information on many materials, and proceeded further to develop a mathematical relationship, that with minor improvements, is still used today.

HOW SOUND BEHAVES

So that we may understand some of the problems of room acoustics let us

IMPROVING ROOM ACOUSTICS

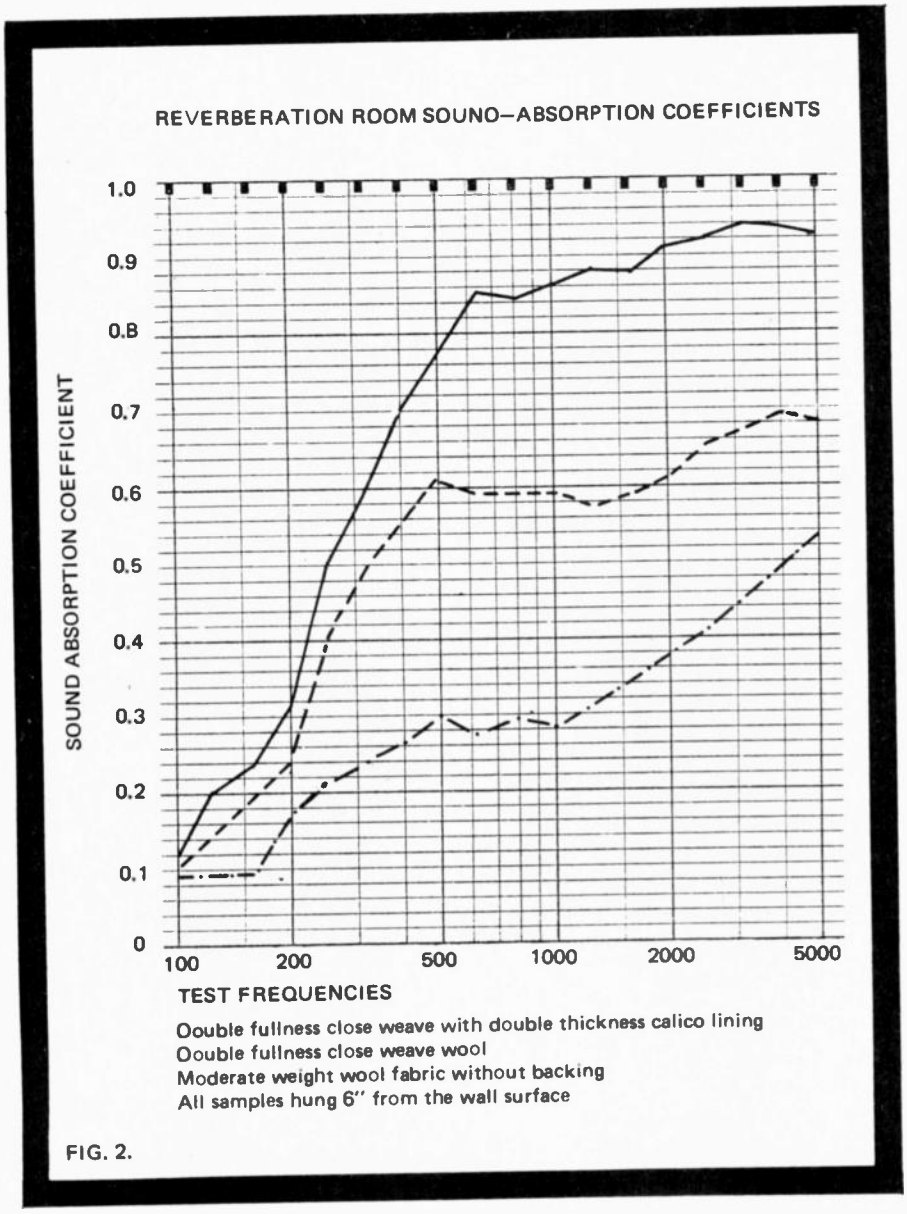


FIG. 2.

look briefly at how sound behaves in a room.

When a sound is created in a room, the sound waves are reflected back and forth between every pair of parallel walls, undergoing a diminuation of intensity at each reflection. They also travel in oblique paths that incorporate any or all groupings of walls, floor and ceiling.

If the room has an irregular shape, the sound waves may take every conceivable path and set up highly complex patterns called room modes. These modes are not harmonically related as such, but are dependent only on the frequency and the room dimensions.

Such modes are a common problem in the average family living room, and may be of such dominance that music played in them suffers a colouration whereby certain frequencies are selectively favoured.

A far more serious problem is that of highly reflective parallel walls bereft of curtains, furniture or other devices to change the direction of sound waves or to absorb them.

If you clap your hands between such walls, you will notice a ringing effect in which the sound waves diminish in cyclical steps. You may have noticed this in unfurnished houses or flats, or even occasionally in occupied rooms.

Technically the phenomena is called flutter echo and results from certain frequencies (related to the dimensions of the room) setting up a decay process that is prolonged by the parallel walls.

ACOUSTIC MATERIALS

Soft, porous fabrics and furnishings absorb a considerable proportion of the sound waves that impinge on them. This they do by converting the sound energy into heat.

Practically all building materials absorb sound to some extent, and the efficiency of this conversion is a measure of whether they may be correctly given the term 'acoustical material' or not. Some materials are effective at all frequencies, but most are effective over a small frequency range only.

HOW DIMENSIONS AFFECT SOUND

Rooms are classified as 'live' when they have little furniture and furnishings, and 'dead' when they have too much furnishings, carpets and drapes.

A 'live' room favours church music, choral works, and the playing of orchestral music. The sound in such a room is composed of two parts, the direct sound, and the reverberant (or reflected) sound. A listener hears the direct sound first, and the first reflections of the reverberant sound a short fraction of a second later. If the rooms is too live, this reverberant sound may continue for upwards of five or six seconds.

Five centuries ago the average cathedral had a reverberation time of less than five seconds and music of the day was composed to make use of the fullness of sound that such a reverberation produced.

Today a reverberation time of 1½ to 2½ seconds is considered the optimum for an orchestral concert hall, and between 0.4 and 0.7 seconds for the average living room.

The effect of room geometry and room volume upon the quality of sound is quite marked, but it is very difficult to define without the use of high powered mathematics. These effects are due to the relationship between the wavelength of the particular sound wave and the room dimensions and geometry. These relationships are particularly complex, but there are a few simple guides.

The wavelength of sound at a given frequency can be approximated by remembering that a frequency of 1 kHz has a wavelength of 1 foot and that wavelength is inversely proportional to frequency. Thus 500 Hz corresponds to 2 feet, 100 Hz to 10 feet, and 50 Hz to 20 feet.

The principle room dimensions of interest, particularly in a rectangular

room, is the longest diagonal. This is the distance between a corner of the room at floor level, and the diagonally opposite corner of the room at ceiling level. This will be the longest straight line in the room; and for a room 15' x 30' x 10' is roughly 33 feet.

For good room acoustics this measurement needs to be at least three to four times greater than the wavelength of the lowest frequency. Thus for the room that has dimensions of 15' x 30' x 10', the maximum wavelength for acceptable acoustics is roughly 10 feet and this corresponds to a frequency of about 100 Hz.

This room will have marked resonances and dips below 100 Hz and sounds below this frequency cannot be faithfully reproduced; apart from this, the response at various positions in the room will be vastly different.

And no matter what hi-fi enthusiasts and salesmen may believe to the contrary, there is no way that you can faithfully reproduce sounds below this lower limit. You will hear sounds certainly, but they will not be, even remotely, a facsimile of the original. The effect is shown in Fig. 1.

ABSORPTION CHARACTERISTICS

For live music, reverberation times of more than one second are required. A professional recording will have reverberant sound lasting at least this long, already incorporated in it, either artificially or naturally.

The ideal listening room has a reverberation time that is short by comparison with that which has been recorded. Such a short reverberation time is difficult to obtain, not because of technical difficulties, but because of the lack of decorative appeal of most acoustical materials. Usually it is necessary to rely on the acoustical properties of the normally used building and furnishing materials to obtain a compromise between appearance and acoustics.

A plaster-board wall, for instance, offers some low frequency absorption, and similarly, timber floors and plaster board ceilings provide some absorption in this region.

And as this is the method of construction commonly used in single dwellings, a suitable reverberation time is often achieved at the low end of the frequency spectrum.

But on the other hand home units and flats present a real problem (to obtain low frequency reverberation time). They are usually constructed with brick walls and concrete floors and ceilings, and these have virtually no low frequency absorption at all. Low frequency absorption may be provided only by the windows.

Absorption in the mid-frequency range may be provided by soft furnishings. Old fashioned armchairs, sofas and carpets are very useful acoustical materials. But modern vinyl covered seats — unless they have padded arms and backs, provide very limited absorption, while the use of parquetry floors often leads to undesirable acoustical properties.

Significant absorption in the mid-frequency range is also provided by people — four people may make a significant improvement to the acoustics of a living room. This may help those who wish to demonstrate their hi-fi to visitors. If the room acoustics are bad — just ask more people!

Absorption in the higher frequency range is provided by soft pile carpet, drapes, and other materials that contain fine, lossely packed fibres.

HOW TO MODIFY YOUR ROOM

The average living room is usually poorly planned for listening to music, and is much too 'live'. The speaker enclosure are usually poorly located on either side of the windows, a fireplace or a sideboard. Almost without exception they face a reflective wall and the first problem is created. They are usually fixed flat against a wall 'for appearances' sake' and all too often they are not placed far enough apart.

For optimum sound the speakers should be spaced between six and twelve feet apart, opposite a wall that has an extensive area of curtains and drapes lined with additional layers of backing cloth to increase the absorption.

Until recently there was little or no data available for the intending user (or expert) to assist in the evaluation or specification of curtain treatments. Most of the data that was available from overseas involved evaluations of muslines, terylenes or fibreglass cloths that are not really suitable for decorating a living room.

But quite recently the Australian Wool Board commissioned a series of measurements to provide detailed results for people who wished to use woollen curtains for this purpose.

The results of this investigation are particularly interesting. They show that woollen curtains, and especially woollen curtains with backing, combine remarkably high absorptions with generally acceptable appearance.

Some of these results are shown in Fig. 2, where it can be seen that medium weight woollen cloth (double fullness) together with a cotton lining (also of double fullness) has particularly good acoustical absorption.

Either of the two 'best' cloths, shown in Fig. 2, would in fact provide dramatically enhanced room acoustics in most living rooms.

Whilst the intention of this article is to help the average hi-fi enthusiast to improve his room acoustics rather than to assist the Wool Board to sell their products, the message is clear.

And that is that woollen decorator cloth will almost totally overcome the difficult problem of excessive reflections from the rear wall behind the listeners.

The effect is to provide good frontal sound with well controlled rear wall reflections.

Finally — if you feel kindly toward your neighbours — place your speakers on a carpet, rubber pads, or some other form of resilient mounting. This will reduce the amount of structure-borne energy that they can transmit. Then remember that the sound level that is right for you is *always* too loud for your neighbours. ●

FOUR-CHANNEL SOUND

Here is a list of records on which spatial data is particularly prominent, they are recommended for use with four-channel simulators.

Andre Kostelanetz; I'll Never Fall in Love Again	Columbia CS9998
Beatles; Let It Be	Apple 34001
Carmen Ballet; Bolshoi Theater	Melodiya/Angel SR-40067
Mahler; Symphony No. 2 — Ressurection	RCA LSC 7066
The Who; Live At Leeds	Decca DC78175
Simon & Garfunkel; Bridge Over Troubled Waters	Columbia KCS9914
Pink Floyd	Capitol/EMIST8B388

AMATEUR RADIO IN ORBIT

a survey of the first ten years,
by George Jacobs (W3ASK)
Perry I. Klein (K3JTE)
(AMSAT)

THE successful launching of the first artificial satellite on 4 October 1957 fired the enthusiasm of radio amateurs throughout the world. Thousands of them dashed to their receivers to listen to the 20 MHz signal of *Sputnik-1*. It was very shortly thereafter that radio amateurs began to talk about constructing satellites of their own!

To carry this dream to reality, a group of radio amateurs, many of whom were professionally engaged as engineers and scientists in the space technology field, banded together in California during 1960 to form the Project Oscar Association.

Oscar is an acronym for Orbiting Satellites Carrying Amateur Radio. Their objective was to design and build satellites that would operate in the bands allocated to the amateur service, and that would permit radio amateurs everywhere to make useful contributions to the new field of space communications.

Working during every spare moment in attics, basements and garages, the Project Oscar group completed their first satellite in about a year.

Radio amateurs entered the space age on 12 December 1961, when the first

Finishing touches being made to Oscar-1, the first in a series of satellites designed and constructed by radio amateurs. Launched successfully on 12 December 1961, the telemetry-beacon transmitter aboard the satellite remained in operation for three weeks. Approximately 600 amateur radio stations in 28 countries participated in tracking the satellite and in propagation and other scientific investigations.

Oscar satellite was successfully launched as ballast aboard a United States space vehicle. The satellite contained a simple 100 mV telemetry-beacon transmitter which operated continuously for about three weeks on 144.98 MHz in the amateur 2-metre band. During this period more than 5000 telemetry, beacon and tracking reports were received from 600 amateur radio stations located in 28 countries and on all continents, including Antarctica.

Amateur radio's second satellite, *Oscar-2* was launched on 2 June 1962.

Almost identical to *Oscar-1*, its telemetry-beacon transmitter remained in continuous operation for 18 days on 144.99 MHz. The response to the second Oscar satellite was even greater than the first. More than 6000 reception and tracking reports were received from 700 different amateur stations throughout the world.

The first two Oscar satellites were successful in introducing radio amateurs to space communications. Their telemetry-beacon signals provided useful propagation data as well as continuous observations of the satellite's behaviour. They also provided radio amateurs with basic satellite tracking experience, and paved the way for *Oscar-3*, amateur radio's first active communications satellite.

Designed and constructed entirely by radio amateurs, the third satellite in the Oscar series was successfully placed into orbit by the United States on 9 March 1965, again provided at no cost since the satellite filled extra space on a scheduled spare vehicle launch. The satellite's 1 W repeater received amateur signals over a small segment of the 144 MHz band, increased their strength, and retransmitted them back to earth in another segment of the same band, but over far greater distances than would have been possible with the terrestrial stations alone.

SATELLITE HISTORY MADE

Oscar-3 made telecommunications history.

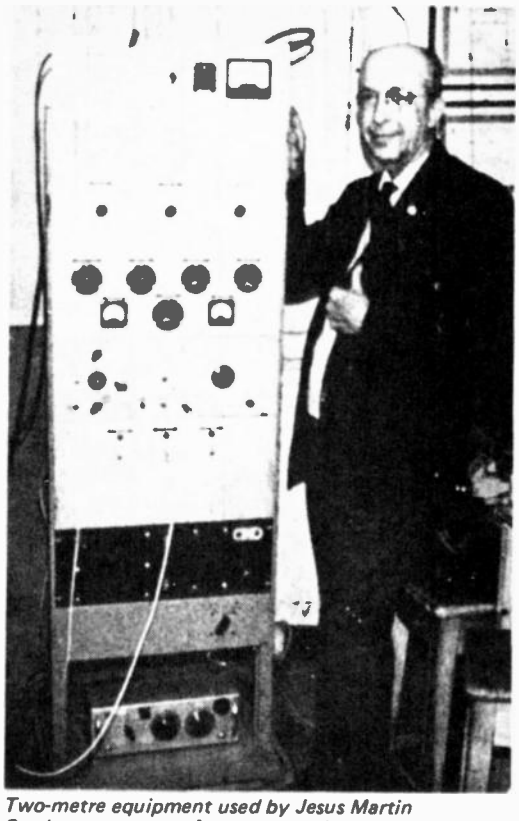
By being launched a month *before Early Bird,* the first International Telecommunications Satellite Consortium (INTELSAT) satellite, it holds the distinction of being the world's *first* free-access communications satellite. One hundred amateur stations in 16 countries communicated through the Oscar satellite during the two-week period that it remained in operation.

The Atlantic Ocean was bridged at least twice through the satellite, when station DL3YBA in Germany contacted WIBU in the U.S.A. and EA4AO in Spain contacted W2AZL in the U.S.A.

On 21 December 1965 amateur radio's fourth satellite was launched. Called *Oscar-4*, it was designed as an active communications satellite with an up-link in the 144 MHz, or 2-metre band and a downlink in the 420 MHz, or 70-centimetre band. While the 3 W repeater aboard the satellite actually functioned, the desired orbit was not achieved, and only a dozen or so two-way contacts were established through the satellite. Nevertheless, Oscar-4 did establish at least one communication record, when on 22 December 1965 amateur radio station K2GUN contacted station UP2ON, for the *first* direct communication via satellite between the United States and the Soviet Union.

AUSTRALIS-OSCAR

Demonstrating the world-wide nature of this undertaking, the fifth satellite in the amateur radio service was designed and constructed by students at Melbourne University in Austalia, under the auspices of the Wireless Institute of Australia. The satellite was prepared and qualified for launch by the Radio Amateur Satellite Corporation (AMSAT), a Washington, D.C. based international organization of radio amateurs having members from at least 25 countries.

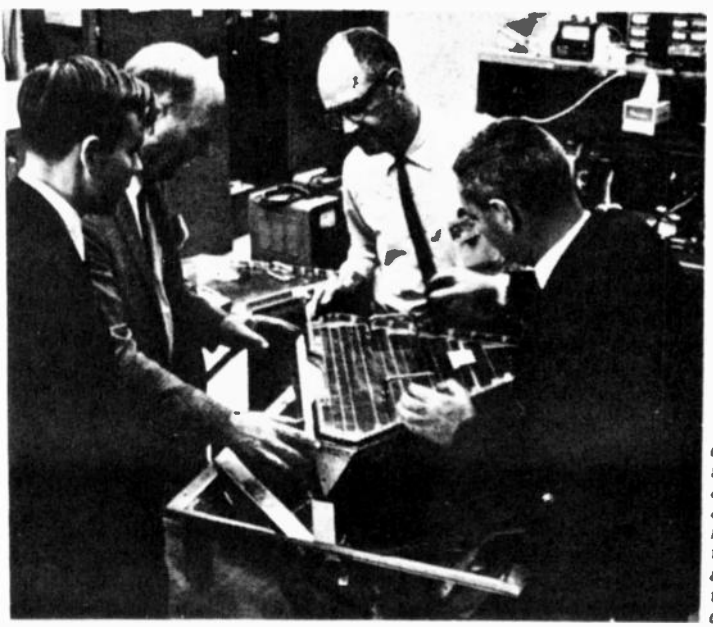


Two-metre equipment used by Jesus Martin Cordova, operator of amateur station EA4AO, to establish direct two-way communications between Spain and the United States through the Oscar-3 amateur communications satellite during March 1965.

The United States National Aeronautics and Space Administration (NASA) launched the Australis-Oscar-5 (AO-5) satellite on 23 January 1970 as a secondary payload on the *Itos-1* weather satellite mission. The amateur satellite carried two telemetry-beacon transmitters, one operating continuously on 144.05 MHz and the other on command on 29.450 MHz in the amateur 10-metre band.

The satellite's electronic system operated for about a month and a half, and terminated with the depletion of the on-board chemical batteries. Although it carried beacon transmitters rather than a communications repeater, AO-5 provided an excellent opportunity to test several important concepts new to satellites in the amateur service.

Perhaps most significant was the command-control system which made it possible to turn the 10-metre transmitter on and off from the ground on a regular, prearranged schedule. This demonstrates that



The Oscar-4 amateur communications satellite undergoes final assembly by some of its amateur builders. Oscar-4 received transmissions on the amateur 2-metre band, amplified and transmitted them on the amateur 70-centimetre band.

AMATEUR RADIO IN ORBIT

This is a look inside of the fifth and most recent satellite to be launched successfully in the Oscar series. Designed and constructed in Australia by students of Melbourne University (three of whom are in our photograph), this was the first amateur satellite to be ground-controlled. Hundreds of amateur stations throughout the world used the satellite's 10- and 2-metre telemetry-beacon transmissions for tracking, propagation and other scientific investigations during early 1970.

emissions from amateur satellites can be controlled in the event interference develops, thus greatly enhancing the practicality of operating amateur satellites in those bands shared between the amateur and other services.

The AO-5 mission was technologically successful in several important respects. A unique, but simple system consisting of a bar magnet and eddy current damper helped stabilize the satellite, and kept it aligned along the magnetic field lines of the earth, much as a compass aligns itself with the earth's poles. This kept satellite spin and subsequent signal fading to a minimum. A seven channel audio tone analogue telemetry system constantly monitored the satellite's alignment, temperature, and power supply performance. The system was so designed that the data could be decoded simply with inexpensive equipment usually found at amateur radio stations.

One valuable result of the AO-5 experiments was the measurements of satellite temperature. Calculations predicted that AO-5 would stabilise at a temperature of 22°C, but when in orbit the telemetry signals indicated that the actual temperature reached 42°C. Investigations showed that the coefficient of solar energy absorption, which scientists had used for years, was incorrect!

AO-5 was the first amateur satellite to transmit in the HF as well as VHF range, permitting propagation studies to be made at two distinctly different frequency ranges. A significant number of propagation anomolies were reported, such as over-the-horizon and antipodal reception and certain auroral phenomena.

Another major success of the AO-5 mission was the interest and enthusiasm it generated throughout the world. Reception, tracking and telemetry reports were received from several hundred amateur radio stations in at least 27 countries.

FUTURE AMATEUR SATELLITES

Groups of radio amateurs on at least three continents are actively engaged at present on the design and construction of various systems and components for future Oscar satellites, and plans are also under way for a repeater which it is hoped some day may be placed on the surface of the moon.

A four-channel hard-limiting FM repeater is being assembled in Australia by the same group of amateurs responsible for the Australis-Oscar-5 satellite. This repeater will receive and demodulate amateur signals from a segment of the 144 MHz band, and remodulate and retransmit them in a segment of the 420 MHz band, with a transmitter output of 1 W per channel.

A Euro-Oscar repeater, a project initiated under the auspices of Region 1 of the International Amateur Radio Union (IARU) is nearing completion in Germany. This will be a 10 W linear repeater with a bandwidth of approximately 50 kHz. It will be capable of receiving signals in the amateur 70 centimetre band, centred on a frequency of approximately 432.1 MHz and will relay them at a centre frequency of approximately 145.9 MHz. The repeater is designed for use with single sideband, CW, FM, teletype and amateur slow-scan television transmissions.

Another linear repeater is nearing completion in the United States. Being constructed by AMSAT, this 2 W repeater will have the capability of receiving signals centred on 145.9 MHz and relay them, centred on approximately 29.5 MHz.

In the United Kingdom a group of radio amateurs are working on Project *Trident,* constructing a 3 W linear repeater with an up-link in the 144 MHz band and a down-link in the 420 MHz band.

Groups of amateurs in Australia and the United States are also developing simplified telemetry systems designed to send information on satellite performance in teletype format, or directly in Morse code.

The next Oscar satellite is expected to be launched by early 1972, and will consist of some of this equipment now under construction throughout the world.

Another somewhat ambitious space communications project has been undertaken by radio amateurs. Called Project *Moonray* (from MOON amateur Re1AY), it is hoped that a linear repeater designed and built by amateurs may some day be placed into operation and left on the surface of the moon.

Tentative plans call for the design of a 5 W repeater, capable of receiving signals in a portion of the 420 MHz band and relaying them throughout the world in this or in another UHF band allocated to the amateur service.

INTERFERENCE AND FREQUENCIES

The amateur service, perhaps more so than any other radio service, is feeling the pinch caused by the congestion in the HF bands. Relative to other services, the number of stations operating per kilohertz in the amateur bands is exceptionally high. To make efficient operation possible under such conditions, over the years the amateur service has continually exploited technical developments stressing the use of narrow-band emission techniques, reductions in receiver bandwidths, use of directional antennae and transferal of operation to the VHF and UHF bands wherever this is technically possible. This same philosophy is being carried forward by radio amateurs in the space age.

Not a single case of harmful interference is known to have been reported from the operation of the five amateur satellites launched to date.

Future amateur satellites are planned that will use each of the HF bands allocated to the amateur service for propagation research, and for extending the use of these bands for

communications purposes during periods when ionospheric conditions will not permit their use by terrestrial stations. Each of the VHF bands will be used for communications, tracking, telemetry and research. The UHF bands will be used mainly for communication purposes and moon relay systems.

In each of the bands assigned exclusively to the amateur service, radio amateurs will continue their traditional policy of self-policing and self-imposing operator disciplinary measures to avoid interference between the transmissions of amateur satellites and terrestrial amateur stations.

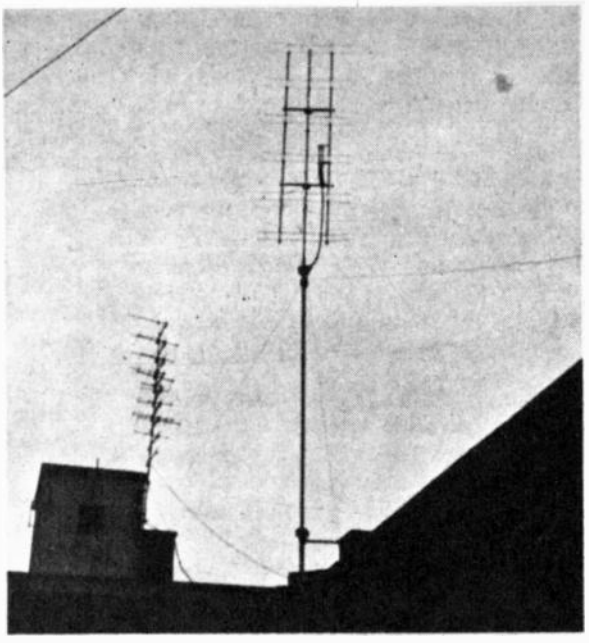
In each of the bands shared between the amateur and other services, future amateur satellites will contain command systems which will enable control of spacecraft transmissions in the event that interference occurs or is likely to occur. They will also contain blanking, filters and other circuitry to reduce the possibility of satellite interference to and from other terrestrial services.

Radio amateurs are confident, based on their long history of handling interference and the experience gained from the first five amateur satellites, that terrestrial stations in the amateur and other services can operate harmoniously with amateur satellites, on an interference-free basis.

BENEFITS FROM AMATEUR SATELLITES

The benefits derived from amateur satellites go far beyond the amateur service itself. Amateur radio, has always served as a successful training technique for the entire field of electronics. Now, amateur satellites have extended this classroom into space as well. What better way is there to gain experience with space communications than by participating actively in it?

From the ranks of amateur radio over the years have come large numbers of trained technicians, operators and instructors. Many of the world's leading telecommunication engineers and officials trace their first interest in their profession to participation in amateur radio. It is expected that amateur satellites will serve both as a tool and as a catalyst to encourage participation and experimentation, especially among the younger generation who will be the engineering and scientific leaders of tomorrow. ●



Collinear 432 MHz antenna array beamed on the Oscar-4 satellite at the amateur station of I1ER in Milan.

APPENDIX

Summary of satellites launched in the amateur radio service 1961-1970

■ *Oscar-1*
- date launched: 12 December 1961
- date communications terminated: 1 January 1962
- orbit: inclined 81.2° equator
- initial apogee: 450 km
- frequency: 144.98 MHz approximately
- power output: 100 mW, telementry-beacon
- antenna: single monopole
- results: more than 5000 telemetry, beacon and tracking reports were received from 600 amateur radio stations in 28 countries.

■ *Oscar-2*
- date launched: 2 June 1962
- date communications terminated: 20 June 1962
- orbit: inclined 73° at equator
- initial apogee: 417 km
- frequency: 144.99 MHz approximately
- power output: 140mW, telemetry-beacon
- antenna: single monopole
- results: more than 6000 telemetry, beacon and tracking reports were received from 700 amateur radio stations throughout the world.

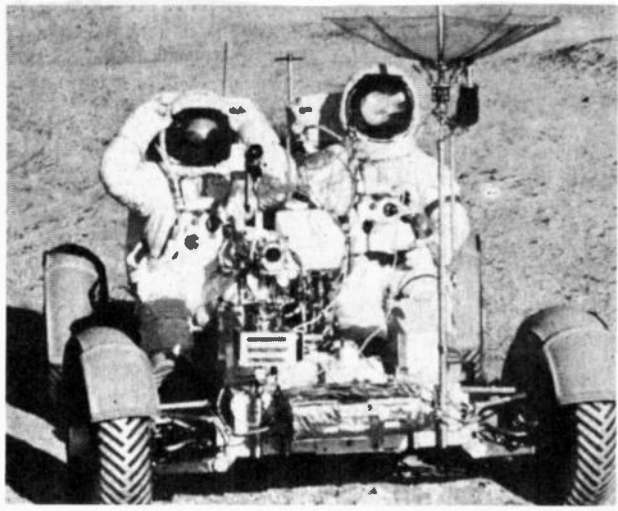
■ *Oscar-3*
- date launched: 9 March 1965
- date communications terminated: 24 March 1965
- orbit: approximately polar
- initial apogee: approximately 975 km
- repeater input frequency: 50 kHz segment centred on 144.1 MHz
- repeater output frequency: 50 kHz segment centred on 145.9 MHz
- repeater system gain: 130 dB (approximately)
- repeater output power:
- 1 W PEP, for single signal in passband
- telemetry-beacon frequency: 145.85 MHz
- telemetry-beacon power output: 50 mW
- antennae: four independent monopoles
- results: world's first free access active communications satellite. Nearly 100 amateur radio stations in 16 countries communicated through the satellite, including two-way trans-Atlantic contacts.

■ *Oscar-4*
- date launched: 21 December 1965
- date communications terminated: mid-March, 1966
- orbit: inclined 26° equator
- initial apogee: elliptical between 200 to 35,000 km
- repeater input frequency: 10 kHz band centred on 144, 100 MHz
- repeater output frequency: 10 kHz band centred on 431.938 MHz
- repeater output power: 3 W PEP, for single signal in passband
- telemetry-beacon frequency: 431.928 MHz
- antennae: four independent monopoles
- results: a dozen two-way contacts were established including the first direct satellite communications between the United States and the Soviet Union.

■ *Oscar-5*
- date launched: 23 January 1970
- date communications terminated: mid-March, 1970
- orbit: inclined 102° equator
- initial apogee: 1500 km
- VHF telemetry-beacon frequency 144.05 MHz
- VHF power output: 50 mW
- HF telemetry-beacon frequency: 29.45 MHz
- HF power output: 180 mW (operated on command)
- antennae: 1/4-wave monopole for VHF, dipole for HF
- results: satellite constructed in Australia, the previous four in the United States. First amateur satellite to transmit on HF band. First amateur satellite to be ground-controlled. First amateur satellite to be self-stabilized to reduce signal fading. First amateur satellite to have multi-channel telemetry system. Reception, telemetry and tracking reports received from several hundred amateur radio stations in at least 27 countries.

— ITT Journal.

Leclanche and lead-acid batteries have been used since 1870, nickel-alkaline since 1900; and these three types account for the greater part of all batteries sold today. But not for much longer — say manufacturers of a whole new breed of power sources — who claim that their revolutionary new products will oust many conventional systems — Collyn Rivers reports.



Recent Apollo 15 Lunar Roving Vehicle was powered by two 36 volt silver-zinc batteries.

BATTERY REVOLUTION

APOLLO 15's dramatically successful Lunar Roving Vehicle was electrically driven. Power for each of the four ¼ hp wheel-motors came from two 36 volt 121 ampere hour batteries. These batteries — designed specifically for the LVR by USA's Eagle Pilcher Industries — used silver-zinc plates operating in a potassium hydroxide electrolyte.

The silver-zinc battery was developed in the 1930s by Professor Henri Andre of Paris. The battery utilises the principle of the silver-zinc electro-chemical couple. The active materials are contained within two 'sacks' together with the electrolyte which is in an absorbed state.

But the success of this relatively new type of battery does not for a moment imply that the traditional lead-acid cell is on its way out.

Britain's Lucas organisation has just announced that after four years they've dropped their zinc-air research and have gone back to researching lead-acid batteries. In their opinion the 'lead-acid battery will continue to be used . . . for mass produced cars . . . during the foreseeable future'.

Their latest polypropylene-cased 'Pacemaker' series are claimed to be 10% smaller, weigh 20% less, yet provide 25% more power with 35% more stored energy per lb. than the existing range.

Apart from variations of the lead-acid cell, zinc mercury and alkaline-manganese dioxide cells have established their place as medium energy density sources. And since their introduction, products have been developed utilising their reduced size and weight.

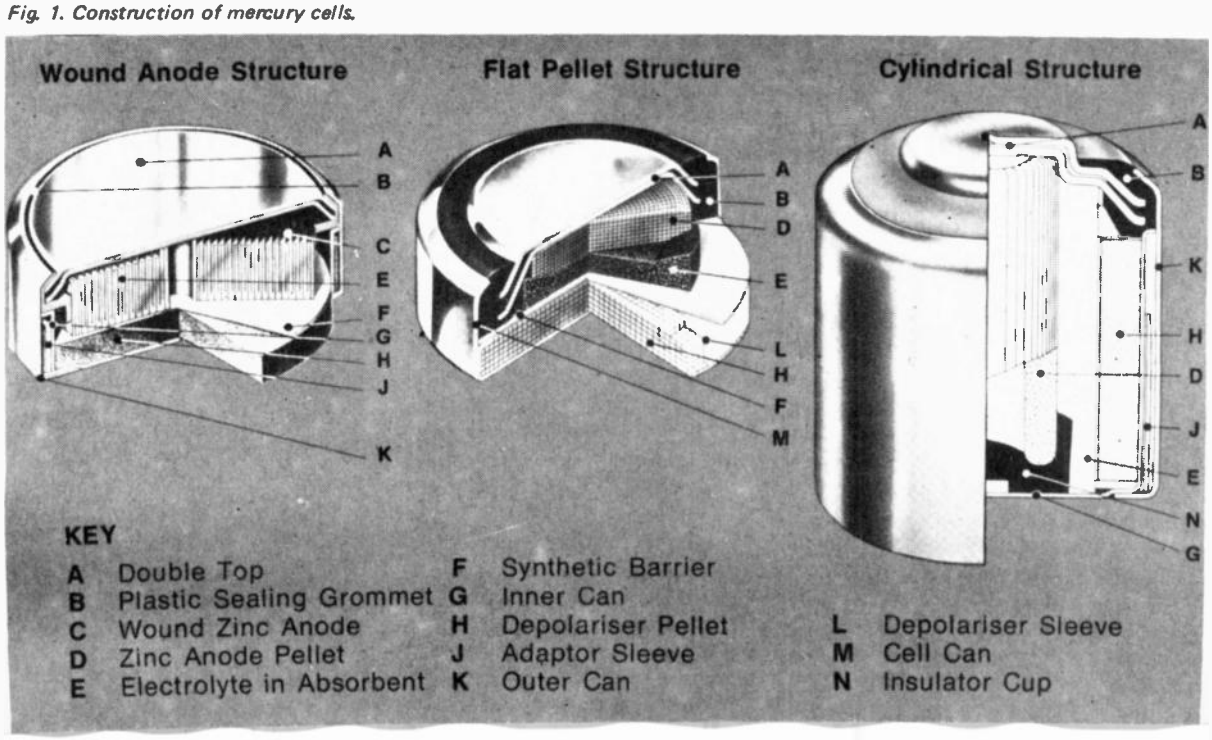
They are essentially primary 'one-shot' systems although both are capable of a small number of charge-discharge cycles.

THE MERCURY CELL

The mercury cell was designed during World War II by Dr. Samuel Ruben to fulfill a need for a primary battery that would retain its potential over long periods of storage in adverse conditions, and be rugged enough to withstand the rigours of combat use.

Mercury cells are produced in cylindrical and flat pellet or button

Fig. 1. Construction of mercury cells.



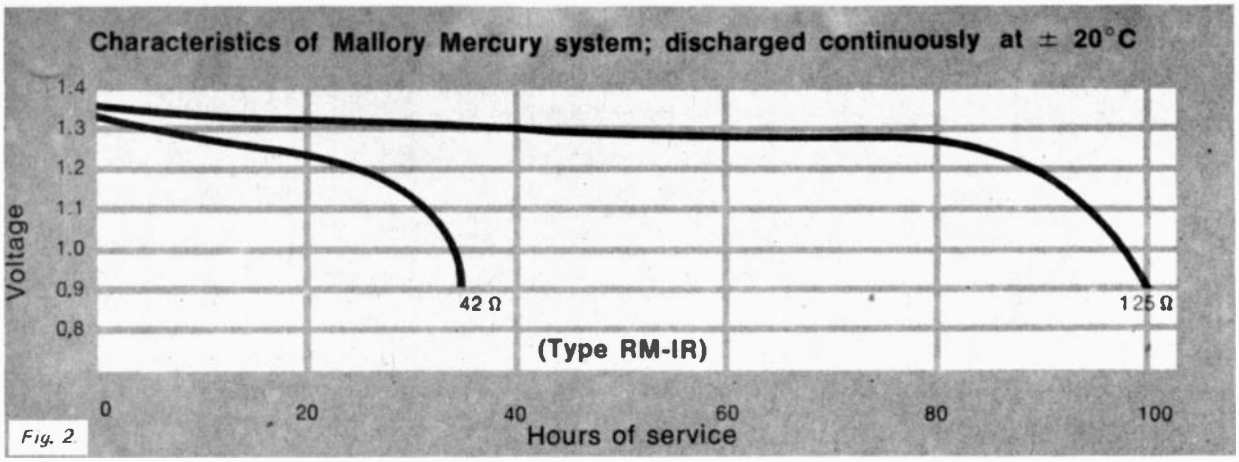


Fig. 2

structure. Electrochemically both forms are identical and differ only in container design and internal arrangement. The basic constructions are illustrated in Fig. 1.

The anode is formed from high purity amalgamated zinc. The cathode is mercuric oxide/graphite and separated from the anode by an ion permeable barrier. The electrolyte is a solution of alkaline hydroxyde whose ions act as carriers for the chemical action of the cell, but is not consumed.

In operation this combination produces a neutral film of mercury which does not inhibit current flow. Thus the terminal voltage remains steady on discharge and recuperation periods are unnecessary. To ensure maximum efficiency, the inner cell top is plated to provide an internal surface with which the zinc anode is electro-chemically compatible.

Cell containers are nickel plated steel to resist corrosion and offer the greatest passivity to the electrolyte.

Mercury batteries may be stored for periods of two to three years with only a slight deterioration of their stored energy.

The stable characteristics of this type of battery are little affected over a wide range of temperatures and one manufacturer has reported successful operation at temperatures above 120°C. A typical discharge curve is shown in Fig. 2.

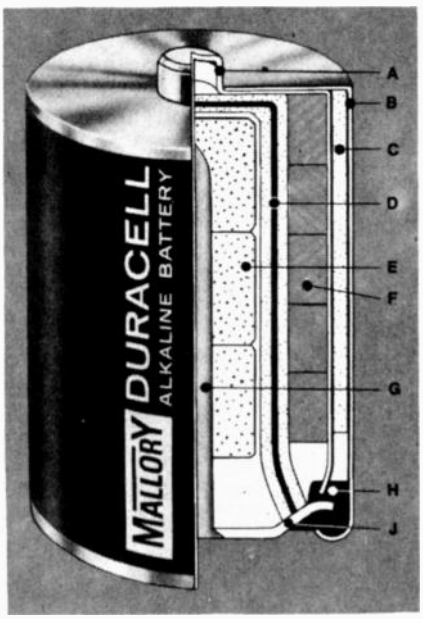
It was in fact a mercury battery that was employed to power the timer on the seismic experimental package that the first lunar astronauts left behind on the moon. The battery, little larger than a thimble, is capable of lasting for two years and is similar to the one used in medicine's heart pacemaker.

ALKALINE MANGANESE DIOXIDE CELL

For more general applications where voltage stability and small size are not so important, the alkaline manganese battery is often chosen.

Alkaline manganese cells are similar in construction to mercury cells, and whilst their voltage is not as constant as mercury cells they are far more uniform than ordinary batteries.

The construction of the alkaline manganese battery is shown in Fig. 3. The positive terminal is formed by a stud at the top of the cell and is in contact with the depolariser via the steel case. The depolariser (or cathode) is a mixture of manganese dioxide and graphite compressed into cylinders that fit around the anode. The electrolyte is a solution of potassium hydroxide.



A Inner Can
B Outer Can
C Adaptor Sleeve
D Electrolyte in Absorbent
E Zinc Anode Pellets
F Depolariser Pellets
G Collector
H Plastic Sealing Grommett
J Top

Fig. 3. Cutaway view of alkaline-manganese cell.

Alkaline manganese cells are capable of providing heavy currents for long periods, and in a similar manner to mercury cells, they have the ability to operate over a wide range of temperatures.

A comparison of discharge characteristics for conventional zinc carbon, alkaline manganese and mercury batteries is shown in Fig. 4; other characteristics are tabled in Fig. 5.

ZINC-AIR CELLS

The zinc-air cell was developed originally by Leesona Moos Laboratories in the US and was, in fact, a spin-off from their research on fuel cells.

Their major advance was the development of air-breathing cathodes that operated efficiently on oxygen absorbed directly from the surrounding atmosphere.

Leesona also contributed to the development of high performance zinc anodes to match these air cathodes, to produce cells combining high power-weight and capacity-weight ratios. They have utilised these advances in a range of mechanically rechargeable batteries developed for military use, as well as continuing research and development on primary and secondary batteries.

The Leesona Company have subsequently licensed Crompton Parkinson in the UK, Hitachi in Japan, and Gould in the USA in an arrangement that gives them full access to all Leesona's patents in this field.

A cut-away showing the important features of a rectangular zinc-air cell is shown in Fig. 6.

A tough plastic outer case contains the anode, which is prepared from amalgamated zinc powder and incorporates the negative terminal of the cell. The anode is in contact with the electrolyte, which is a concentrated solution of potassium hydroxide. This combination allows

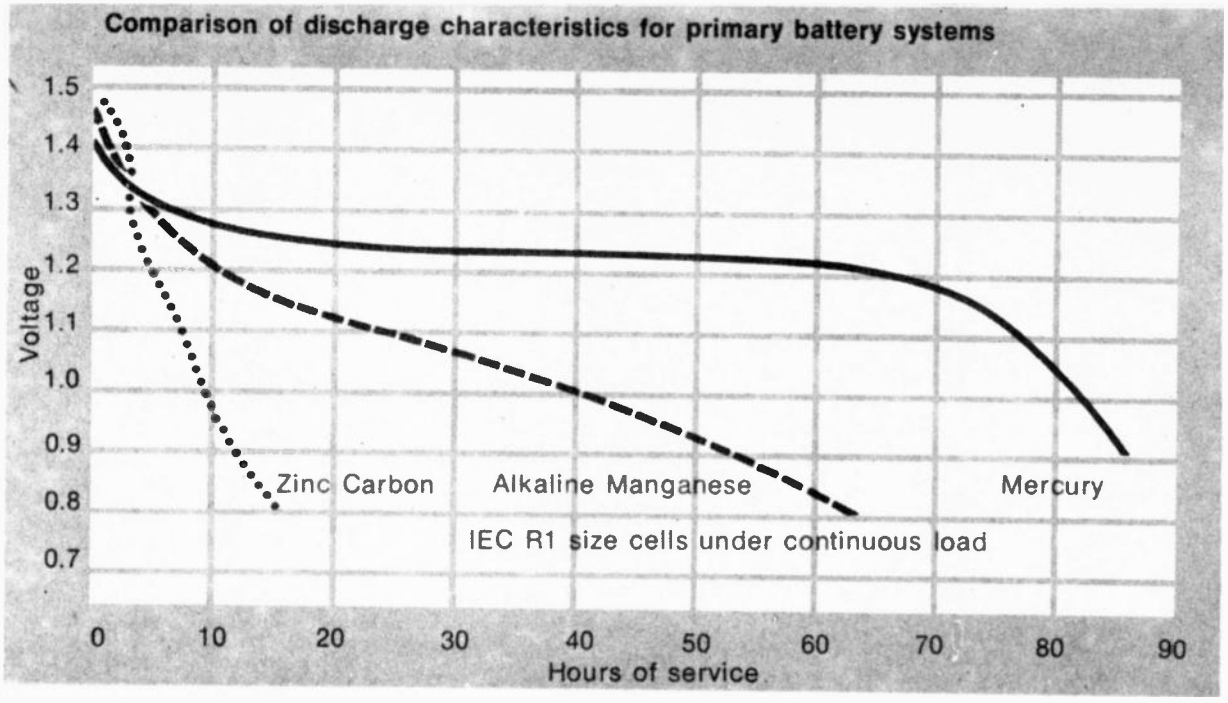


Fig. 4. Graph shows discharge performance of zinc-carbon, alkaline manganese and mercury batteries.

BATTERY REVOLUTION

large currents to be drawn without serious polarisation of the anode.

The cathode structure consists of several layers, held in an external plastic frame. The outer layer of the cathode is a micro-porous PTFE film, which allows oxygen from the atmosphere to diffuse through it into the cell. Since this is a hydrophobic material, it also serves to contain the liquid electrolyte so that the battery can be used in any position.

The inside face of the PTFE carries a layer of catalyst. This, being also in contact with the electrolyte, converts the oxygen to hydroxyl ions without itself being consumed or changed in the process. An effective but relatively inexpensive catalyst has been developed to provide a high current density at the cathode.

The current generated at the catalyst layer is collected by a metal mesh connected to the positive terminal of the cell.

The final layer is a permeable separator, which, although allowing free passage of the conducting ions, prevents direct electrical contact between the anode and cathode.

CHARACTERISTICS OF ZINC AIR CELLS

The market for primary batteries is mainly in the relatively small sizes, and considerable research and development has been necessary to design such cells in forms suitable for economic large-scale production, without sacrificing the high performance of the zinc-air system. Cells are now being produced on a pilot scale which exceed in current output and capacity, the equivalent sizes of alternative premium cells, (such as alkaline manganese and mercury cells) by a useful margin. The cost of these zinc-air cells is already comparable, and could reduce further as production expands.

It is more difficult to compare zinc-air cells realistically with the common Leclanche dry cells, since the former operate best in continuous or semi-continuous service at high currents, whereas Leclanche cells can only operate intermittently at high currents or continuously at much lower currents. However, due to their low cost and ready availability Leclanche cells are sometimes used in applications for which their characteristics are not well suited, and in some of these zinc-air cells can offer very considerable advantages in size, weight and effective cost for the power delivered.

The maximum current output of a zinc-air primary cell is mainly governed by the cathode area. The capacity, however, depends on the volume available for the zinc anode, since the cathode will operate continuously as long as there is access of air to its surface.

System	Nominal Voltage	Storage to 80% Capacity (months)	Watt Hrs./ Lb.	Watt Hrs./ Cu. In.
Mercury	1.35 or 1.4	30	46	6.0
Alkaline-Manganese	1.5	30	35	3.5
Zinc Carbon	1.5	6-12	22	2.0

Fig. 5. Characteristics of mercury, alkaline manganese and zinc carbon cells.

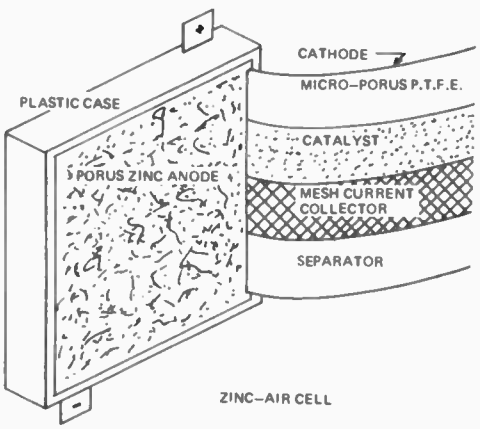


Fig. 6. Section of rectangular zinc-air cell.

Frankly, we don't know how they do it. However the remarkable Sansui Model 210 is likely to be the most popular Sansui model ever, including the record sales AU-555 and AU-222 stereo amplifiers. The Model 210 opens a bold new vista for the audio enthusiast and sets a new standard for audio equipment values. For only $185 you get a tuner *designed specifically for Australian conditions* and a superb stereo amplifier. Although the Sansui Model 210 compares favorably with other models in the Sansui tuner/amplifier range, superfluous facilities for Australian conditions (such as F.M. and Multiplex) have been discarded. This saves some cost; further savings have been made by Sansui in arranging heavy volume production to meet the expected Australian demand.

Power output is 34 watts music power into 4 ohm speaker systems or 22 watts R.M.S. Frequency response is 25-30,000 Hz. ± 2 dB. Sensitivity suits magnetic cartridges at 3 mV. — and 180 mV. sensitivity caters for auxiliary inputs and tape recorders.

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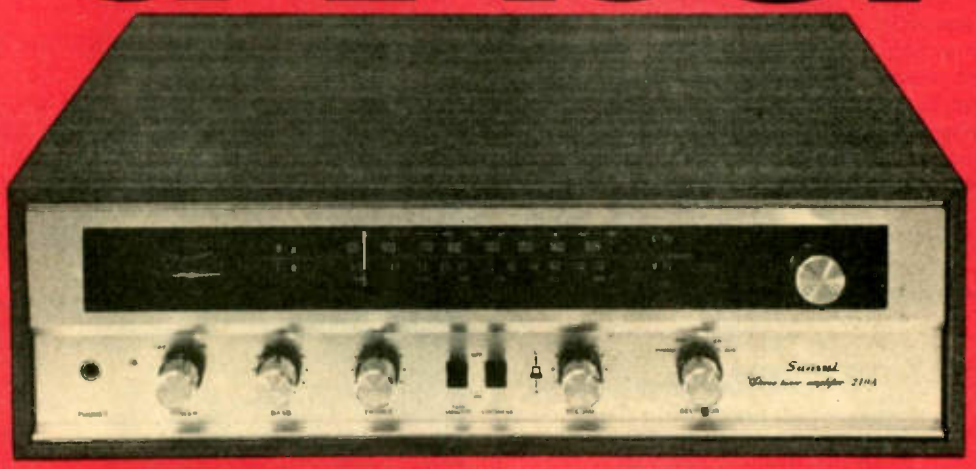
TRUST SANSUI



It takes Japan's leading audio only manufacturer ...Sansui...to design and manufacture an outstanding stereo tuner/amplifier expressly for Australia, and to keep the price down to only $185!

BATTERY REVOLUTION

Depending on the type of application, a zinc-air cell can produce six to eight times the output of an equivalent high-performance Leclanche cell, or alternatively, a weight saving of a similar order. The systems are not, of course, strictly comparable in that, size for size, the Leclanche system would not be capable of the higher discharge rates which zinc-air can provide.

In addition, this high current is delivered, continuously if required, at a voltage which remains very nearly constant throughout the discharge. This is in strong contrast to the sharply declining voltage characteristic of the Leclanche system.

The curve Fig. 7 compares the output of two Crompton Parkinson ZETA A cells with equivalent size standard and high performance Leclanche, alkaline manganese dioxide and mercury-zinc cells.

Typical weights of the AA size cells and of the zinc-air equivalent are as follows:—

Leclanche, ordinary:	15 g.
Leclanche, high power:	15.5 g.
Alkaline manganese:	21.5 g.
Mercury:	27.5 g.
ZETA zinc-air: (each)	16 g.

The output of the zinc-air cell corresponds to 185 watt-hours/kilogram. Specification of the Zeta cells are given in Fig. 8.

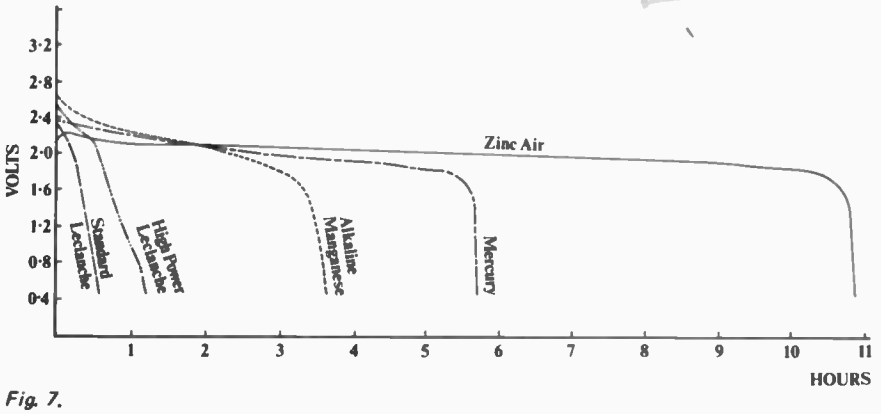


Fig. 7.
Discharge curves of various types of cell compared to a zinc-air battery of the same physical size.

ISOTOPE POWERED BATTERIES

Isotope batteries and power supplies utilise the heat generated when the energy of ionising radiations emitted by a radio-active source is absorbed.

A proportion of this heat is then converted to dc electrical power by the thermo-electric effect. This effect was discovered by Johann Seebeck nearly 150 years ago. In 1822 Seebeck observed that a magnetic needle was deflected when placed near a closed loop of two dissimilar metals when a temperature difference was maintained across their two junctions.

The effect was largely ignored, except for temperature measurement, (i.e. thermocouples) until the advent of the transistor in 1948. It was then discovered that by doping certain pure metals a valence could be obtained as in transistors. Considerable power could be generated by making a closed loop, and then heating one junction and cooling the other.

And this is the principle used in isotope batteries made today.

The radio-isotopes used as a source of heat in the isotope batteries are recovered from spent nuclear reactor elements. The radio-isotopes generate heat as they decay — a process that takes many years.

An isotope battery suitable for use in implantable heart pacemakers is being developed at the Atomic Energy Research Establishment, Harwell. It converts the spontaneous heat generated by the radioactive isotope plutonium-238 into electricity using a thermopile, as shown in Fig. 9.

The battery is matched to the pacemaker circuit by a dc to dc convertor, which can be designed to enable any circuit to be used. A schematic view of a completed pacemaker is given in Fig. 10.

The ultimate lifetime of this battery is limited by the decay of the isotope but, with PU-238 (half-life about 90 years), lifetimes of greater than 10 years are feasible.

Pu-238 is primarily an alpha-emitting isotope and, with reliable canning, an ultra-safe source capsule can be produced; it will neither emit radiation harmful to the patient nor constitute a hazard to the general public even if — and this is highly unlikely — it is heated to 850°C.

The battery is a heat engine which uses an isotopic heat source, with a thermopile to convert the heat to electrical power. It therefore has no moving parts. Heat losses are minimised because the source and the thermopile are surrounded with thermal insulation inside an outer can, which also serves as a secondary containment of the isotope.

The can, which is made of stainless steel and is hermetically sealed, will maintain its integrity up to 600°C. The thermopile, however, may be damaged by temperatures in excess of 150°C. Even so, this is more than sufficient for sterilization and it does mean that the temperature to which the complete unit can be raised will be limited by the electronics rather than by the battery as at present.

RECHARGEABLE ZINC-AIR BATTERIES

Although the development of an electrically rechargeable zinc-air battery remains an important long term objective, it has not yet reached a

Voltage	—	Open-circuit: 2.8V. On-load: initially 2.4-2.2V, depending on load. End-point: 1.8 volts.
Current:	—	Recommended continuous maximum: 250mA peak: 500mA.
Capacity:	—	2.5Ah after 3 months sealed storage under temperate conditions.
Dimensions:	—	50mm x 28mm x 14mm (2in. x 1.1in. x 0.6in).

Battery size and terminal layout make it a direct replacement for two conventional cylindrical penlight AA cells, mounted side by side and connected in series.

Weight: — 32g. (1.1 oz).

Fig. 8. Characteristics of the zinc-air battery shown in Fig. 7.

This isotope battery powered heart pacemaker was successfully implanted in a patient on July 15, 1970. The unit is expected to operate for at least ten years.

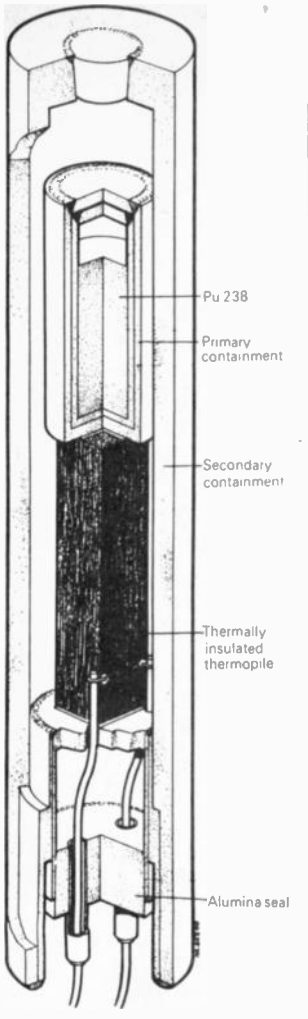


Fig. 9. Isotope battery developed for experimental heart pacemaker. Approximate size is 1.75" x 0.7".

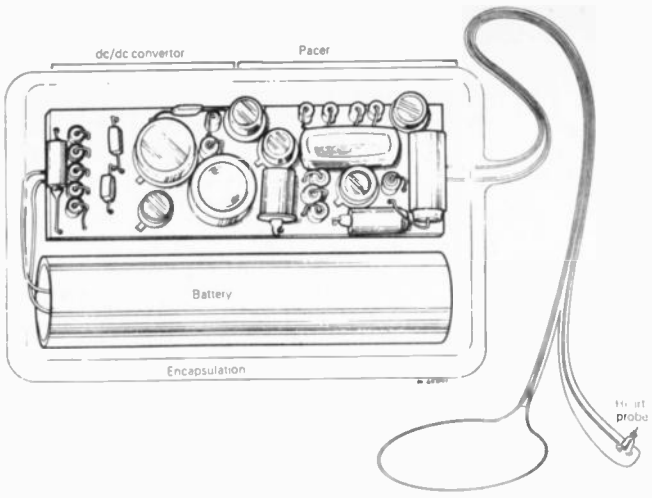


Fig. 10. Drawing of complete isotope powered pacemaker.

stage when market evaluation can be considered.

The cycle life so far attained is insufficient for an immediate practical application in electrical vehicles. A design to be competitive with the conventional long cyclic life lead-acid traction batteries, must approach the same level of cost per unit of capacity per cycle as those batteries, otherwise the economics accruing from the increased pay load in delivery vehicles using zinc-air batteries will be swallowed up in a greater annual investment cost.

So far it has not been possible to achieve the same order of cost per watt-hour per charge/discharge cycle as the lead acid cell.

Although Lucas have abandoned their research project, development work still progresses at other organisations since with the rising cost of labour the economic balance can significantly shift and the effect of a higher annual cost per watt hour per cycle be diluted.

Another type of battery currently under evaluation by Mallory Battery Corporation in the USA is the titanium system. The battery is in many ways similar to conventional lead-acid units except that nitrided titanium is used instead of lead. It is said to be about half the weight and two thirds the volume of conventional lead-acid batteries.

But despite all the effort and research no truly high energy density system has yet emerged that is commercially viable with the possible exception of the fuel cell.

FUEL CELLS

The fuel cell is an extraordinarily attractive concept — that of producing electrical energy continuously by direct conversion of the energy stored in chemical substances.

The first practical fuel cell was developed by Cambridge University's F.T. Bacon in 1959. This unit combined nickel electrodes with an acqueous potassium hydroxide electrolyte.

Considerable development was subsequently undertaken by a number of American organisations as part of the NASA programme. Fuel cells developed for space craft operated by combining hydrogen and oxygen gases in an electro-chemical reaction — electrolysis in reverse as it were.

The cutback in the NASA programme slowed down fuel cell development and interest appeared to be waning, until quite recently, when a totally new type of natural gas powered fuel cell was announced by a 32 member non-profit organization called TARGET.

This organisation (Team to Advance Research for Gas Energy Transformation) together with Pratt and Whitney have developed the new system as a method of generating on-site electricity in substantial quantities.

The new method uses the same non-combustive reaction as the smaller space-craft cells, but the hydrogen is obtained from natural gas, and the oxygen is recovered from the air.

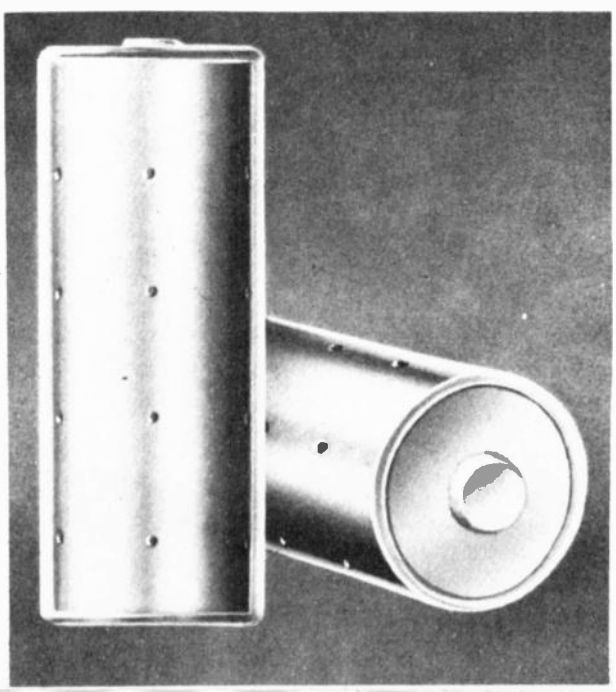
In this new system natural gas is firstly broken up into its carbon and hydrogen elements. The carbon is transformed into carbon dioxide, and is fed into the fuel cell together with the hydrogen.

The hydrogen and carbon dioxide are fed to a porous fuel electrode. Hydrogen ions are thus formed releasing a flow of electrons that pass through the external electrical load and then to an air electrode on the fuel cell. At this point the electrons transform oxygen from the air into an ionic state: oxygen-bearing ions are thus released into the electrolyte and these migrate to the porous fuel electrode, thus completing the electrical circuit.

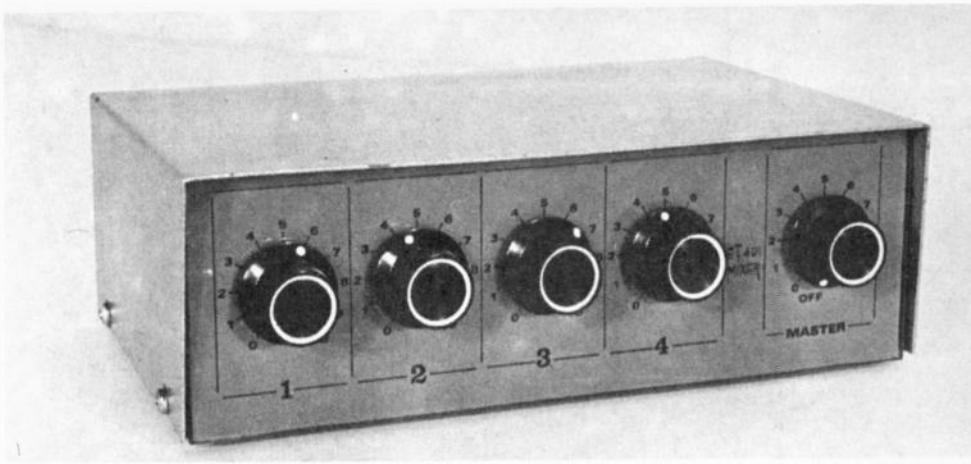
The new method is claimed to be one third more efficient than any previous method of generating electricity and it appears feasible to construct units with outputs up to several megawatts.

Whether or not the method can be used for small scale power generation remains to be seen.

Zinc-air cells manufactured by Energy Conversion Ltd. in England.

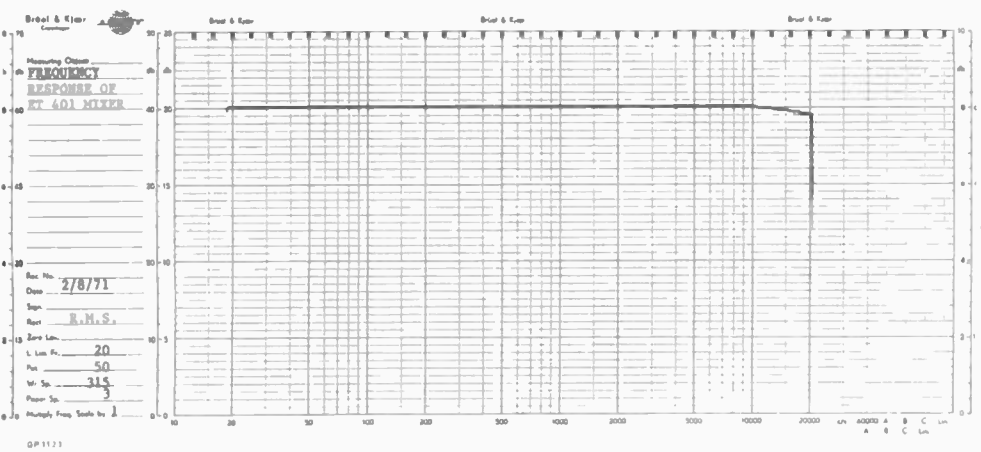


ET PROJECT



FET FOUR-INPUT MIXER

Mix any combination of four audio signals with this easily constructed unit.



THREE guitars and a microphone. One record player, two tape decks and an electronic organ. Or any combination you like of two, three or four separate audio signals can be smoothly blended together by using ELECTRONICS TODAY's new ET 401 Input Mixer.

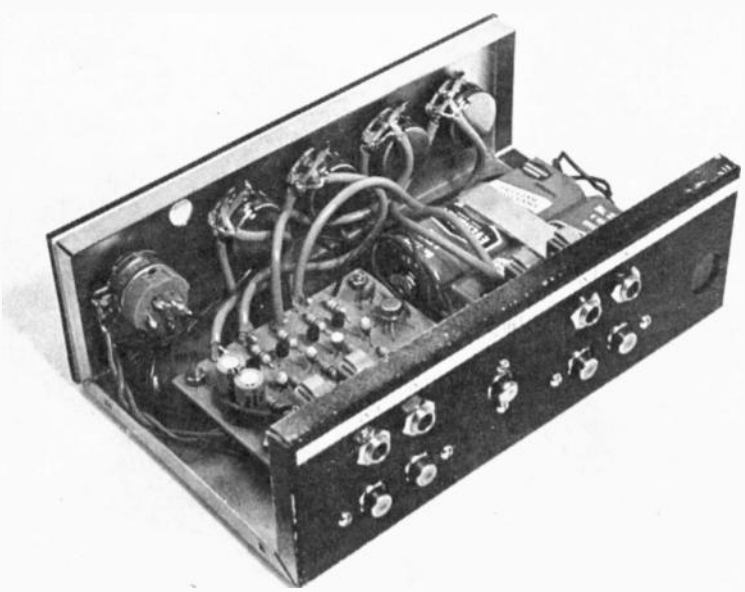
The unit can handle input levels from 2mV to 2V, input impedances from 4 ohms to 1 megohm. It provides a maximum gain of 20 dB, and has a frequency response that is absolutely flat from 20 Hz to 10 kHz, and is still within 1 dB at 20 kHz. The response curve is shown in Fig. 1.

Battery operation has ensured that internally generated noise is kept to a very low level, and the unit is suitable for all types of inputs with the possible exception of very high performance dynamic microphones with outputs of less than 2mV. Life expectancy of the batteries specified in the parts list is at least 100 hours of continuous use.

CONSTRUCTION

The circuit diagram of the complete unit is shown in Fig. 2, the circuit board pattern is shown in Fig. 3, and the component layout in Fig. 4.

Make sure that the electrolytics are connected the right way round, and do not use excessive heat when soldering



Interior of completed unit.

HOW IT WORKS

The mixer consists of four identical input stages and one summing amplifier.

Each input stage consists of a variable attenuator and a FET source follower. The attenuators are one megohm potentiometers, and since the input impedance of a FET is very high, the input impedance of the mixer is that of the attenuator — i.e. 1M.

Input signals are coupled to the mixer via standard jack plugs and sockets or RCA connectors. Both types of input connector were fitted to each input of the prototype unit — each pair being wired in parallel. Provision for both types has been made on the sheet metalwork drawings and included in the parts list. Either type may be omitted if required.

The output impedance of the FET stage is approximately 1k, and the internal gain of the FET is unity.

The summing amplifier is a LM 301A operational amplifier. This has an open loop gain of around 100,000 and a cut off frequency of approximately 10 MHz. Gain control is varied by the feedback potentiometer RV5.

Output impedance of the mixer is less than 100 ohms. It is desirable that the load impedance should exceed 2k. The mixer is however, short circuit proof, and the only effect of excess load is distortion. The output is dc coupled, and the offset voltage (dc component) is typically 2mV.

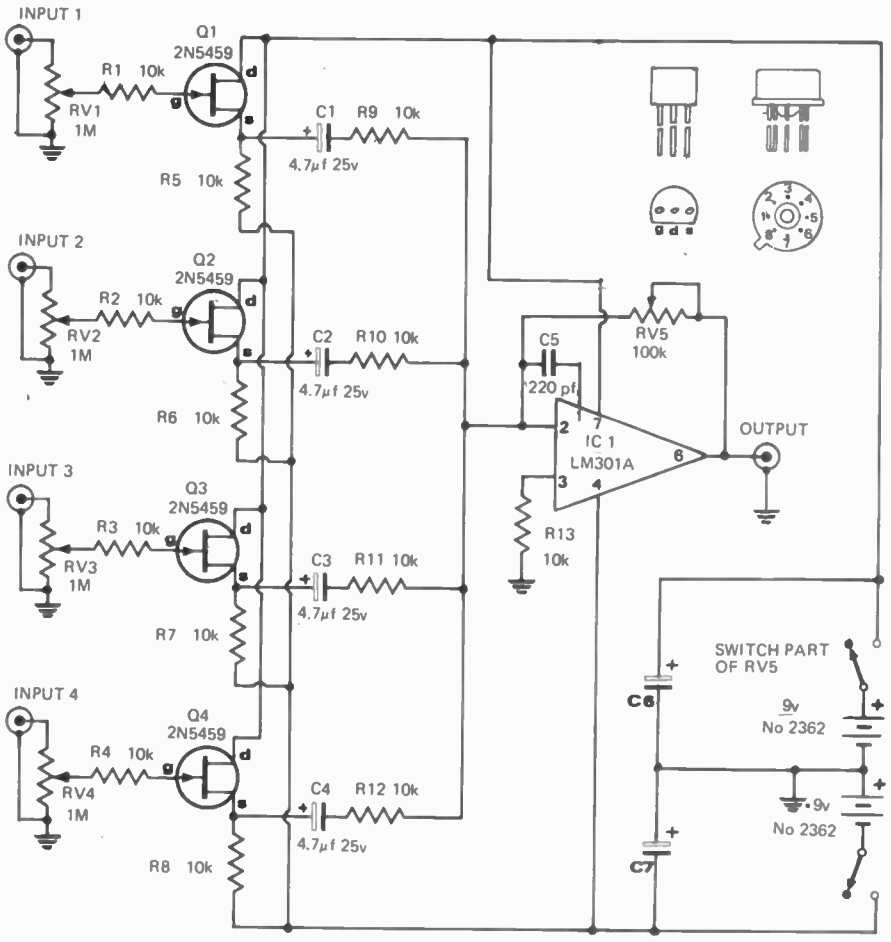
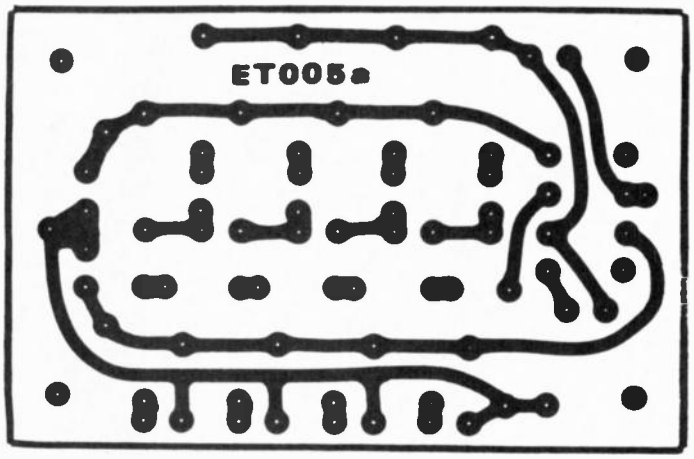


Fig. 2, Circuit diagram of complete unit



PARTS LIST

R1-R13	—	resistor 10k, ½W, 5%
RV1-RV4	—	potentiometer, 1 Megohm, logarithmic.
RV5	—	potentiometer, 100k, logarithmic, with double pole switch.
Q1-Q4	—	field effect transistors, 2N5459
C1-C4	—	Tag tantalum capacitors, 4.7µF.
C5	—	capacitor, 220µF
C6-C7	—	capacitor, pc board mounting, 100µF electrolytic.
IC1	—	integrated circuit LM 301A (National Semiconductor) metal can type, or µA 301A Fairchild metal can type.

Plus — 4 closed circuit jack sockets, McMurdo type 1291-06-01 or similar.
2 double type RCA sockets.
1 single type RCA socket
1 printed circuit board — ET 005a
2 nine volt batteries, Eveready type 2362 or equivalent.
1 metal case and cover.
4 spacers for pc board.
1 perspex front panel.
5 control knobs.
Coax cable, screws etc.

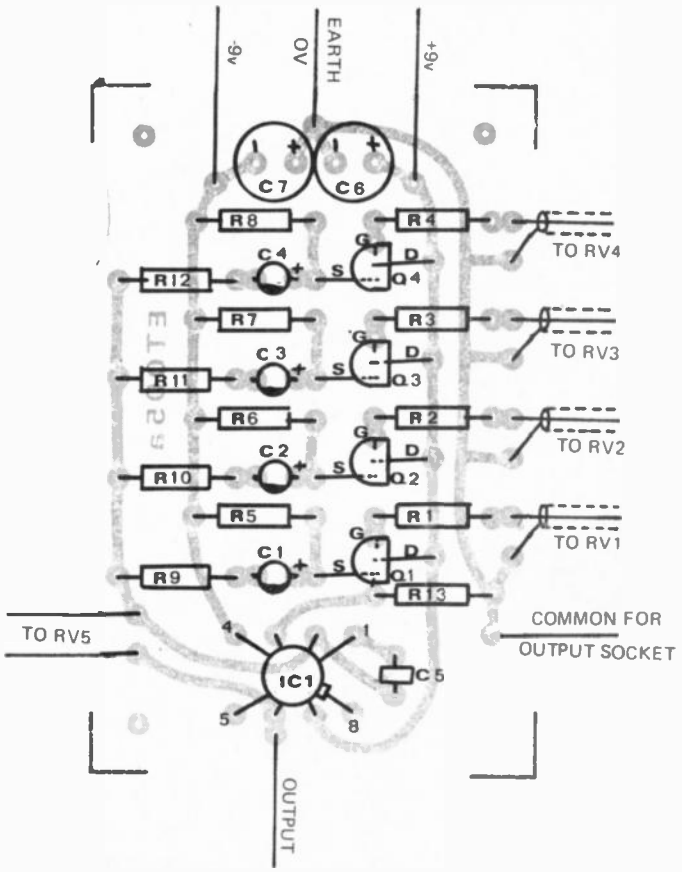


Fig. 4. How components are mounted on the printed circuit board — seen from components side.

FET FOUR-INPUT MIXER

the connections of the FETs and the I/C. Screened wire must be used for all leads from the input sockets to the potentiometers, and from the potentiometers to the printed circuit board.

Sheet metal drawings for the chassis and cover are shown in Figs. 5 and 6.

Finished artwork for the front panel is reproduced on glossy paper on page 121 of this issue. Cut the artwork around the outer edges, punch out the holes for the potentiometer bushes, and then clamp the artwork between the front metal panel of the chassis and a sheet of perspex (smoked perspex looks superb — if you can locate it). The complete assembly of chassis, artwork and perspex is sandwiched together by the potentiometer mounting nuts.

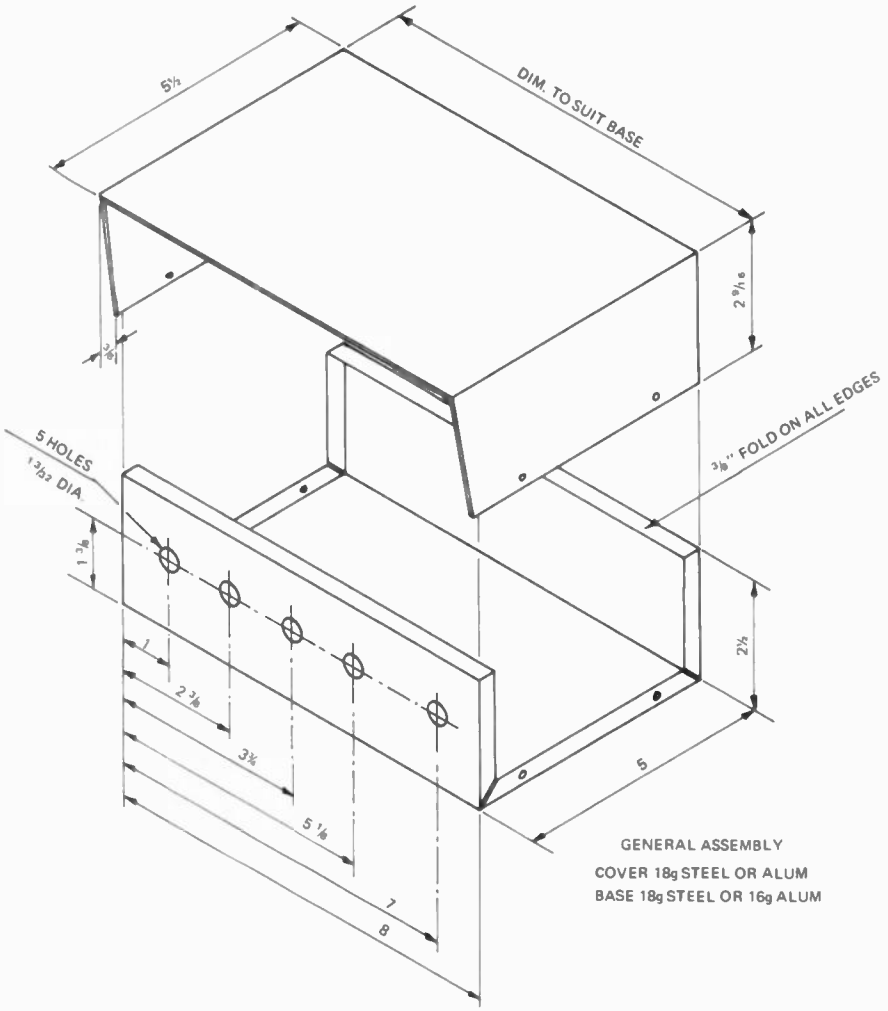
This will result in a very professional looking unit.

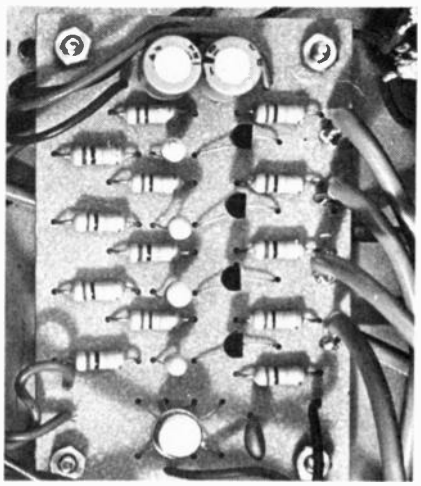
THE UNIT USE

The mixer may be connected, via screened cable, to any tape recorder or amplifier.

Connect the required audio inputs — again via screened lead — and set all four channel input controls to zero. Set the master gain control to just beyond halfway. Adjust the level of your amplifier (or if you are using a tape recorder, to the normal recording level) and bring up the level of each signal input as required. Leave the level of all unused inputs at zero.

Adjust the overall sound level by using the master gain control on the mixer. ●



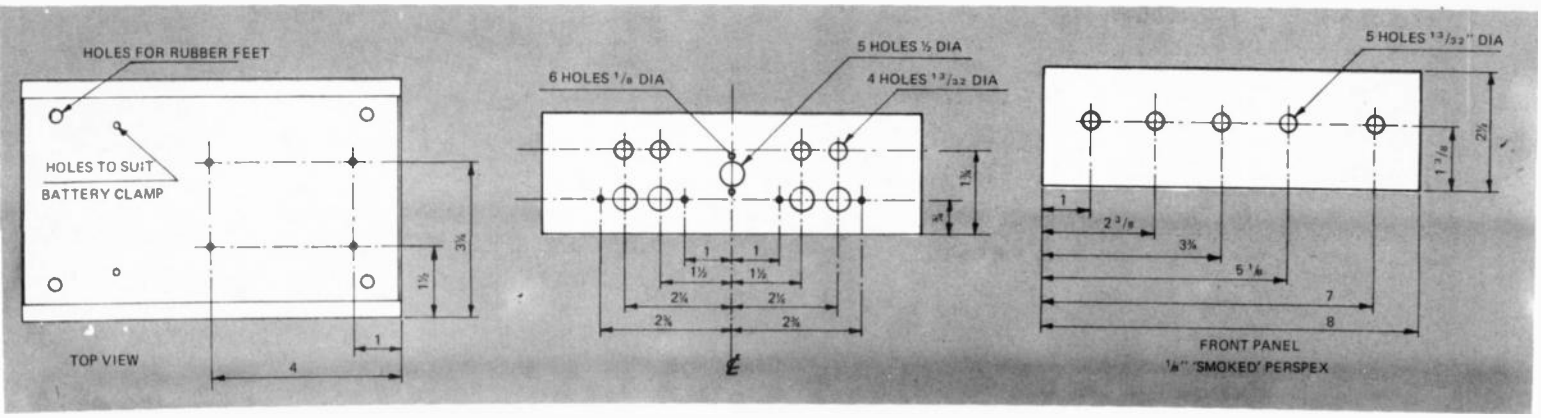


Compare this photograph of finished board with Fig. 4.

ET 401 MIXER

No. of inputs	—	4
Input impedance	—	1 Megohm
Input voltages	—	2mV -2V
Gain -max.	—	20 dB
Max. output V.	—	3V rms
Output impedance	—	<100 ohms
Output load	—	>2000 ohms
Freq. response	—	within 1dB (20Hz to 20kHz)
Power supply	—	18V at 15ma
Batteries	—	2 x 2362
Battery life	—	100 hours approx.

Fig. 6. Drilling details etc., of (below) base of chassis, (below centre) rear panel of chassis, (below right) perspex cover.



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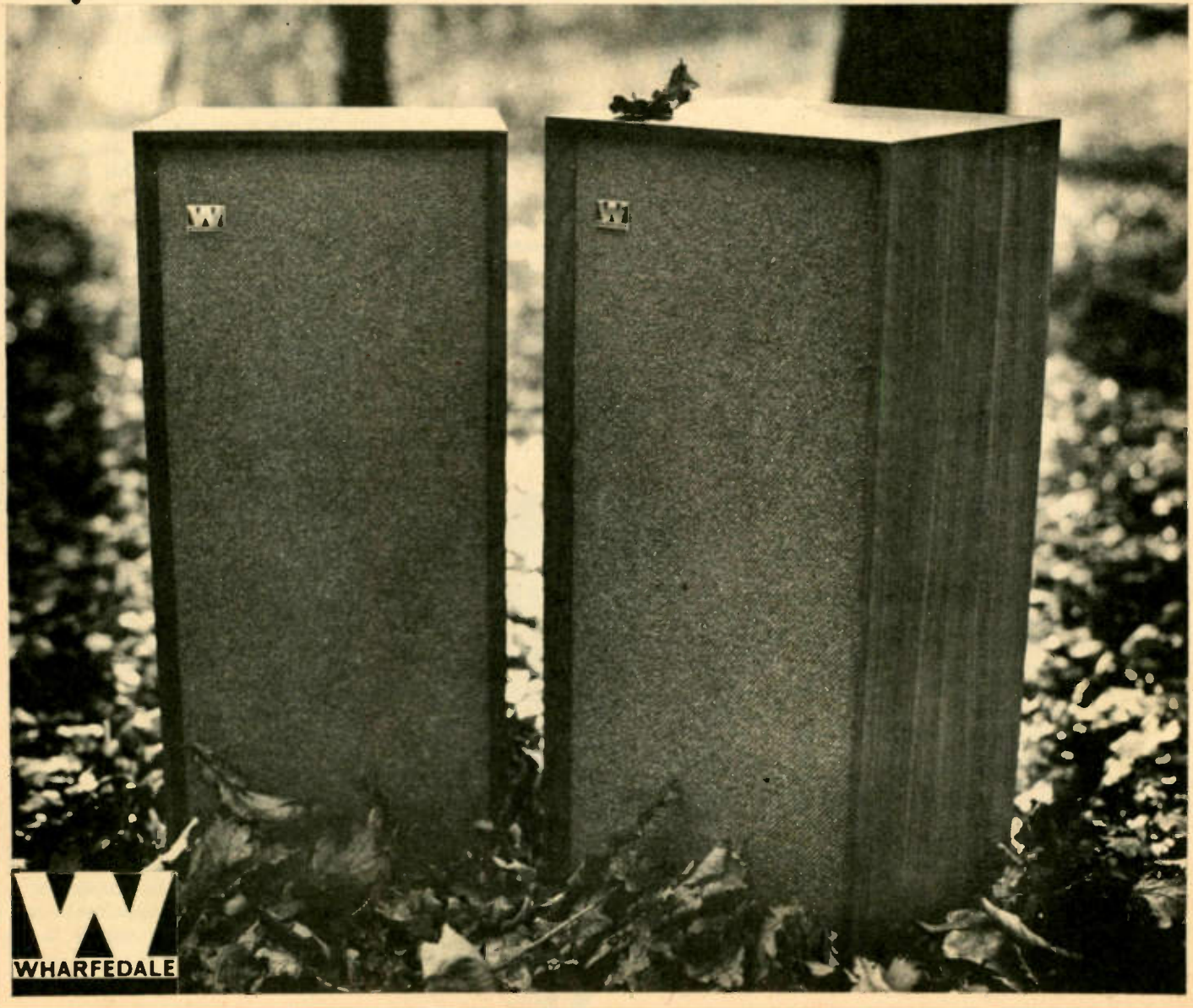


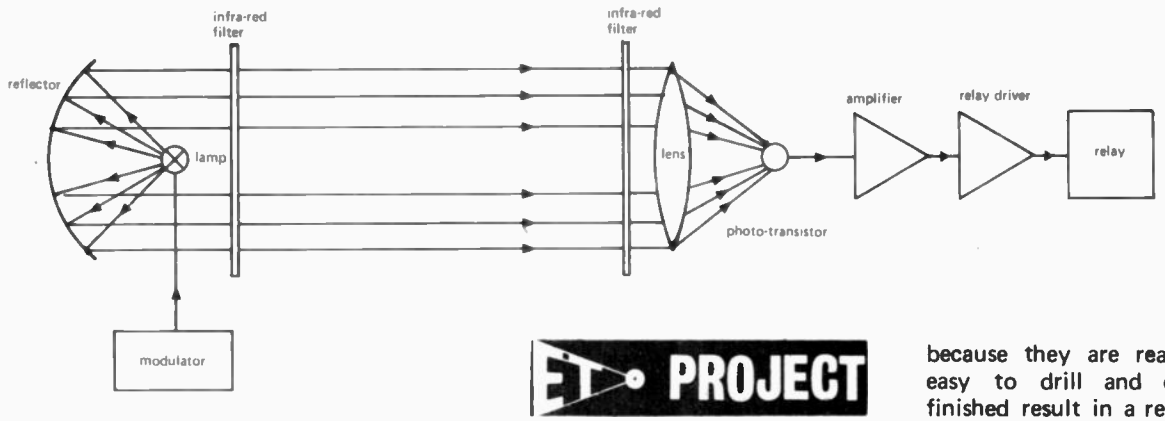


FIG. 1. PRINCIPLE OF OPERATION

ET PROJECT

INFRA-RED INTRUDER ALARM

Sophisticated infra-red intruder alarm has over 200ft. range.

One of the most reliable and efficient devices that can be used to detect the presence of a burglar is the infra-red beam.

The beam described in this project is fail safe and virtually tamper proof. It can be constructed from readily available parts, is easily installed and can be used over a range of at least 200 feet.

An alarm will be given the instance that an intruder passes through any part of the beam.

PRINCIPLE OF OPERATION

The basic principle of operation is shown in Fig. 1.

The transmitter consists of a source of infra-red energy (a tungsten filament lamp) modulated and focussed into a beam by a concave reflector and filtered to remove all visible light.

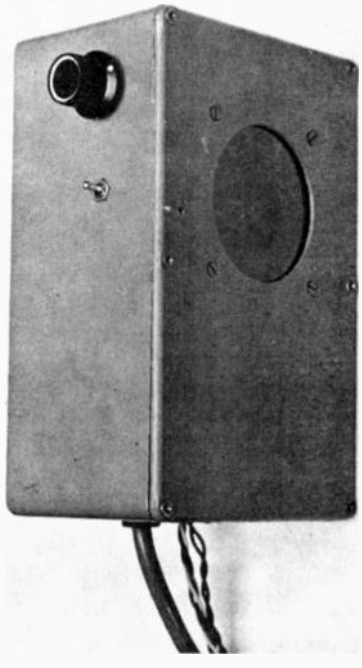
To make the beam tamper proof, and at the same time insensitive to ambient light, the transmitter is modulated at a low frequency. A burglar attempting to bypass the beam with a torch will discover this to his cost.

The receiver consists of a condenser lens which focuses the energy from the transmitter onto a phototransistor. The output of the phototransistor is amplified and used to drive the alarm relay. A filter is fitted in front of the lens to eliminate unwanted ambient light (such as that from fluorescent tubes).

CONSTRUCTION DETAILS

(a) Mechanical

An excellent method of construction is to build this alarm unit into a pair of diecast boxes. These were chosen because they are readily obtainable, easy to drill and cut, and when finished result in a really professional product. An alternative construction might well employ timber boxes made out of marine quality plywood.



A sealed beam lamp was chosen as the transmitter because it simplifies the optics and it produces a beam wide enough to facilitate easy alignment. The relatively wide beam width also reduces the risk of false alarms due to vibration of the beam mounting points.

For suggested mechanical details the reader is referred to Fig. 2.

The lamp can be glued to its mounting platform using silicone rubber, Plastibond or Permabond. Although this is a difficult glass to metal joint, we have found the Dow Corning silicone rubber in particular, to be very effective.

(b) Electrical

The electronic components for both transmitter and receiver are contained in the receiver unit. This results in compactness, and because only one printed circuit board is used, construction is relatively easy.

The circuit diagram of the complete unit is shown in Fig. 3.

The component layout, and copper foil side of the printed circuit board are shown in Figs. 4 and 5.

While assembling the board, check carefully the polarity of the electrolytic capacitors, and avoid overheating the transistors whilst soldering.

When the board is complete, recheck carefully, and connect the transformer, voltage regulator transistor Q2, and other components — as shown in the circuit diagram and illustrated in Fig. 7.

In this form the unit is mains operated, and a power failure will result in alarm operation. For some applications this may not be a serious problem; but if required, automatic changeover to battery operation may be provided by including the extra components shown in Fig. 6.

These components should be wired as shown and connected to the points marked X and Y on Fig. 3. If this facility is included, the mains on/off switch (SW1) must be changed to a double-pole type to enable the battery as well as the 240V supply to be

switched off when the beam is not required to be in use. The recommended batteries are two Eveready type 731 in series.

TESTING THE UNIT

1. Contact the lamp supply on the printed circuit board to the lamp in the transmitter.
2. Temporarily remove the filters from both transmitter and receiver.
3. Locate the transmitter some 10 to 20 feet from the receiver.
4. Set the latching switch on the receiver to the 'non-latch' position.
5. Connect the 240V supply to the receiver unit and switch on. The lamp in the transmitter should be flickering at a fairly high rate.
6. Align the transmitter so that the beam falls onto the lens of the receiver.
7. Adjust the receiver lens so that the light beam is focussed squarely onto the photo-transistor.
8. Adjust VR1 so that the relay is held closed by the light beam. The relay should open when the light beam is interrupted, but should reclose when the beam again falls on the receiver.
9. Switch the latching switch to the 'latch' position, and again momentarily interrupt the beam. This time the relay should open and stay open.

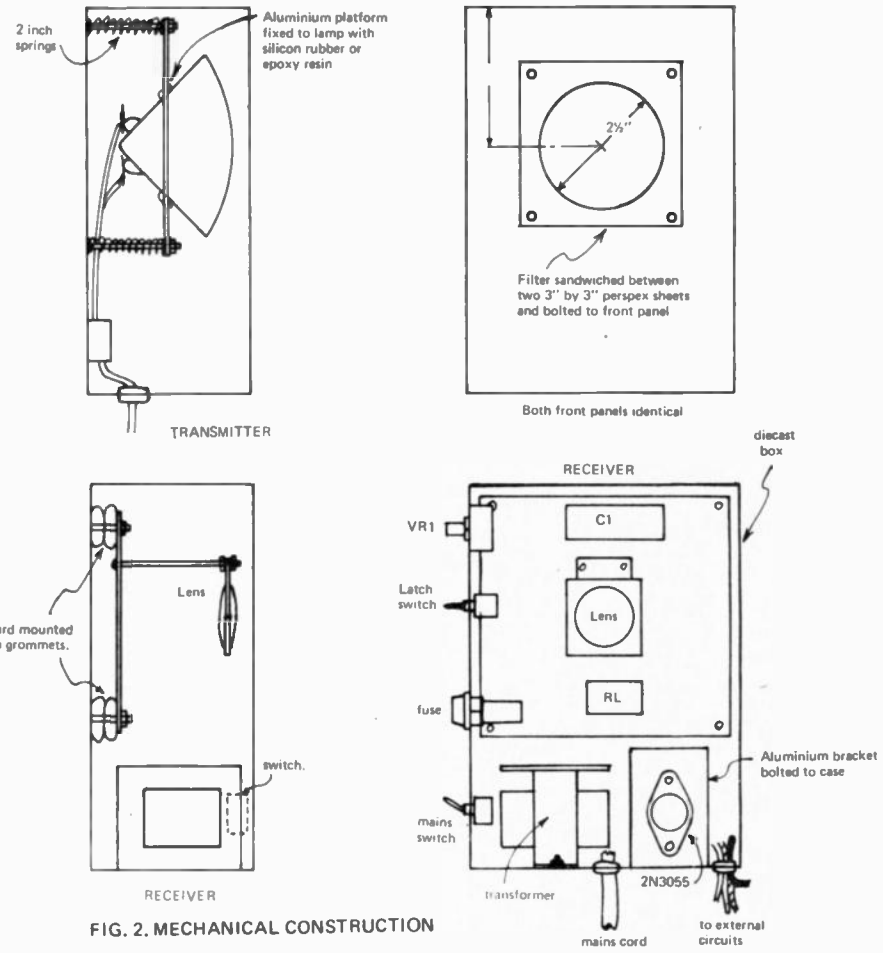
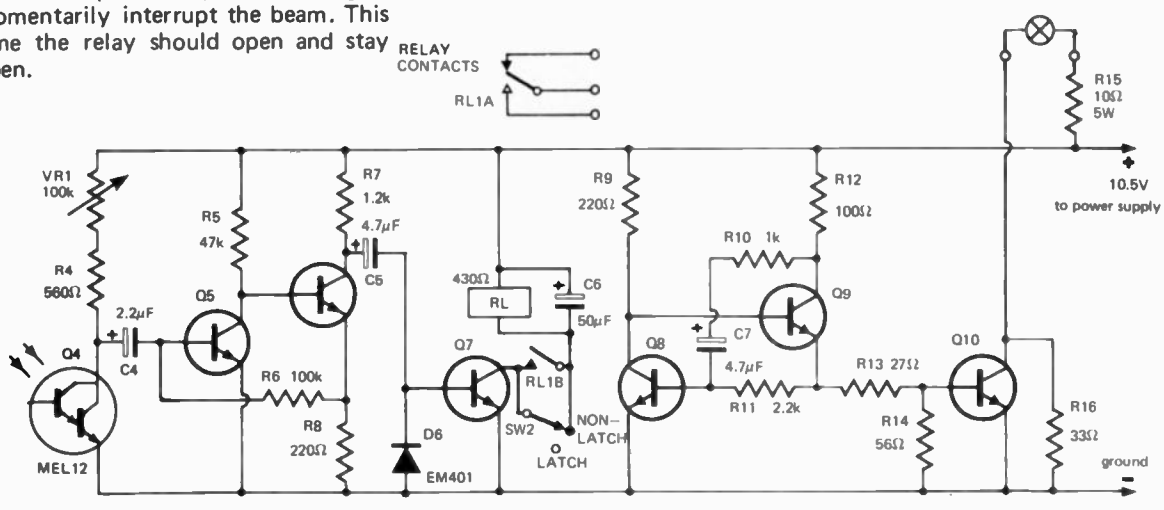
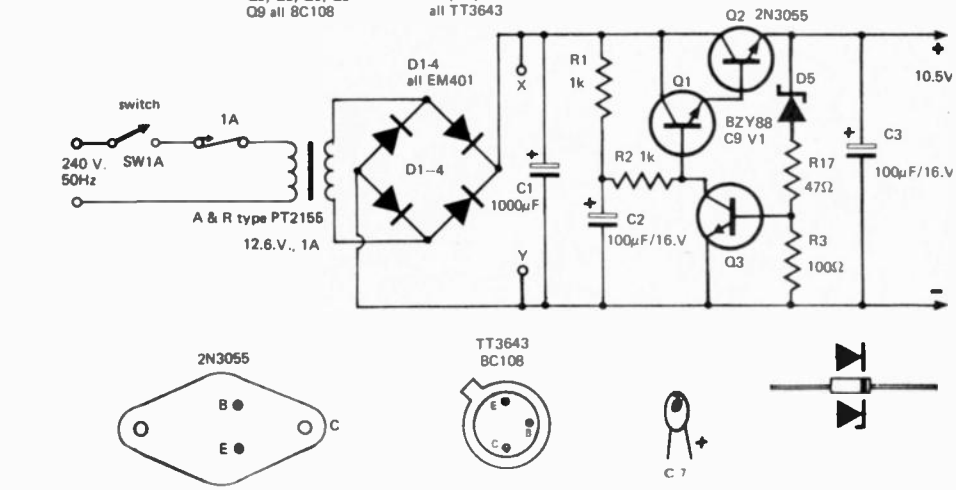
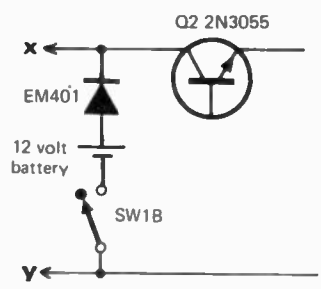


FIG. 2. MECHANICAL CONSTRUCTION







STANDBY BATTERY CIRCUIT

FIG.6.

FIG. 3. CIRCUIT DIAGRAM OF COMPLETE UNIT.

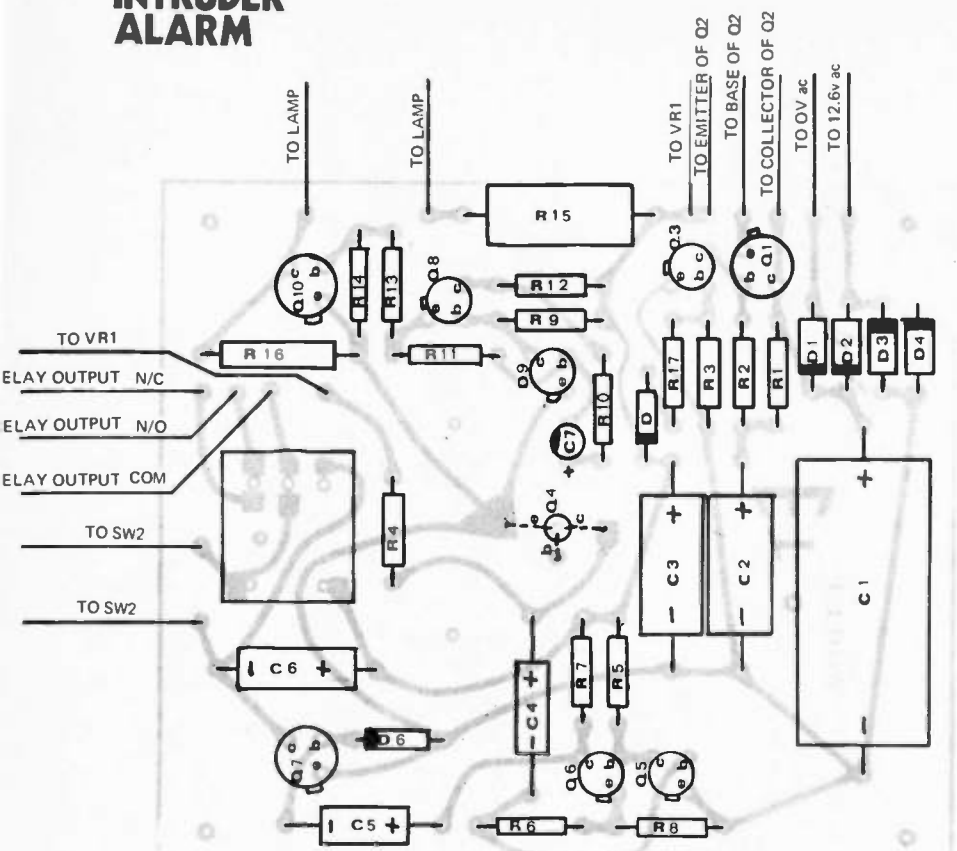


Fig. 4. How the components are located on the printed circuit board.

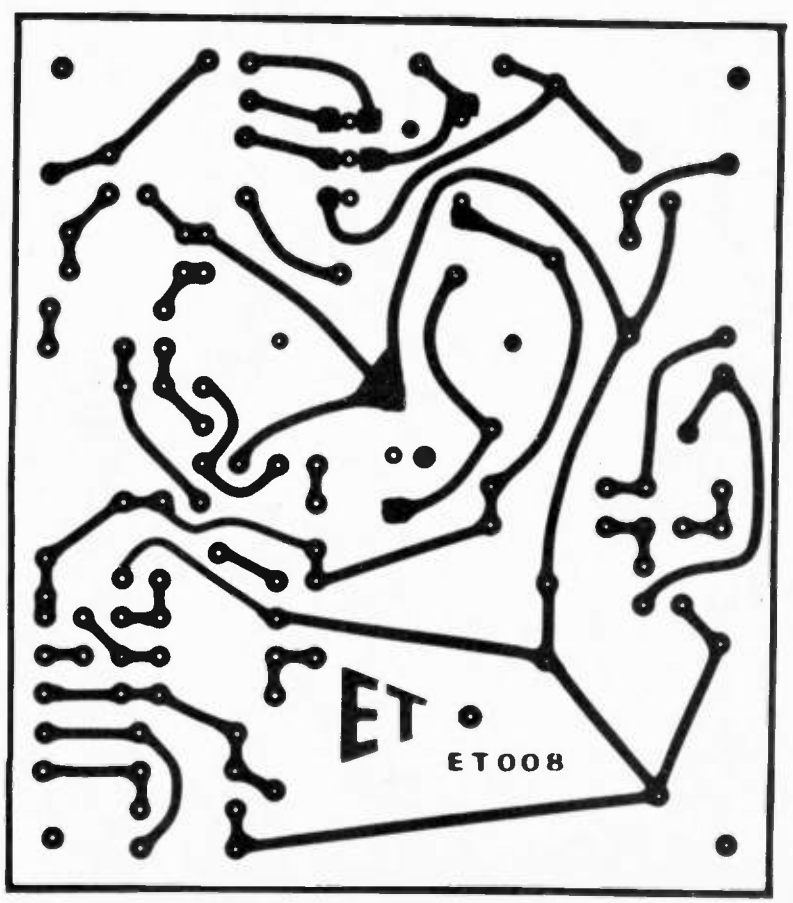


Fig. 5. Foil pattern for printed circuit board — full size.

INSTALLATION

The lamp mounting platform has been mounted on springs to enable the beam alignment to be adjusted after the transmitter box has been finally located.

However a useful precaution is to temporarily locate the transmitter at the designated point, connect the beam, and with the filter removed, ensure that the light beam falls on the point designated for the receiver.

Temporarily remove the filters from both transmitter and receiver and align the beam so that it falls squarely onto the photo-transistor.

Refit the filters and with the latching switch in the non-latch position adjust RV1 so that the relay is held in by the

HOW IT WORKS

Transmitter

Transistors Q8 and Q9 form a type of astable multivibrator of which the frequency of oscillation is determined primarily by C7.

Lamp driving transistor Q10 is switched by the positive pulses appearing across potential divider R13/R14. Resistor R16 biases the lamp, and by so doing, reduces the current flow through Q10.

For the lamp specified in this project, R16 should be approximately 33 ohms. The correct value should be such, that with the base of Q10 disconnected, the lamp filament can be seen just barely glowing when viewed in the dark.

Receiver

The receiver consists essentially of three stages:—

(a) photo-transistor detector stage
(b) amplifier
(c) relay driver

The photo-transistor stage consists of a Darlington-pair photo-sensitive transistor connected to a variable load resistor. The base of the photo-transistor is left disconnected. As this transistor is prone to saturate at high light levels, VR1 has been included to enable the sensitivity to be adjusted under operating conditions.

The output of the photo-transistor is capacitively coupled to a two-stage amplifier, Q5 and Q6. Transistor Q5 is stabilised by negative feedback through the 100k resistor R6.

The output of the amplifier is capacitively coupled to the relay driver Q7. The base end of C5 is clamped to ground by diode D6 to ensure that Q7 receives positive going pulses to drive the output relay (RL).

Capacitor C6 prevents this relay chattering due to the relatively low frequency of lamp modulation.

Latching Operation

A single-pole single-throw switch (SW2) is used, (in conjunction with one normally open set of relay contacts — RLIB), to provide a latching function. The purpose of this is to lock the contacts of the relay in the 'alarm' condition when the beam is interrupted, thus ensuring that they do not reclose when the beam is again restored. This facility may be switched in or out as required.

The unit is initially switched 'on' with the latching switch in the 'non-latch' position. With the beam operating normally, the relay RL is held in, and the normally open contacts close, shorting out the switch contacts of SW2. The latching switch is now set to the 'latch' position. If the beam is interrupted, relay RL will be de-energised and the normally-open contacts will be released thus preventing the relay from re-closing.

The unit is reset by momentarily switching the latching switch to the non-latch position and then returning it 'latch'.

Power supply

The power supply unit is a full-wave series regulated unit which has a fixed output of approx 10.50 volts. A high degree of stabilisation is required to prevent the fluctuating load of the transmitter lamp from modulating the receiver circuit.

beam; check that there is some reserve 'power' by momentarily blanking off part of the receiver lens. The relay should not drop out.

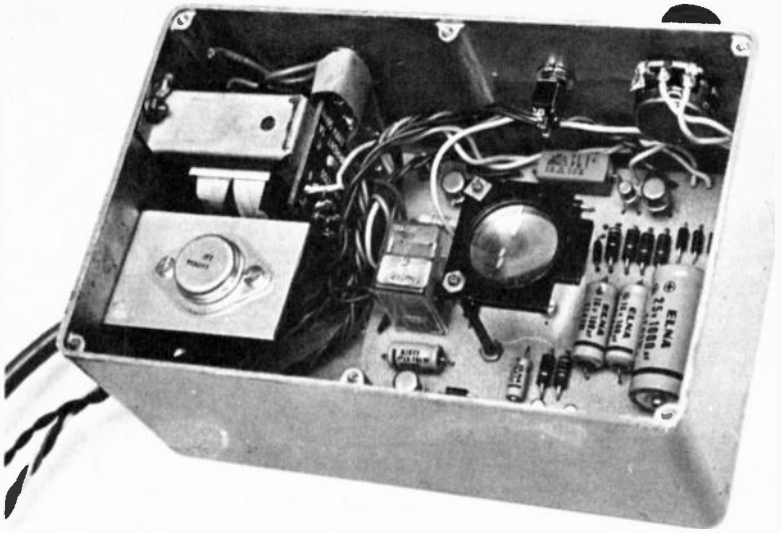
Set the latching switch in the 'latch' position and check that the relay remains locked out when the beam is momentarily interrupted.

The relay specified has two sets of change-over contacts. One set (RLIB) is used for the latching function, the second set (RLIA) is used for the alarm output. These latter contacts may be used in the conventional way to switch an external battery and bell circuit, or may be wired to the normally closed inputs of the Electronics Today Intruder Alarm control unit. (May and June issue 1971).

The maximum range of the beam depends upon whether or not it is to be used in daylight. The range at night may exceed 500 feet, but if daylight operation is required the range may be restricted to 100 feet to 200 feet.

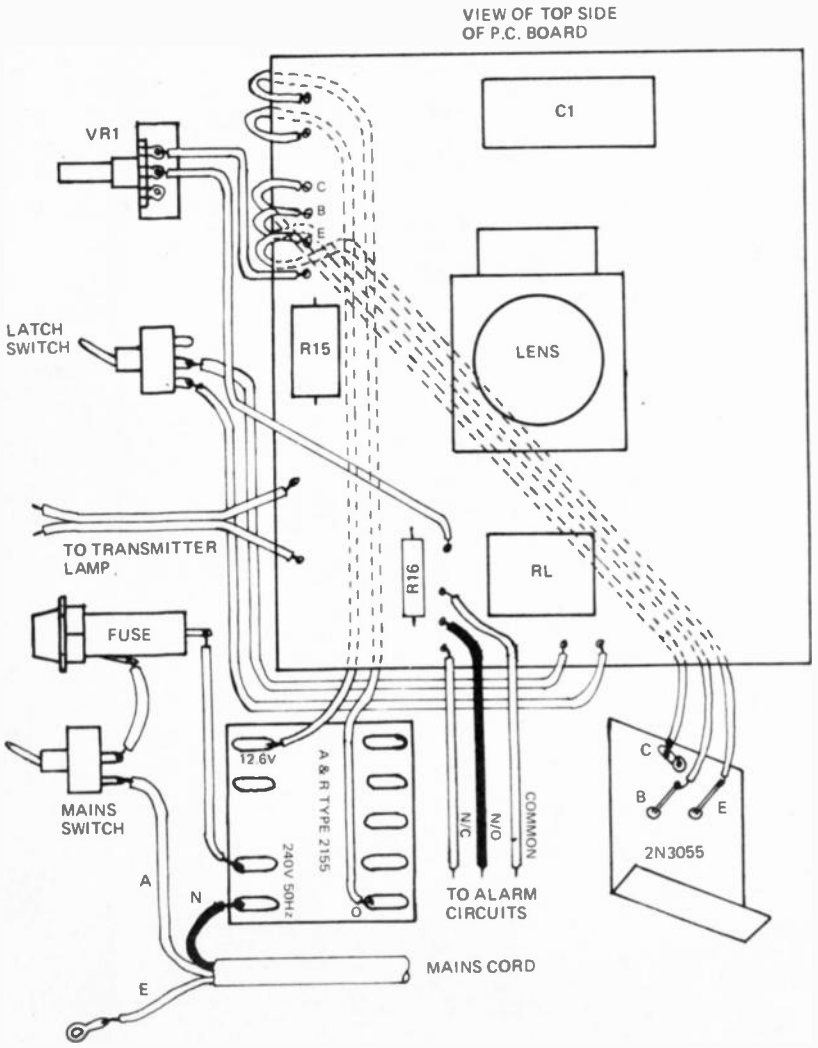
Try to arrange the receiver so that direct sunlight never falls onto the lens. If necessary fit a round metal or cardboard tube, (the diameter of the lens and about 6" to 12" long), to shield the receiver lens from ambient light. The inside of the tube should be painted matt black.

Final alignment should be carried out at night as it is easier to see the beam (with the filters removed).



Interior of prototype unit.

Infra-red radiation behaves much as visible light, and so mirrors may be used if it is necessary to direct the beam around corners. Shaving mirrors are ideal for this purpose.

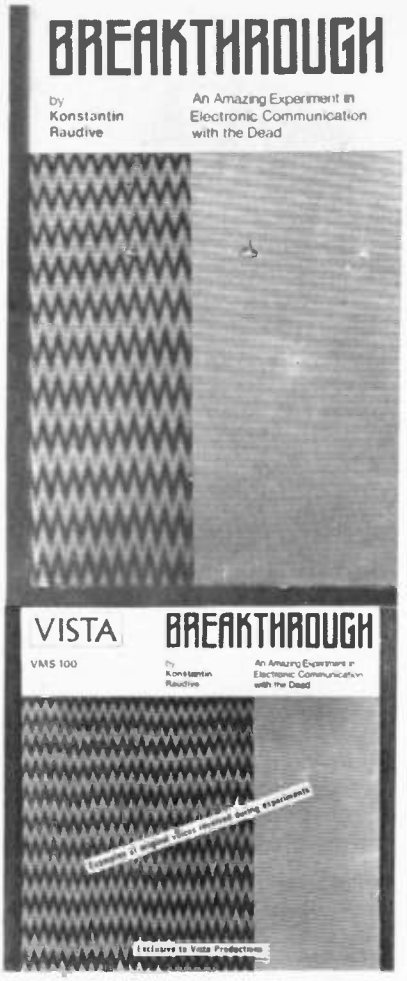


PARTS LIST

R1	—	resistor	1k,	½W, 5%
R2	—	"	"	" "
R3	—	"	100 ohm	" "
R4	—	"	560 ohm	" "
R5	—	"	47k,	½W 5%
R6	—	"	100k,	" "
R7	—	"	1.2k	" "
R8	—	"	220 ohm	" "
R9	—	"	"	" "
R10	—	"	1k	" "
R11	—	"	2.2k	" "
R12	—	"	100 ohm	" "
R13	—	"	27 ohm	" "
R14	—	"	56 ohm	" "
R15	—	"	10 ohm	5W "
R16	—	"	33 ohm	1W "
R17	—	"	47 ohm	½W "
VR1	—	potentiometer 100k linear		
C1	—	capacitor 1000μF,	25V.	
C2	—	" 100μF,	16V.	
C3	—	" 100μF,	16V.	
C4	—	" 2.2μF,	25V.	
C5	—	" 4.7μF,	25V.	
C6	—	" 50μF,	16V.	
C7	—	" 4.7μF,	16V.	
Q1	—	transistor TT 3643		
Q2	—	" 2N3055		
Q3	—	" BC108		
Q4	—	phototransistor MEL 12 (available from Warburton Franki) or equivalent.		
Q5	—	transistor BC108.		
Q6	—	" BC108.		
Q7	—	" TT3643		
Q8	—	" BC108		
Q9	—	" BC108		
Q10	—	" TT3643		
D1 through D4	—	silicon diodes EM401 or equivalent.		
D5	—	zener diode BZY88/C9V1		
D6	—	silicon diode EM401		
Transformer	—	A & R type PT 2155		
Relay	—	Cradle type relay — double pole changeover. 430 ohm coil, Varley VP2 or equivalent.		
SW1	—	switch toggle type, 240 volt single or double pole (see text).		
SW2	—	switch toggle type, single pole, single throw.		
Lamp	—	G.E. Sealed beam lamp type GE 4546. Infra-red filters —		

Infra-red filters — Kodak type 87 or 88A. Sundries, two diecast boxes, one 2 way connecting block, rubber grommetts, printed circuit board, three core cable and plug, four 2" compression springs, front loading fuse holder and one amp fuse, one small condenser lens, (2" focal length), perspex sheet, pointer knob, hook-up wire, assorted nuts and bolts.

◀ *Fig. 7. Connections to and from the printed circuit board.*



FURTHER

A carefully controlled experiment has been carried out earlier this year in attempt to resolve the claim that 'voices from the dead' can be made to appear on an otherwise clean tape.

The experiment was conducted in the laboratories of Belling and Lee, who are Britain's leading manufacturers of electronic suppression equipment.

Among those taking part was one of the world's leading authorities in this field – Mr. Peter Hale, who is also the scientific advisor to the British Government.

Subsequent to the experiment Mr. Hale made the following official statement –

"From the result we obtained last Friday I must state that something is happening which I can no longer explain in normal physical terms."

Also present at this experiment were the physicist Ralph Lovelock who was acting as invigilator, and Mr. D. Ellis a scholar from Trinity College, Cambridge, who has been given a post-graduate scholarship to investigate this phenomena.

A few days previously another experiment was performed under most carefully controlled and monitored conditions by no less an authority than Mr. Ken Attwood, the chief engineer of Pye Recordings Ltd.

In this experiment extreme measures were taken to ensure that there was no possibility of electro-magnetic pick-up from any external source.

The experiment was carried out over a period of nine hours from 5.30 p.m. to 2.30 a.m. the following morning. On replaying the master tape it was found that approximately 200 voices had manifested themselves on the tape. Of these, 27 were so clearly audible that the engineers connected a loud speaker to the recorder so that these sections of the tape could be played back for the benefit of the 25 persons present.

These included Sir Robert Mayer, D.Sc., LL.D, Lady Mayer, Mr. Malcolm Hughes – a scientist, Mr. Ray Prickett, Mr. Kenneth Attwood and

The Raudive Phenomenon

In an apparently foolproof scientific investigation, "voices from the dead" communicate by tape recorder. BRENDAN McGANN, a Trinity psychologist, discusses the evidence of the Raudive phenomenon.

IN JUNE, 1965, a Latvian psychologist embarked upon a series of investigations, the results of which, if confirmed, will have effects on mankind so far-reaching as to be beyond our comprehension at the present time. His findings to date are reported in a book called "Breakthrough" (published by Colin Smyth at

Late Late Breakthrough

"Unprecedented, unheard-of and unbelievable . . . . is how the international press and television have described the reaction of the Irish to the two Late Late Shows – one and a half hours each – which presented the question of life after death and the voice phenomena.

Since the publication of Breakthrough, Peter Bander, joint Managing Director of the publishing house, who also wrote the preface to the book, has participated in twenty-seven programmes throughout the U.K. and Ireland. Ten English speaking countries have repeated some of the programmes. Ireland is of very special interest in this case. Because of the Catholic

dead, getting in touch with us again, worries you, you may not want to listen to this programme. A lot of people find this rather sinister, spooky or frightening. If you do, please switch off your set now and go to bed, we don't want to worry you, . . . (laughter in the audience) . . . but there is no reason why you should, but if you don't want to hear about it, please don't."

After the usual preliminaries, during which Peter Bander briefly outlined the phenomenon, the controlled tests carried out by PYE Records Ltd., Belling and Lee Ltd. and further developments in the research, Mr. Ted Bonner, a regular panelist on the show gave his opinion:

"I have spent most of my time recently, reading the book right

the Church?"

Fr. Pistone – "That there is life after death."

Gay Byrne – "Yes, – and more?"

Fr. Pistone – "There is a contact we can have with the people that are dead. The contact the Church maintains is the help we can give them. This is clear from the many voices that they cannot help themselves."

Gay Byrne – "Father, do you accept that these voices are something extraordinary. I could not put my finger on any one of them and state 'this is such and such a person'. The message they hold for me is confirmation, (if that were necessary), that there is life after death. There is a stage in the life after death in which one is in expectation of fulfilling one's own life before returning to the Creator."

When the show was signed off the air at midnight, a queue of reporters was waiting outside the dressing Gay Byrne announced that ramme with Peter r. Pistone would be on as possible. ate Show on 22nd May led as the climax of the sion viewing. Apart from Peter Bander was joined enneth Attwood, Chief f PYE, who had been in one of the controlled The panel of experts larged and many kers to the show d. Gay Byrne recedented through

Real & Imaginary

by "Vector"

Electronic Communication with the Dead?

I don't often deal with technical matters on this page. The way I figure it is that you, having digested the *hors d'oeuvre* of editorial thunderings and survived the main dish of electronics theory and practice, would have to be a masochist to demand another helping of the mixture as before.

However, every rule has its exception. Free Grid's comments on metamorphosed waves (see page 212, April Issue) reminded me of a curious incident which happened to me some years ago and for which I have never been able to find a rational explanation. When I was about fourteen years old I discovered, lying in a loft, an of the type which I believe 1920s as a 'det-2 l.f.' This detector (a triode) with coil

be found to reproduce voices originating from the dead.

Now there are few words which are more emotive than 'spiritualism', with vehement pro- and anti-camps arising at the mere mention of it. So if you are anti- and feel the hackles rising and find yourself muttering 'More mumbo-jumbo about vibrations and ectoplasm!', just hold your horses and bear with me for a few minutes more.

Personally, at the moment, I stand uncommitted. I only know what I have read. The author, Dr. Raudive, is not an electronics man, but he has apparently recorded some 72,000 of these voices and a selection of these has been put on to a gramophone record which is on general sale. What is even more important from our standpoint is that he has called in a host of independent opinions, including those from physicists and electronics hom verify the claim that the tape.

circuitry is screened.

(c) *The radio method.* Here a standard radio set is coupled to the tape recorder, the receiver 'aerial' being a few cm of wire. The general approach is to select a blank spot between stations or, preferably, a weak unmodulated carrier.

(d) *The 'auto-transmission' method.* For this a local oscillator is used (in conjunction with a standard radio receiver) for the 'voices' to modulate.

As for the end products, these are described as "voices which identify themselves, call our names, tell us things that make sense (or sometimes puzzle us), and the names they give belong to people we know to have left this earth. The voices are on a tape which can be listened to and heard by everybody. The physicists cannot explain the phenomenon and the psychologists cannot offer an explanation either. Scientific tests have shown (in a Faraday cage, for example) that these voices originate outside the experimenter and are not subject to auto-suggestion or telepathy. Philologists have examined the phenomenon and testified that, although audible and understandable, the voices are not formed by acoustic means, they are twice the speed of human speech and of a peculiar rhythm h is identical in the 72,000 examples so ined." (My italics.)

also that the in char

What others are saying –
Left, Irish times, 7th July 1971
Centre, Wireless World, June 1971
Right, report of TV programme, 9th July 1971

'BREAKTHROUGH'

Mr. H. V. Bearman, the secretary for the Scientific Committee of the Churches Fellowship for Pschycical Study. Of particular significance was a recording – connected with a statement made by Sir Robert Mayer. Sir Robert said in the course of a recording that surely if the voices could address themselves to Dr. Raudive, other voices might manifest themselves to him – after all his life-long friend of late pianist, Arthur Schnabel, would surely seize such an opportunity to communicate with himself or with Lady Mayer.

No sooner had Sir Robert begun to speak when a voice clearly called out (on the 86th revolution of the tape), 'Artur'; (on revolution 251), the words 'nanti wir danken'; (on revolution 333) 'Artur'; (on 347,) 'wir sind hier' ('we are here'); on (480 'Artur'); and (on 485) a sentence which finishes on revolution (502) with 'Barbirolli',". (Barbirolli was the famous conductor who died last year.)

WHAT HAS BEEN PROVED

Experiments performed by technically competent people in a variety of laboratories have made every effort to *prevent* the voices from appearing on the tape by every known means, without success. So what are we left with?

The facts established so far are as follows:–

1. Voices are recorded for which there is no explanation. According to physicists and electronic engineers there is no known reason for these voices to be on tape.
2. All known tests to eliminate such a recording have failed so far, and

Last month we published a review of 'Breakthrough' by Dr. Konstantin Raudive, who claims to have recorded the voices of dead people. This book has caused tremendous interest in Europe and is sure to do so in Australia. Whatever the validity of Dr. Raudive's hypothesis, a great amount of scientific evidence has now been collected which shows that his experiments are not a hoax. Here are the latest findings and comments.

"No one can offer any theory which reconciles known natural laws with the phenomenon".

'Vector' – Wireless World.

"It may seem to be as unbelievable as a horror film, but Trinity College (Cambridge) has taken it seriously enough to have awarded a special scholarship to a physicist, so that he can investigate it further."

Graham Rose – Sunday Times.

"What Dr. Raudive's book makes one wish for is a concerted and convincingly scientific investigation of this phenonomen."

David Cohen – New Scientist

"In spite of background noise, the words and voices could be clearly made out."

Edgar Holt – Sunday Telegraph

"Roman Catholic theologians as well as psychologists and scientists, bear witness to the authenticity of this extremely strange phenomenon".

The Church Times

I have apparently succeeded in reproducing the phenomenon. Voices have appeared on a tape which did not come from any known source".

Brenden McGann – Irish Times

"The traditional medium's call 'Is there anybody there' has entered the electronic age".

Malcolm Stuart – The Guardians

"The whispered snatches of conversation were picked up by a tape recorder in a silent room".

Robert Chapman – Sunday Express

"Dr. Raudive's sincerity cannot be challenged and the voices themselves are impressive indeed".

Harold Hancock – Manchester Evening News

Anybody taking the trouble to study Dr. Raudive's experiments will soon cease to mock".

The Rt. Rev. Mgr. Dr. Pfleger, Chaplain to the Holy See

"To our amazement and surprise the control indicator registered recordings of a weak but definitely discernable nature".

Ken Attwood – Chief Engineer
Pye Recordings Ltd.

". . . The scientific reason to which this all has been subjected seems to be very, very difficult to overcome. This is no trick, this is something we have never dreamed of before".

Ted Bonner, Decca Ltd., on TV

these tests have been performed by companies such as Pye Ltd.

3. The psychologists and para-psychologists are satisfied that the origin of these voices is para-normal.
4. Recent tests have shown that a certain dialogue between the experimenter and the originators of the voices can take place, thus the voice phenomenon must be attributed to an intelligent source.
5. Recent experiments with the visible voice spectrograph have proved beyond a shadow of doubt that the voices received can manifest themselves visibly and are identifiable as coherent human speech.
6. A series of tests conducted by psychologists point to the fact that the "animistic theory", namely, that the sub-conscious of the experimenters may have projected such voices, is highly improbable.

The most important question, however, whether these voices are from the DEAD, is only a theory. Whether or not it will ever be possible to produce irrefutable evidence for this hypothesis remains to be seen. What is important, however, is that other theories that have been put forward have been proven untenable.

Interest in the phenomenon is growing rapidly and this is perhaps best illustrated by the response to a programme on the subject shown on the TV Late Late Show in Dublin earlier this year.

A 45 minute slot had been allocated in the show which was hosted by Gay Byrne. Format of the show was a panel consisting of Ted Bonner, Terry Prone and Brian McMahon who questioned the guests consisting of Peter Bander of Colin Smythe Limited, the publisher of Breakthrough, and Father Pistone SSP, Superior General of the Paulist Fathers in London.

As a result of this item the station had an unprecedented response, both in phone calls and letters. Some people were sceptical about the whole thing, saying it was all a load of rubbish, but most people expressed a genuine interest in what it was all about.

So high was the interest that the station subsequently devoted an entire 90 minute programme to the phenomenon with the same host and panel, with the exception Brian McMahon was replaced by Austin Williams. The guests were again Peter Bander and Father Pistone with the addition this time of Ken Attwood, the chief engineer of Pye Recordings Ltd.

The discussion in this programme was extensive and wide ranging but the programme itself was remarkable for several reasons. Firstly Father Pistone said that the Catholic Church did not oppose the experiments and had every reason to believe that the results were genuine, although no official statement to this effect had been made, or would ever be likely to be made. He considered that nothing coming out of the experiments was in conflict with the church's teaching.

With this, however, some members of the panel and some members of the audience disagreed, quoting the bible denunciation of necromancy and communication with "familiar spirits".

The audience throughout the programme were quite vocal and frequently interjected.

About half-way through the programme, the floor manager crossed in front of the cameras to appeal to the panel members to make some answer to the hundreds of telephone enquiries that were swamping the switchboard.

As with any controversial subject that is discussed earnestly, time ran out all too quickly and the programme came to an end in the midst of shouts from the audience. Gay Byrne made his final statement: "Just hold on a moment, I have to sign off from the air and then we can talk as long as we like."

HOW THE RECORDINGS ARE MADE

The four basic methods of recording the 'voices' are fully described in Dr. Raudive's book. The methods are very simple.

1. THE MICROPHONE METHOD

In this method the microphone is connected to the tape recorder as for a conventional recording. The tape is run continuously and those present may converse freely, provided some quiet periods are allowed for the voices to manifest themselves.

2. THE DIODE METHOD

The circuit used is very simple and by normal electrical theory should be quite useless, however, it consists of a short aerial wire about 2" long connected to the recorder input by a diode. An 0.5 millihenry coil is connected between the aerial/coil function and earth and the input is shunted to earth by a 100k ohm resistor. The circuit must be fully screened with the exception of the short aerial. This method is reported to give very good results.

3. THE RADIO METHOD

The approach here is to use a few inches of aerial and tune the radio to a position on the dial where noise only can be heard, or, a weak unmodulated carrier. The radio output is recorded in the normal way by taking the detected output straight to the recorder.

4. THE AUTO TRANSMISSION METHOD

In this method a local oscillator is used, as a carrier for the voices to modulate, in conjunction with a standard radio receiver and again the normal recording method.

It has been suggested by many people that experiments should be carried out with video recorders and steps are probably being taken in this direction now. Perhaps also the use of computer auto-correlation techniques could be used to lift the signal-to-noise ratio and make communication easier.

Who knows what the results of these experiments may be. ●

Extract from 'Breakthrough', page 383.

III. *THE LISTENERS VERIFY*

Between February 1966 and June 1968 a series of 43 listening-in tests took place in which about 300 persons participated. The tests included approximately 150 to 200 "voices" each. Participants were not allowed to communicate whilst a test was in progress.

Most of the voices demonstrated during tests belonged to audibility-group "A"; participants had difficulty in hearing "B" voices and with only a few exceptions listed them as "insufficiently audible".

The results of some of the tests have already been mentioned in the commentaries of participants in actual experiments and have therefore been omitted from the following selection:

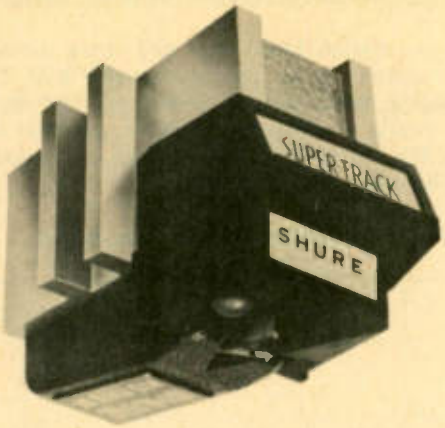
1. On 21st June 1968 a test took place in Bad Krozingen; 150 voices were demonstrated. Participants in the test were:

Prof. Dr. Hans Bender could hear 50 voices very clearly, 57 clearly and the rest insufficiently clearly. At the end of the test he remarked: "Some of the recordings and particularly those I marked 'very good!' are so clearly audible that the danger of 'projection against a background of noise' seems to be ruled out."

Dr. G. Rönicke, physicist, understood two of the voices very clearly, 48 clearly and the rest insufficiently clearly.

Dr. Arnold Reinecke has had great experience in this branch of research and had already listened to many recorded voices. He could understand 65 voices very well, 78 well, and the rest insufficiently well.

world's highest trackability at the lightest tracking forces



SHURE

V-15 TYPE II (improved)

now . . . with improved bass and mid-range trackability

The world-famous, computer-designed Shure V-15 Type II Super Trackability phono cartridge heralded a new epoch in high performance cartridges. Now, Shure has improved the trackability of the bass and mid-frequency range of the V-15 Type II without affecting its redoubtable treble . . . so that even recordings with very heavily modulated low frequency passages can be tracked at super-light, record-saving forces!

WHAT TRACKABILITY MEANS TO YOU & YOUR RECORDINGS

The "secret" of High Trackability is to enable the stylus tip to follow the hyper-complex record groove up to and beyond the theoretical cutting limits of modern recordings — not only at select and discrete frequencies, but across the entire audible spectrum—and at light tracking forces that are below both the threshhold of audible record wear and excessive stylus tip wear.

THE SHURE V-15 TYPE II IMPROVED GIVES SUPERIOR TRACKABILITY AT LIGHT FORCES

No cartridge that we have tested (and we have repeatedly tested random off-the-dealer-shelf samples of all makes and many models of cartridges) can equal the Shure V-15 Type II in fulfilling all of the requirements of a High Trackability cartridge—both initially and after prolonged testing, especially at record-and-stylus saving low tracking forces. The Shure V-15 Type II Improved "Super-Track" Cartridge is capable of tracking the majority of records at ¾ gram!* However, state-of-the-art advances in the recording industry have brought about a growing number of records which require 1 gram tracking force in order to fully capture the expanded dynamic range of the recorded material.

THE PRACTICAL EFFECT OF IMPROVED BASS TRACKABILITY

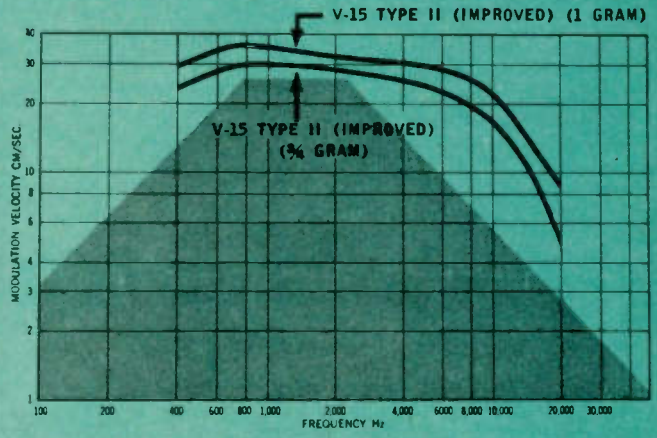
Where, in the past, you may have been required to increase tracking forces to track heavily modulated bass drum, tympani, organ pedal, bassoon, tuba or piano passages, you can now play these passages without increasing tracking force, without bass flutter, or IM distortion. This means that you can reduce 1¼ gram tracking force to 1 gram, or 1 gram to ¾ gram for records with high velocity bass material.

YOU CAN IMPROVE YOUR PRESENT V-15 TYPE II

You can attain this superior bass trackability with your present V-15 Type II by using the VN15E IMPROVED stylus listed at right. Look for the word "Shure" in red letters on the stylus grip.

TRACKABILITY AS A MEANINGFUL SPECIFICATION

This chart depicts the new performance specification of trackability. Unlike the over-simplified and generally misunderstood design parameter specifications of compliance and mass, trackability is a measure of total performance. The chart shows frequency across the bottom, and modulation velocities in CM/SEC up the side. The grey area represents the maximum theoretical limits for cutting recorded velocities; however, in actual practice many records are produced which exceed these theoretical limits. The smoother the curve of the individual cartridge being studied and the greater its distance above the grey area, the better the trackability. The trackability of the Shure V-15 Type II Improved is shown by the top (solid black) lines.



***SPECIAL NOTE:**

¾ gram tracking requires not only a cartridge capable of effectively tracking at ¾ gram, but also a high quality manual arm (such as Shure SME) or a high quality automatic turntable arm capable of tracking at ¾ gram.

SPECIFICATIONS

Trackability at 1 gram tracking force using a Shure/SME Arm:
28 CM/SEC at 400 Hz — 30 CM/SEC at 5,000 Hz
35 CM/SEC at 1,000 Hz — 22 CM/SEC at 10,000 Hz

Frequency Response: From 20 to 25,000 Hz

Output Voltage: 3.4 mv per channel at 1,000 Hz at 5 CM/SEC peak velocity

Channel Separation: Over 25 db at 1,000 Hz
Over 17 db at 500 to 10,000 Hz

Channel Balance: Output from each channel within 2 db

Stylus: VN15E Bi-Radial Elliptical Stylus, Diamond Tip.
.0007 Inch (18 microns) frontal radius;
.0002 Inch (5 microns) side contact radii;
.0010 Inch (25 microns) wide between record contact points
VN7—.0007 inch diameter, spherical stylus

Tracking Force ¾ to 1½ grams

Recommended Load Impedance: Nominally 47,000 ohms (per channel). Can be used up to 70,000 ohms with almost inaudible change in frequency response.

Input Capacitance: 400-500 Pico-Farads per channel, including tone arm wiring.

Inductance: 720 millihenries

D.C. Resistance: 630 ohms

Terminals: 4 terminals (with loop pinjack for 3-terminal connection)

Weight: Net weight—6.8 grams

Mounting: Standard ½ inch (12.7 mm) mounting centres.

MODEL V-15 TYPE II IMPROVED SUPER-TRACK CARTRIDGE

MODEL VN15E IMPROVED ELLIPTICAL STYLUS
fits V-15 Type II Improved, V-15 Type II, or V-15 II-7

MODEL V-15 II-7 SUPER-TRACK CARTRIDGE WITH .0007" SPHERICAL STYLUS

MODEL VN7 STYLUS—.0007" DIAMOND STYLUS
fits V-15 II-7 Cartridges

HIGH TRACKABILITY CARTRIDGES AT M

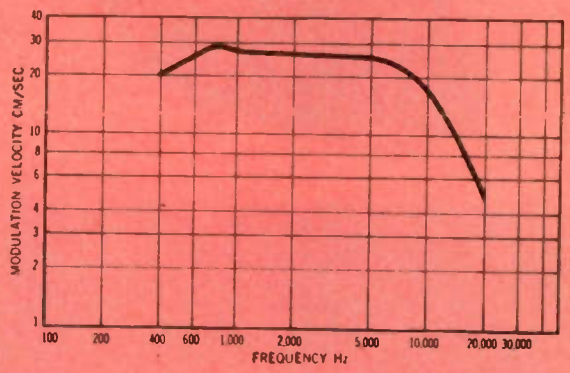
¾ to 1½ grams tracking

SHURE

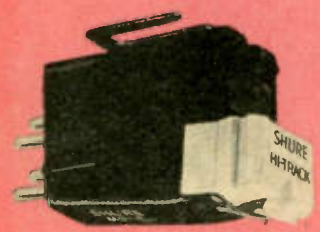
MODEL M91E-EP
HI-TRACK ELLIPTICAL
EASY-MOUNT

Optimized design parameters give these cartridges trackability second only to the incomparable V-15 Type 11. The trackability chart tells you that these cartridges will track even heavily modulated grooves at velocities that are well above the theoretical cutting limits of recordings! Model M91E-EP has an elliptical stylus.

MODEL N91E Elliptical Replacement Stylus



1½ to 3 grams tracking



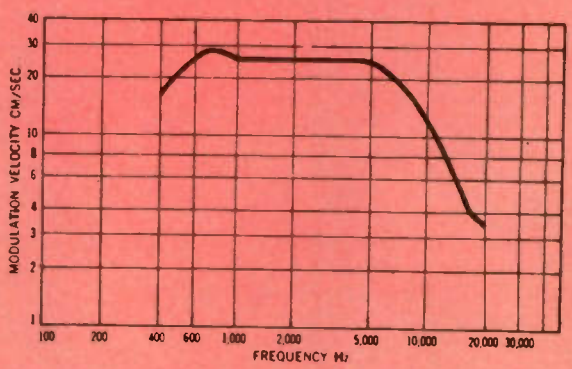
SHURE

MODEL M93E-EP
HI-TRACK ELLIPTICAL
EASY-MOUNT

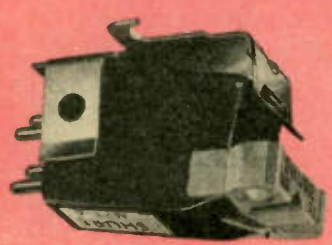
An outstanding performer in turntables that track in the 1½ to 3 gram range.

MODEL M93 Hi-Track Cartridge

MODEL N93E Elliptical Replacement Stylus



1-5 grams tracking



SHURE

MODEL M71EB-EP
EASY-MOUNT

SPECIFICATIONS
M71 AND M73 CARTRIDGE SERIES
N71 AND N73 STYLI SERIES

Model Number	Diamond Stylus Replacement	Output Voltage (1,000 Hz. at .5 cm/sec.)	Stylus Color Grip	Tracking (Grams)
M71EB	NEB71 Elliptical Side Contact Radius: .0004" (.010 mm) Frontal Radius: .0007" (.018 mm)	6.2 millivolts	Green	1½ to 3
M71-6	NB71-6 Radius: .0006" (.015 mm)	6.2 millivolts	Beige	1½ to 3
M71C	NC71 Radius: .0006" (.015 mm)	9.0 millivolts	Blue	3 to 5
M73G	N73G Radius: .0006" (.015 mm)	6.2 millivolts	Grey	1 to 1½
	N75-3,* Radius: .0025" (.064 mm)	4.4 millivolts (monaural)	Green	1½ to 3

*The N75-3 stylus may be used to reproduce the standard 78 rpm records. In this case, the amplifier should be set to "Monaural" or "A+B".

ODERATE PRICES

Specifications for M91E-EP

Trackability at 1 gram tracking force using a Shure/SME Arm:
20 CM/SEC at 400 Hz — 25 CM/SEC at 5,000 Hz
28 CM/SEC at 1,000 Hz — 18 CM/SEC at 10,000 Hz

Frequency Response: From 20 to 20,000 Hz.
Output Voltage: 5.0 mv per channel at 1,000 Hz at 5 CM/SEC.
Channel Separation: Over 25 db at 1,000 Hz.
Channel Balance: Output from each channel within 2 db.

Stylus: Elliptical with diamond tip.
.0007 inch (17.8 microns) frontal radius.
.0002 inch (5 microns) side contact radii.
.0010 inch (25 microns) wide between record contact points.

Tracking Force: ¾ to 1½ grams.

Recommended Load Impedance: Nominally 47,000 ohms (per channel). Can be used up to 70,000 ohms with almost inaudible change in frequency response.

Input Capacitance: 400-500 pico farads per channel, including arm cable and preamplifier.

Inductance: 720 millihenries.
D.C. Resistance: 630 ohms.
Terminals: 4 terminals.
Weight: 5 grams.

Mounting (M91E-EP): Snap-in type; standard ½" (12.7mm) mounting centers on retaining clip.

Specifications for M93E-EP

Trackability at 2 grams tracking force using a Shure/SHE Arm:
18 CM/SEC at 400 Hz — 24 CM/SEC at 5,000 Hz.
25 CM/SEC at 1,000 Hz — 13 CM/SEC at 10,000 Hz.

Frequency Response: From 20 to 20,000 Hz.

Output Voltage: 6.2 mv per channel at 1,000 Hz at 5 CM/SEC.

Channel Separation: More than 25 db at 1,000 Hz.

Channel Balance: Output from both channels within 2 db.

Stylus: N93E Elliptical with diamond tip.
.0007 inch (17.8 microns) frontal radius.
.0004 inch (10 microns) side contact radii.
.0010 inch (25 microns) wide between record contact points.

Tracking Force: 1½ to 3 grams.

Recommended Load Impedance: 47,000 to 70,000 ohms (per channel).

Input Capacitance: 400-500 pico farads per channel, including arm cable.

Inductance: 720 millihenries.

D.C. Resistance: 630 ohms.

Terminals: 4 terminals.

Weight: 5 grams.

Mounting: Snap-in type, standard ½" (12.7mm) Mounting centers on retaining clip.

TRACKABILITY:

M71EB at a stylus force of 1½ grams
400 Hz. — 14.3 cm/sec.
M71-6 at a stylus force of 1½ grams
400 Hz. — 14.3 cm/sec.
M71C at a stylus force of 3 grams
400 Hz. — 14.3 cm/sec.
M73G at a stylus force of 1 gram
400 Hz. — 14.3 cm/sec.
Higher stylus forces within specified range improve trackability.

FREQUENCY RESPONSE: From 20 to 20,000 Hz.

CHANNEL SEPARATION: More than 20 db at 1,000 Hz.

RECOMMENDED LOAD IMPEDANCE: 47,000 ohms per channel.

INDUCTANCE: 720 millihenries.

D.C. RESISTANCE: 630 ohms.

MOUNTING: Standard ½" (12.7 mm) mounting center using new "Easy-Mount" snap-in bracket.

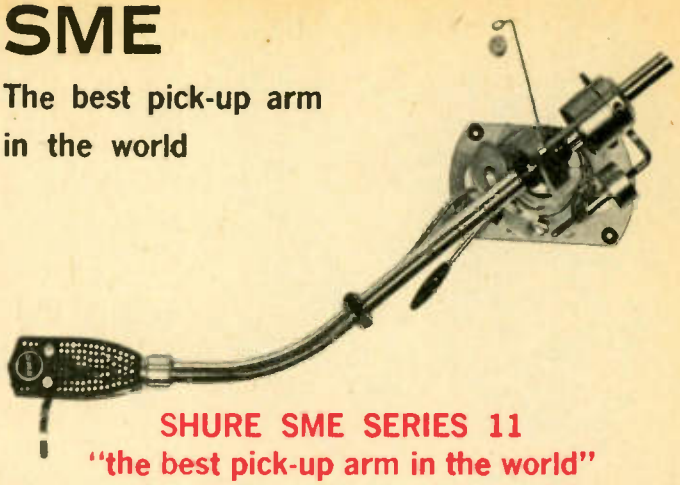
WEIGHT: 5 grams.

TERMINALS: 4 terminals.

GENERAL: The M71 and M73 Series of Dynetic phonograph cartridges has been developed for use with all high fidelity amplifiers having magnetic and constant velocity inputs.

SME

The best pick-up arm in the world



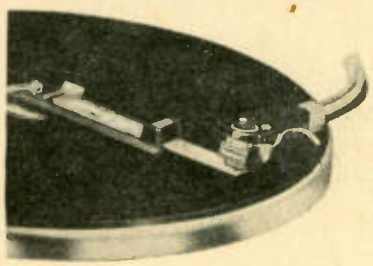
SHURE SME SERIES 11
"the best pick-up arm in the world"

The Shure-SME, Series 11, the ultimate in independent tone arms, provides features and quality unattainable in any other tone arm. Manufactured to singularly close tolerances and standards by skilled British craftsmen. Utterly accurate adjustments are provided for every critical factor relating to perfect tracking, such as helght, overhang, length, tracking force and bias (anti skating). These arms accept cartridges weighing 3 to 20 grams and allow tracking forces from ¼ of a gram to 5 grams to be used. Because the Shure-SME tone arms realize the full potential of the cartridge and the record they are especially suited for use in combination with any Shure cartridge. Highly recommended for use In the very finest component high fidelity systems.

Some of its many features include . . .

- Virtually frictionless knife-edge bearings.
- Effective "anti-skating" bias adjuster counterweight.
- Hydraulic cueing device.
- Two models are made, 3009 and 3012, pivot to stylus distance 9 inches and 12 inches respectively.
- Distortion due to tracking error is minimised by geometry which aims at lowest distortion rather than lowest tracking error.
- Extremely low pivot friction is achieved by the use of high precision ball races protected against the entry of dust.
- Low inertia.
- Camera finish in satin-chrome gun-black and anodised alloy.
- Shell accepts all cartridges with ½" fixing centres.

WEIGHT WATCHER – PAR EXCELLENCE



SHURE

SFG-2 PRECISION STYLUS FORCE GAUGE

A MUSIC LOVER'S MUST

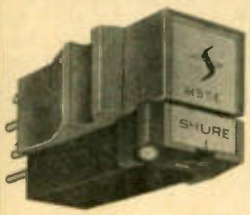
New from the ploneers of High Trackability! The Shure SFG-2 Stylus Force Gauge Is an easy-to-use, ultra-accurate measuring tool that quickly detects "excessive" or "insufficient" tracking force, and allows you to maintain optimum tracking force. Helps protect and preserve the fidelity of all your records by guarding against prematurely worn records and stylus tips caused by heavy tracking, and record groove mutilation due to excessively lightweight mistracking.

The positive "counterweight balance" principle of the Shure SFG-2 assures long life and continued accuracy — there are no springs to weaken or wear out. The cost? About what you'd pay for one good stereo recording. The Shure SDG-2 Stylus Force Gauge is a must for serious audiophiles!

PREMIER FAMILY OF STEREO REPRODUCERS

SHURE

Contact your local HI-FI dealer or any of the following for more information:
N.S.W.: Audio Engineers, 342 Kent Street, Sydney. 29 6731. Q'LAND: Ron Jones Pty. Ltd., 57 Castlemaine Street, Milton 4061 36 0711. VICTORIA: Audio Engineers (Vic.), 2A Hill Street, Thornbury. 44 3295. W.A.: Athol M. Hill Pty. Ltd., 613-15 Wellington Street, Perth. 21 7861.



SHURE

M55E-EP

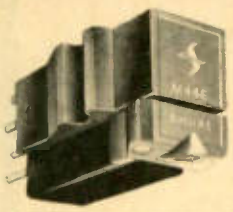
for 3/4 to 2 grams tracking

STEREO DYNETIC

A popular cartridge that gives professional performance within a moderate budget. Incorporates BI-Radial elliptical stylus. Note the wide variety of features and impressive specifications.

SPECIFICATIONS

Frequency Response: From 20 to 20,000 Hz.
Output Voltage: 6.6 millivolts per channel at 1,000 Hz at 5 CM/SEC.
Channel Separation: Nominally over 25 db at 1,000 Hz.
Channel Balance: Output from each channel within 2 db.
Compliance:
Horizontal } 20.0 x 10^{-6}
Vertical } CM/dyne
Effective Stylus Tip Mass: 1.2 milligrams.
Tracking Force: ¾ to 2 grams.
Stylus N55E: Elliptical shaped diamond tip.
.0007 inch (17.8 microns) frontal radius.
.0002 inch (5 microns) side contact radii.
.0010 inch (25 microns) between points of contact with groove.
Input Impedance: 47,000 ohms (per channel).
Inductance: 720 millihenries.
D.C. Resistance: 630 ohms.
Terminals: 4 terminals.
Weight: 7 grams.
Mounting: Standard ½" (12.7 mm) mounting centres.
MODEL M55E-EP Cartridge.
MODEL N55E Stylus.



SHURE

M44-EP SERIES

Combines Quality and Economy

Four cartridges in the modest price range to fill the needs of the hi-fi hobbyist who wants the most for his money. All have received ample critical acclaim as the best in their price class. Note: All M44 series styli are interchangeable.

SPECIFICATIONS

Frequency Response: From 20 to 20,000 Hz.
Output Voltage: At 1,000 Hz at 5 CM/SEC.
Model M44-5-EP, 7 millivolts per channel;
Model M44-7-EP, 11 millivolts per channel;
Model M44-E-EP, 9.3 millivolts per channel.
Channel Separation: More than 25 db at 1,000 Hz.
Input Impedance: 47,000 ohms per channel.
Inductance: 720 millihenries.
D.C. Resistance: 630 ohms.
Terminals: 4 terminals.
Weight: 7 grams.
Mounting: Standard ½" (12.7 mm) mounting centres.
FOR LIGHT TRACKING: ¾ to 1½ GRAMS.
A .0005-inch radius spherical diamond stylus MODEL N44-5.
FOR HEAVIER TRACKING 1½ to 3 GRAMS.
MODEL M44-7-EP Cartridge. With .0007-inch radius spherical diamond stylus MODEL N44-7.
FOR HEAVIEST TRACKING 3 to 5 GRAMS.
MODEL M44-E-EP Cartridge. With .0007-inch frontal radius elliptical diamond stylus MODEL N44-E.

SHURE

FIRST AT THE ALL-IMPORTANT SOURCE OF SOUND

True high fidelity sound re-creation begins at the *source of sound:* that point at which miles of stereo record grooves pass under the tiny tip of the stylus. What happens at this point is critical in the performance of the total high fidelity system. The stereo cartridge (a remarkably precise, miniaturized electric generator) must translate the record groove modulations into useable electric impulses —without adding to or subtracting from what is really on the recording. Just as the camera can be no better than its lens, stereo componentry can be no better than the stereo cartridge that links it to fine recordings. At Shure, where the revolutionary total cartridge performance measurement known as "Trackability" was born, there is an uncommon appreciation of the importance of the stereo cartridge, and a continuing pursuit of engineering excellence. To this end, the design, assembly and quality control standards of Shure Stereo Dynetic Cartridges are rigidly maintained at the highest possible levels.

APOLLO 15- AUSTRALIA'S ROLE

Tracking stations throughout Australia played a vital role in the recent dramatically successful lunar mission.

PARTICIPATION of more than 400 personnel in four space-tracking stations in Australia in the recent Apollo 15 mission was a striking example of international co-operation between Australia and U.S.A. in space-flight programmes which began in 1960.

The four tracking stations involved are at Carnarvon (W.A.), Honeysuckle Creek and Tidbinbilla (A.C.T.) and the NASA switching centre at Deakin (A.C.T.).

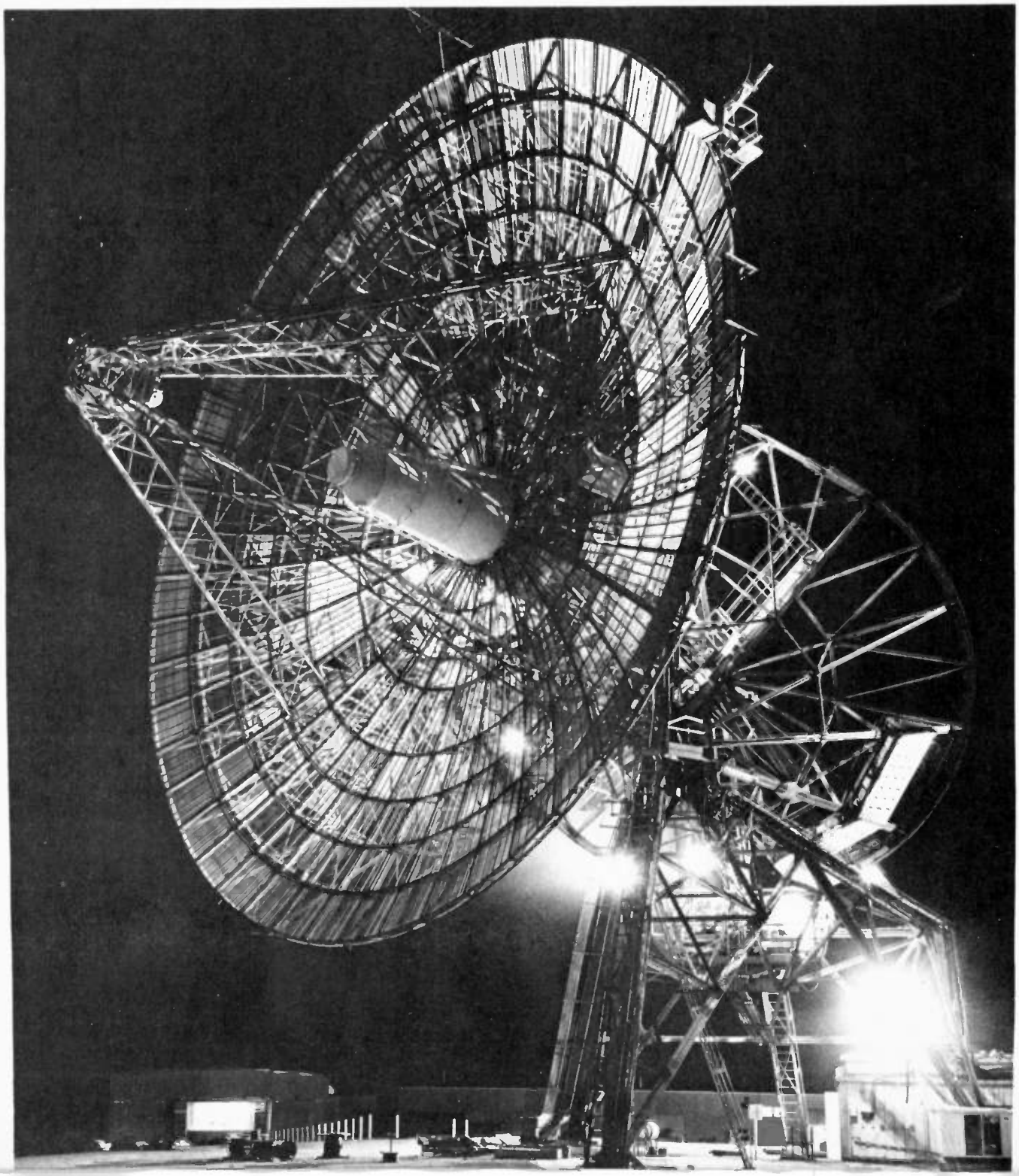
CARNARVON

At Carnarvon, a team of 170 engineers, technicians and support staff averaged 85 hours a week during the Apollo 15 mission.

During the earth orbit phase, the station was the prime site with voice communications, ranging and command

(Continued on page 77)

The 85ft. diameter, 200 ton antenna, which is a predominant feature of the Tidbinbilla tracking station.



THE SANSUI SR 4050 C TURNTABLE

electronics TODAY product test

First Australian test of Sansui's top quality turntable unit.

SANSUI have been producing turntables, arms and magnetic cartridges for some years.

One of the most recent releases is the SR 4050 C turntable assembly. This is an unusually attractive unit consisting of turntable, arm, cartridge, plinth and acrylic cover.

The unit comes in a large box with all the bits including die-cast aluminium turntable, drive belt, plug-in head shell complete with cartridge, corrector weight, oiling bottle, perspex dust cover and 45 r.p.m. spring centre adaptor neatly packed and well protected in polystyrene foam.

Once unpacked, our first impression was that of an extremely well finished product. Assembly of the system took only a few minutes and when completed proved that there are no problems likely to be encountered by the average purchaser.

The table, which is finished in matt black, is mounted on a plastic plinth with oiled walnut edge. The turntable is an aluminium casting machined on all faces; it weighs 3½ lbs. and has very low rumble.

A tinted acrylic dust cover is clipped onto spring loaded hinges, these are damped to minimise shock caused by accidentally dropping the cover (and resultant damage to stylus or record). The construction of this dust cover impressed us. It is exceptionally strong and rigid.

The tone arm has a very smooth chrome finish, even in the gimbal-joint components. Balancing the arm was simple, and proved to be accurate. The main counter weight is simply screwed backwards or forwards to adjust the balance point. The lateral balance weight was factory preset for the cartridge supplied with the unit, it proved rather awkward to adjust when we fitted a different cartridge in the head.

MEASURED PERFORMANCE OF SANSUI SR. 4050C TURNTABLE FITTED WITH CARTRIDGE TYPE SC 34 S/N 320110735

Frequency Response:	20 to 20kHz $^{+\,2}_{-\,3}$ dB
Cross Talk:	32dB at 1kHz
Channel difference:	1.5dB at 1kHz
Wow and Flutter:	0.1% R.M.S.
Rumble:	better than –40dB re 1kHz signal at 5 cm/sec. equalised but unweighted.
Speed Accuracy:	+ 0.74% at 33 1/3 rpm + 0.93% at 45 rpm
Output:	2.4 mV at 1kHz 5 cm/sec.
Signal to Noise Ratio: (in absence of earth loops)	better than 50dB
Price approximately:	$273 complete

MAGNETIC ANTISKATING

The inclusion of a magnetic antiskating adjustment is unusual, but technically acceptable. Such a device, if correctly designed, is capable of providing a more accurate compensation of the lateral skating force than some other systems. But what must be realised is that only one combination of tracking weight, stylus profile and speed can be uniquely correct and all other combinations must change the relative accuracy of the settings shown on the dial.

The magnetic antiskate adjustment, although extremely simple and smooth in operation, required setting to a slightly different marking in order correctly to bias a two gram tracking force set on the main counterweight. (Thus a 2½ gram setting was required instead of the normal two gram setting indicated.)

A feature not seen on most tone arms is an external lip fitted to the arm rest. This prevents the tone arm dropping between the arm lifter and the arm rest. The lifting and lowering of the tone arm is cleverly operated by the control lever that is well damped in both the lifting and lowering modes. The control arm has three positions – OFF, ON, and PLAY.

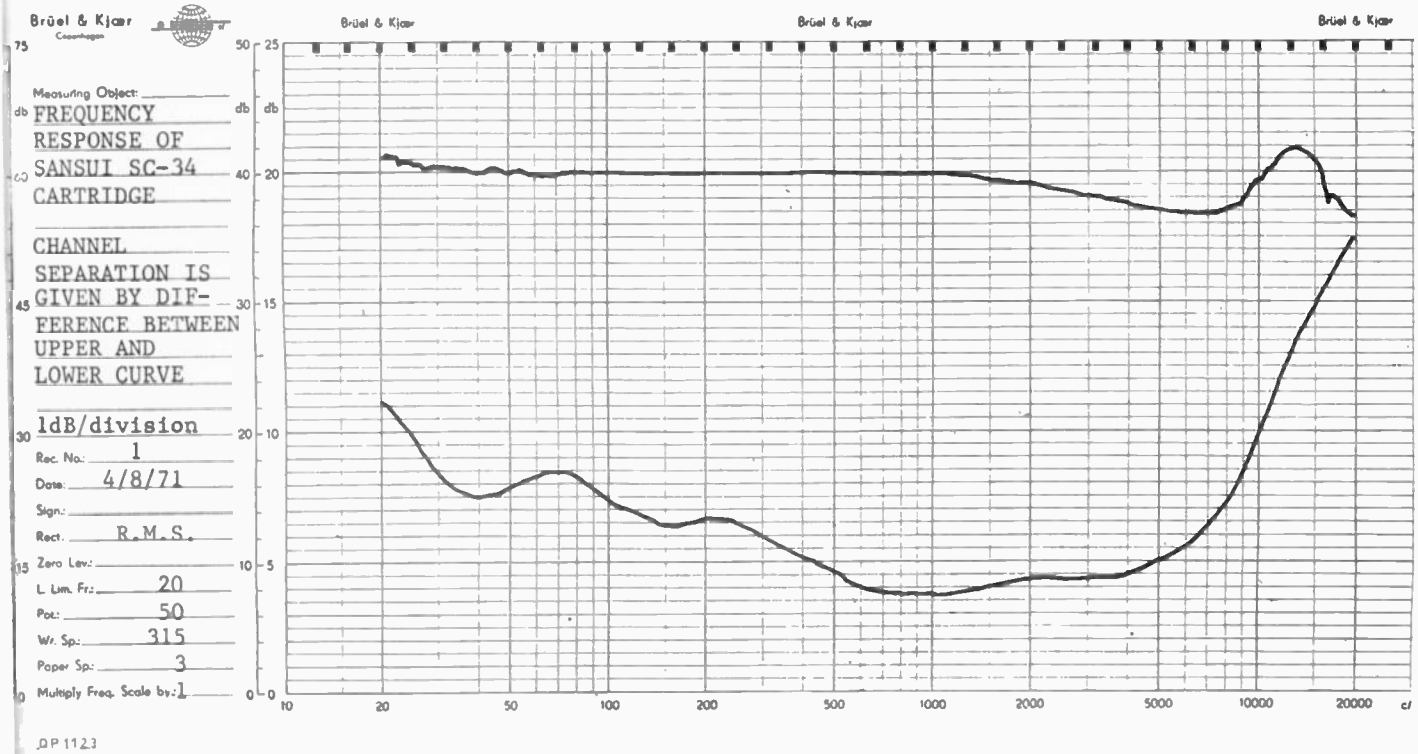
In the OFF position the power is isolated and the two speed selector knobs locked out to protect the drive belt. The arm lifter also moves automatically to the raised position so that it is impossible to knock the tone arm off its rest and onto the turntable.

In the ON position, power is applied to the turntable. Speed selection may be changed by pressing the 33 1/3 rpm or 45 rpm selector button. A small illuminated bezel above the speed selector button indicates which speed is selected.

Moving the lever from the ON to the PLAY position lowers the stylus after it has been manually positioned above the correct part of the record. Even with the arm lifter in the lowered position it is still not possible to damage the stylus by knocking it off the edge of the record onto the turntable base.

The only other control on the turntable is the MANUAL or AUTO UP STOP lever. In the MANUAL position it is necessary manually to stop the record and lift the tone arm by operating the control lever.

In the AUTO position the tone arm automatically lifts and the control lever returns to the OFF position at



DP 1123

THE SANSUI SR 4050 C TURNTABLE

the end of a record. Two settings are provided in the AUTO position, one for 7" records, and one for 10" and 12" records.

MECHANICAL CONSTRUCTION

A four-pole hysteresis synchronous motor provides high torque and very quiet operation The motor is vibrationally isolated from the base and drives the turntable through a stepped pulley and plastic belt on to an extended flange below the turntable.

The belt has a very smooth inner surface; and the rumble of the turntable is as low as that measured on any other non-professional turntable that we have seen.

The speed change is mechanically operated by two buttons. These are linked to a long lever that is interlocked with the control lever when the latter is in the OFF position. This protects the plastic belt against the damage that would result from attempting a speed change with the motor stationary.

The plastic belt is unusual in that it has definite self damping characteristics further to reduce the wow and flutter. The plinth of the turntable has four large foam rubber pads. These provide a second vibration mounting to the springs fitted between the deck and the plinth.

Bearing friction in the gimbal joint is negligible and thus cartridges with a tracking weight of as low as ½ gram may be used.

We were impressed by the smoothness of operation of the speed change buttons, and of the control lever that provided positive positioning of the tone arm at any height for accurate cueing of the stylus. The speed accuracy, and wow and flutter measurements fall short of the manufacturer's claims; in other respects the turntable is particularly good. The Sc-34 cartridge has reasonable frequency response and good channel separation but showed signs of slight mistracking with stylus velocities in the region of 20 to 25 cm/sec. at frequencies above 8kHz and with a tracking weight of 2 grams.

The socket for the removable head shell provides approximately 15° of alignment correction for planar adjustment of the stylus. This head shell will accept only cartridges with the standard ½" mounting. The main weight plus subweight provides adequate balancing for cartridges weighing in excess of 15 grams.

An unusual feature of the electrical circuitry is a solenoid actuated switch that automatically earths the two outputs from the cartridge when the power is off. In most other record players a micro switch or relay is employed to perform this function.

Selector switches under the cast aluminium turntable provide for either 50 .Hz or 60 Hz operation, and voltages between 100V and 250V.

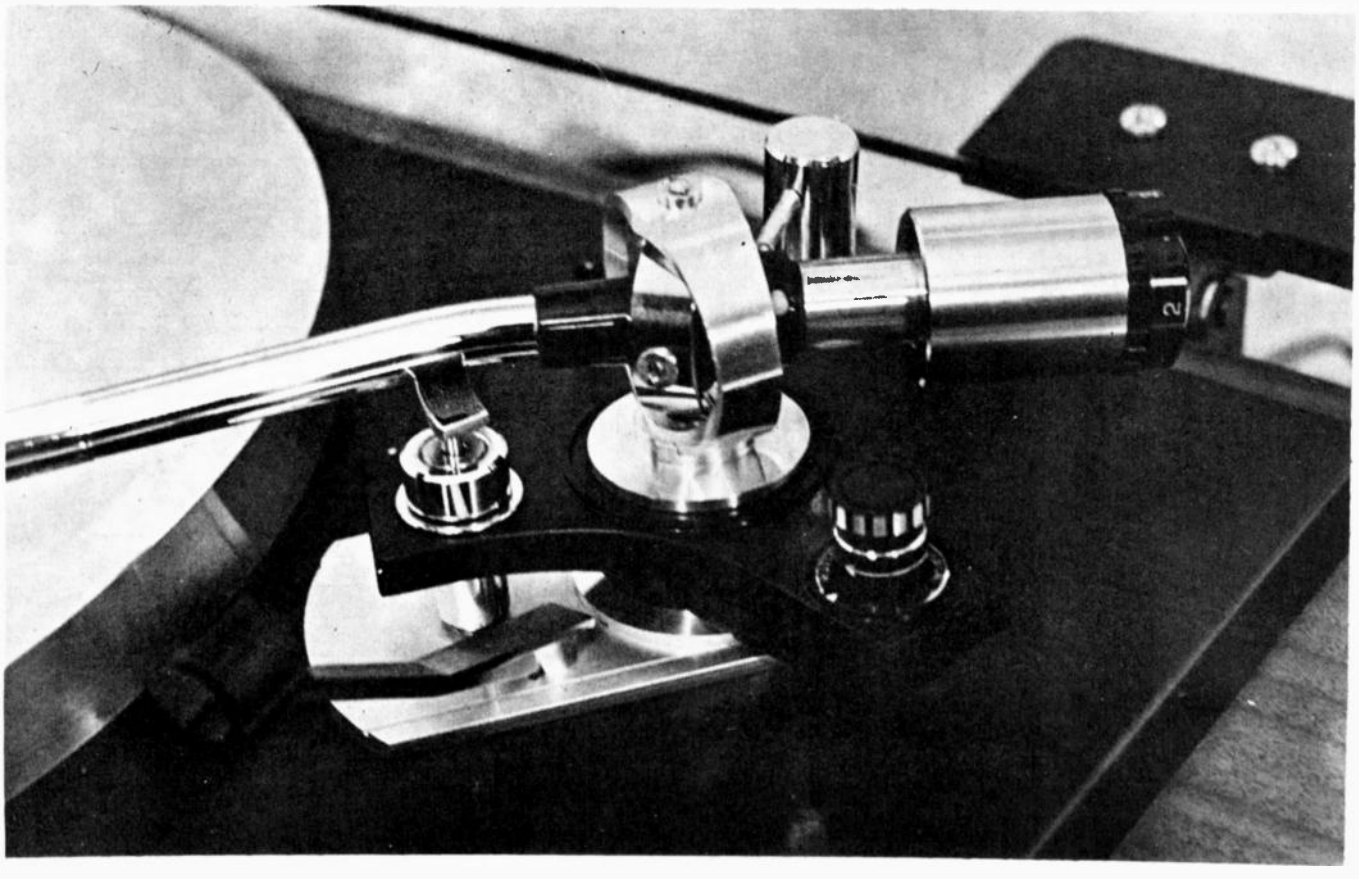
Sansui include a ten page operating and instruction manual that provides full details of all assembly and operating requirements, including changing of capstans for 50 or 60 Hertz operation, oiling details (a small bottle of oil being included) and general comments on maintenance and operations.

The turntable comes complete with power cord fitted with a two pin power plug of the Japanese (or American) style and a twin output lead fitted with R.C.A. coaxial plugs.

This turntable is one of the most impressive units which we have yet tested. Its technical performance lags very slightly behind one or two other units but it packs a large number of practical commonsense and unusual features into one ready to use unit.

The styling, ruggedness and flexibility of this turntable and arm are hard to beat. The cartridge currently supplied with the unit is not quite of the same order of excellence, but if the cartridge with better trackability were supplied, this unit would be good value for money. ●

A very fine example of precision engineering.



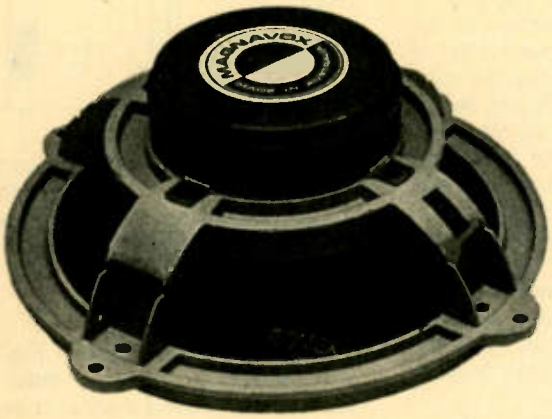
INSTROL

SANITARIUM HEALTH FOOD CO.
PLANT DEVELOPMENT DIVISION

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 "Electronics Today", it handles 30 watts RMS, features a new high performance 8" speaker, two 3" tweeters, and is available in cabinet 20¼" x 12¼" x 8¼" (1 cu. ft.) or 23¼" x 15½" x 10¼" (1.6 cu. ft.). Available in teak or maple veneer.

COMPLETE SYSTEM

Kit of Parts ..... $49.00 (1 cu ft), $61.00 (1.6 cu ft)
Built and tested ..... $62.00 (1 cu ft) $77.00 (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)

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 22½" 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 ..... $25.00 (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 8½" x 8½".

COMPLETE SYSTEM

Kit of Parts $28.00
Built and Tested $35.00

SEPARATE COMPONENTS

Enclosure Kit ..... $10.00 (maple), $10.50 (teak)
Built Enclosure ..... $16.50 (walnut), $17.00 (teak)

ECONOMY BASS REFLEX SYSTEM

Special 1970 design 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) $25.00
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)

PEERLESS 3-25 SYSTEM

Consists of CM120W woofer, G50 MRC mid range and MT20 HFC tweeter. With crossover network. Cabinet 26½" x 16½" x 16½".

COMPLETE SYSTEM

Kit of Parts $89.00
Built and Tested $106.00

SEPARATE COMPONENTS

Enclosure Kit ..... $30.50 (maple), $32.00 (teak)
Built Enclosure ..... $46.00 (walnut), $48.00 (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 speaker enclosures. These will be sent by road transport or passenger rail; freight payable on receipt of goods.

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..... at $ .....
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I enclose my money order/cheque for $.....

NAME.....

ADDRESS.....

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PRACTICAL GUIDE TO REED SWITCHES

The dry reed is an almost perfect low-current switch.

It is fast – operating times of less than one millisecond are typical. It is reliable – as many as one billion operations can be achieved. And it is cheap – quantity price is well under 50 cents.

The dry reed switch is not by any means a new device for it was invented back in 1945 by Dr. W. B. Ellwood of the USA's Western Electric Corporation.

But it was ahead of its time. It remained practically unnoticed by the engineering world until only a few years ago when it was 'rediscovered' by the telephone industry.

And since then reed switches are receiving interest and acceptance at an ever increasing rate.

In its basic form, a reed switch is a magneto-mechanical relay. In other words it relies upon a magnetic force to initiate a mechanical switching action.

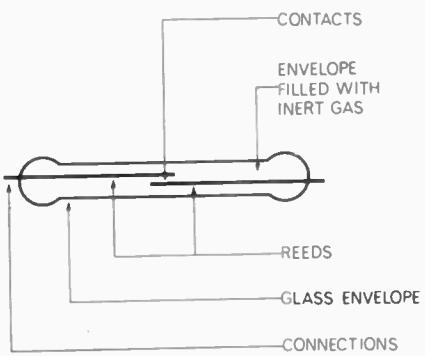


Fig. 1. The basic reed switch.

THE BASIC SWITCH

A typical reed switch is shown in Fig.1. It consists of two flattened ferromagnetic reeds sealed in a glass tube. The reeds are fixed, one at each end of the tube, so that their free ends overlap in the centre but with a 0.01" gap between them.

During the sealing operation the air inside the tube is pumped out and replaced by dry nitrogen so that the contacts operate in an inert atmosphere.

When the reed switch is brought within the influence of a magnetic field (either from a coil or a magnet) the reeds – being ferromagnetic – become a flux-carrying portion of the magnetic circuit. The extreme ends of the reeds will assume opposite magnetic polarity, and if sufficient flux is present, the attraction forces overcome the stiffness of the reeds and they flex towards each other and touch.

When the magnetic field is removed the reeds spring back to their original positions. There is however a difference between the value of field required to close the reeds, and the reduced value that will allow them to open again.

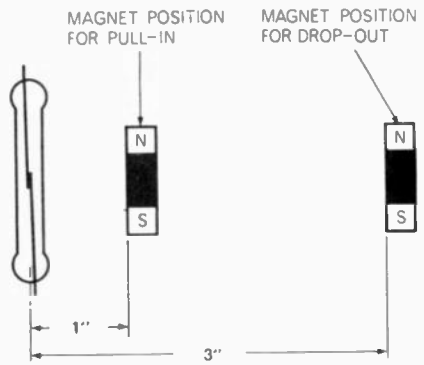


Fig. 2. The reeds close when the magnet is brought within one inch, and will remain closed until the magnet has been moved at least three inches away.

A typical example of this is shown in Fig.2. In this example the reeds close when the magnet is brought within one inch, but they will remain closed until the magnet has been moved about three inches away.

This phenomena – which is caused by magnetic hysteresis in the reeds – can be considerably reduced by introducing a second magnet, of opposite polarity, on the further side of the switch. This is illustrated in Fig.3. The fixed magnet must not be mounted within the normal pull-in position for single magnet operation, otherwise the reed switch will be held in a closed position by the second magnet and will open when the moving magnet is brought close to the switch. By selecting the correct types and strengths of magnets the differential can be set to practically any required value.

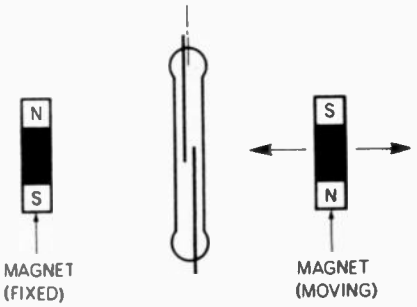


Fig. 3. A fixed magnet of opposite polarity to the moving magnet may be used to reduce pull-in, pull-out differential.

OPERATING MODES

As can clearly be seen in Fig.1, the reed switch is 'normally open'. The reeds close when a magnet is brought close to the switch enclosure.

However there are many applications where the switch is required to be 'normally closed' and to open when the magnet is introduced. This can be done either by biasing the switch with a second magnet (as shown in Fig.4), or by using a reed switch with change-over contacts (Fig.5).

In most applications where a reed switch is opened or closed by a permanent magnet, the magnet is fitted to a moving part, and the reed is fitted to a stationary part.

There are, however, a number of applications in which both the magnet and the reed must be located on a

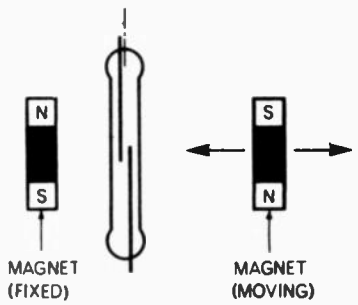


Fig. 4. 'Normally closed' operation can be obtained by biasing a 'normally open' reed switch with a fixed magnet. The moving magnet cancels out the fixed magnet and thus allows the switch to open.

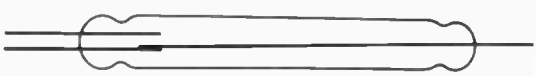
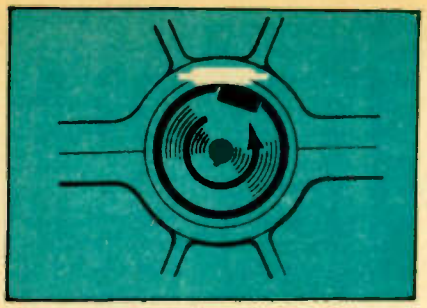


Fig. 5. This type of reed switch may be used for either change-over, or normally closed operation.



Tachometer applications, requiring the simplest addition to the moving part and offering ability to work in unfavourable conditions, plus high speed operation.

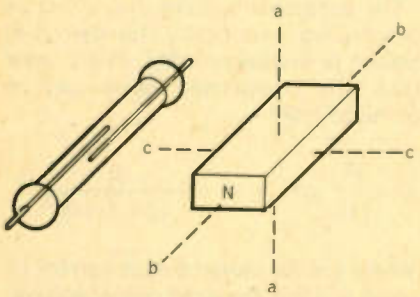


Fig. 6. Linear planes of operation; movement of the magnet in any of the planes indicated may be used to actuate the switch.

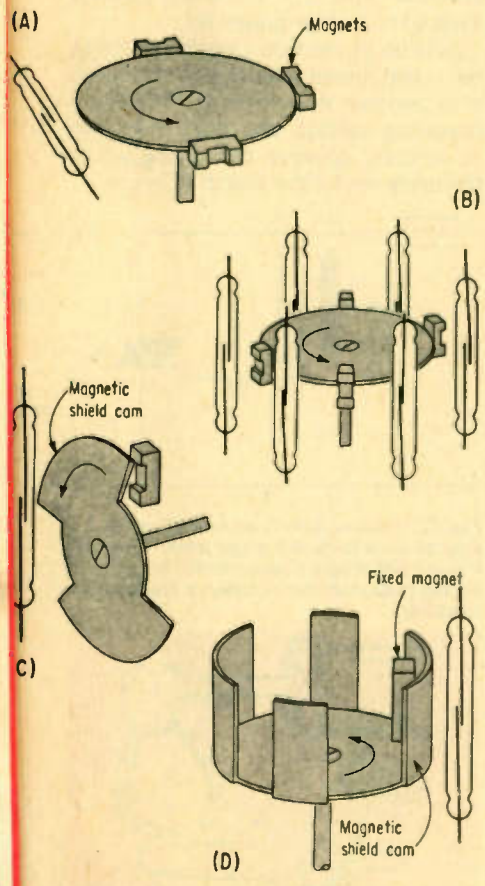


Fig. 7. Rotary motion may also be used to actuate a reed switch. In A and B the switches are stationary and the magnets rotate. In examples C and D both the switches and the magnets are stationary and the switch operates whenever the cutout portion of the magnetic shield is between magnet and switch.

stationary component. Operation may then be effected through distortion of the magnetic field by an external moving ferrous mass. If the magnet and the reed are sufficiently close, the reeds switch will be normally closed, but will be opened by the magnetic shunting effect of the external ferrous object. Alternatively, the magnet may be located so that the reeds are normally open and the external ferrous object used to 'reinforce' the field and thus close the reeds.

There are many different ways in which a moving magnet may be caused to operate a reed switch.

Linear planes of operation are shown in Fig. 6.; movement of the magnet in any of the planes a-a, b-b, and c-c will operate the switch. Magnet selection is fairly critical if the switch is operated in mode b-b, spurious operation may be caused by negative peaks on the magnet's field pattern curve. If these are large, the reeds will pull-in three times as the magnet is moved from one end of the switch to the other.

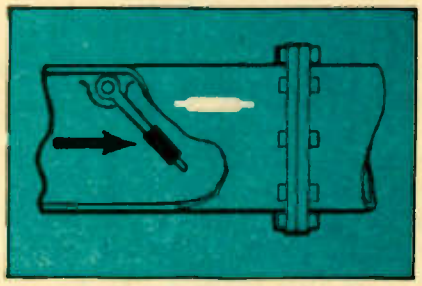
Rotary motion may also be used. Various ways of achieving this are shown in Fig.7. (A most versatile and simple impulse generator can be put together in a few minutes by placing one or more magnets on a gramophone turntable and fastening a reed switch to the motor base board. (Fig.8). Switching rates from approx one every two seconds to well over 2000 a minute can be selected merely by changing the turntable speed and/or using more magnets!)

Since the reed switch is truly a sealed device, it can be used in applications where conventional switches are not permitted, or where they have very limited life. Reed switches are frequently used in simple on/off push buttons, and outdoors, in dusty areas such as cement plants, especially in areas where explosive gases may be present.

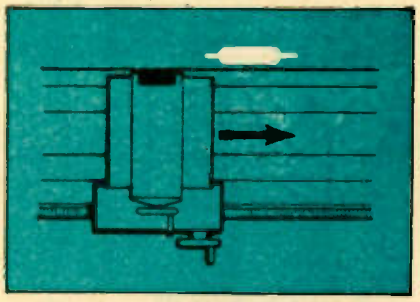
OPERATING LIFE

The operating life and load carrying characteristics of reed switches are interrelated, A switch may operate for 100 million or even 1000 million closures providing it is switching very

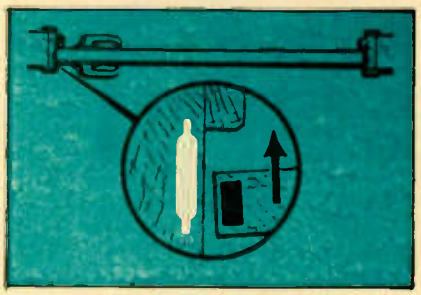
The reed switch is functional and versatile. It is almost the simplest elemental form of switch and has innumerable applications — from straightforward functions in which switch actuation is initiated by the proximity of a permanent magnet — to complex logic and computing functions, using hundreds of electromagnetically driven reeds. This practical three-part article, by Collyn Rivers, explains how and why they are used.



Flow control and indication, minimising restraint on the moving part and avoiding perforation of the container wall.



Position control and indication, obviating mechanical contact with its implications of wear, and simplifying mounting.



Door switches, obviating mounting and adjustment problems, and offering total concealment for security devices.

PRACTICAL GUIDE TO REED SWITCHES

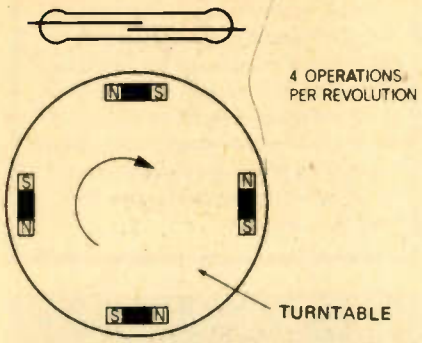


Fig. 8. Simple yet versatile impulse timer can be improvised by placing one or more magnets on a gramaphone turntable.

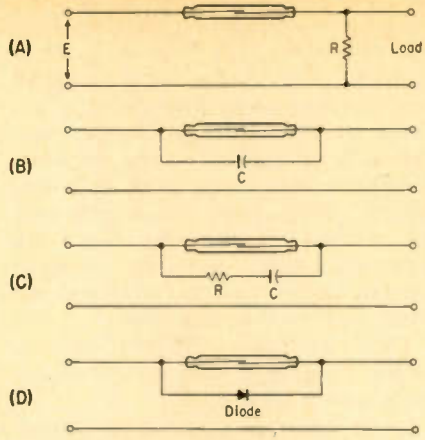
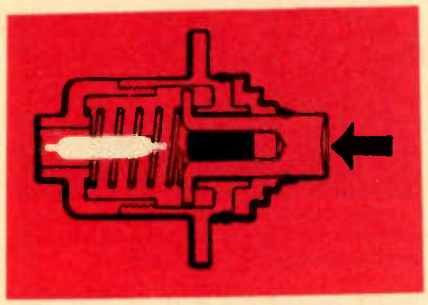


Fig. 9. Contact protection techniques: A — Resistor shunting load. B — Capacitor shunting contact. C — Resistor-capacitor series network for ac loads. D — Diode shunting.

low currents. But the same type of switch may fail after half a dozen switching cycles if the load greatly exceeds the designed rating. The majority of reed switches are manufactured with contact ratings between 0.1A and 3.0A.

The current handling capacity of reed switches varies from type to type.



Switching in explosive atmospheres, obviating ignition risk; in dust filled atmospheres where conventional contacts would be unreliable; and in extremely cold conditions where ordinary switches would freeze up. In radioactive environments, magnetic operation can maintain integrity of shielding.

In general the rating will be determined by the size and surface plating of the reeds, for the reed is an electrical conductor, and current rating will be a function of contact area.

The maximum rated contact loading is only applicable for purely resistive loads. If the load is capacitive or inductive the switch must either be drastically derated, or the switch contacts protected in a suitable fashion.

Four suitable methods of contact protection are shown in Fig.9.

In dc circuits all that may be required is a resistor shunted across the load (Fig.9A). Where the load is a relay coil or operating solenoid a resistor of approximately eight times the coil resistance is adequate to absorb a major portion of the induced energy when the circuit is interrupted. The addition of the resistor will of course increase the steady-state current flow but this extra load is negligible.

Another cheap and simple way to protect the reed switch is to wire a capacitor across the contacts. The required value depends upon load current, but something between 0.1 uf and 1.0 uf will be sufficient. (Fig.9B).

The most generally used method of protection is the resistor-capacitor series network shown in Fig. 9C. This circuit must be used if the switched load current is ac. The resistor should be approximately 160 ohms and the capacitor somewhere between 0.1 uf and 1.0 uf. That this is an extremely effective method was proven by a recent trial during which a motor starter was switched 50 million times without failure.

The component values may either be determined empirically (as described below) or mathematically. In the latter case, the component values can be obtained from —

$$C = \frac{I^2}{10}\ \mu F \quad , \quad R = \frac{E}{10 \times I\left(1+\frac{50}{E}\right)}\ \Omega$$

Where I is the closed circuit current in amps and E is the open circuit voltage in volts.

A fourth method of protection is to connect a diode across the switch contacts. (Fig.9D). This method is effective only with dc; diode polarity must of course be preserved.

Suitable protection circuits are often best determined empirically. One way is to connect the switch to the normal operating voltage and load, and then to actually observe the arcing across the reeds whilst the switch is in use.

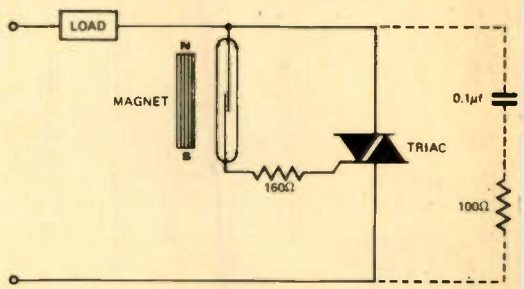
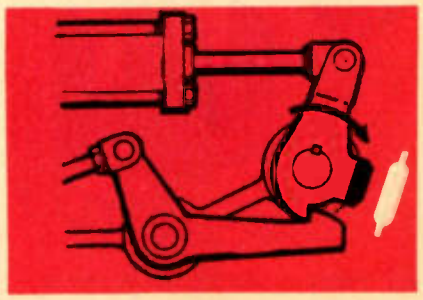


Fig. 10. Reed switch/Triac combination may be used to switch single phase loads as high as 125 Amps. Components shown in dotted lines must be included if the load is reactive.

SPECIFICATIONS	STANDARD	MINIATURE
Maximum voltage	150 Vdc 250 Vac	50 Vdc 150 Vac
Maximum current	2.0A	0.5A
Maximum power	25W	6W
Max. initial resistance	50 m.ohms	100 m.ohms
Max. end-of-life resistance	2 ohms	2 ohms
Peak breakdown voltage	500 V	300 V
Closure rate	400 Hz	2000 Hz
Insulation resistance	5000 M.ohms	1000 M.ohms
Temperature range	-55°C to +150°C	-55°C to +150°C
Contact capacitance	1.5 pF	0.5 pF
Vibration	10G at 10-55Hz	10G at 10-55 Hz
Shock	15G minimum	15G minimum
Life at rated load	5 x 10^6 operations	5 x 10^6 operations
Life at zero load	500 x 10^6 operations	500 x 10^6 operations

Table 1. Typical specifications for standard and miniature reed switches.



Safety interlock switching, giving extreme reliability and simplicity of application to complex mechanical layouts. Reed insert completes circuit to illuminate warning lamp or permit further stage of operation.

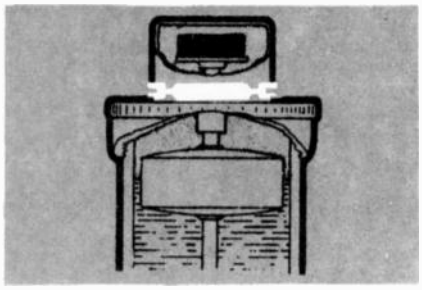
HEAVY CURRENT SWITCHING

There will be many applications in which a reed switch can usefully be used to switch very large currents. This can be done quite simply by combining a reed switch with a Triac. (Fig.10). Even miniature reed switches will safely carry the gate current required to trigger the largest Triacs, and by using this system it is possible to switch single phase loads of whatever Triac rating is used. Triacs can be readily obtained with ratings from 1 amp to 125 amps.

Three phase loads can also be switched by using the reed switch to energize a miniature three pole relay that in turn triggers a Triac in each of the phases of the supply.

SWITCHING AT LOW LEVELS

One great advantage of the reed switch is its ability to operate reliably when switching currents and voltages at very low levels. This is a major problem with standard switches because there is insufficient energy to break down non-conducting films on the switch contacts. But a reed switch – due largely to its gold-plated contact surfaces and inert atmosphere – will perform satisfactorily for at least a billion operations.

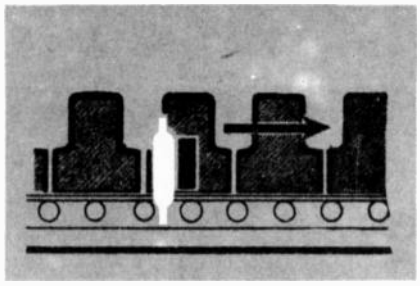


Hydraulic brake fluid level indicator, where feasibility depends on simplicity and ease of application.

Some idea of the extraordinary reliability of reed switches was shown during a series of tests undertaken by the Bell Telephone Company in the USA. In one test four switches were operated at 120 closures a second carrying a load of 500 micro-volts, 100 microamps, dc. Each switch completed 50 million consecutive closures without a single instance of closed resistance exceeding 5 ohms.

FAILURES

A reed switch rarely fails completely. As load currents are increased the contacts suffer the same form of contact erosion experienced in conventional switches. The resultant particles are magnetic and collect in the air-gap. If these fragments become



Proximity counting, providing a very easy method of recording the passage of ferrous items past a point.

numerous enough they intermittently bridge the gap and cause a failure-to-open. It is also possible for these fragments to alter the closed contact resistance.

The most common cause of contact failure is the mechanical locking of a spike on one reed and a corresponding crater on the other. This type of failure is commonly called a 'weld' but it is not a weld in the true sense. The contacts are not joined by molten metal but are held by friction or interlocking, between the spike and the crater.

NEXT MONTH

The second part of this article, which will be published next month, will describe applications in which reed switches are electrically energized. ●

VOICES FROM THE DEAD!

THE BOOK

Dr. Konstantin Raudive maintains that life after death is a reality which can be scientifically proved. The results of these experiments have been the subject of discussion at scientific congresses and in the international press. Mr Peter Hale, scientific adviser to the British Government, took part in the investigations and stated, "from the result I must state that something is happening which I can no longer explain in normal physical terms."

It appears incontrovertible that some sort of "breakthrough" has been achieved.

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APOLLO 15- AUSTRALIA'S ROLE

(Continued from page 67)

being uplinked to the spacecraft through the unified S-band antenna.

It was during this phase that the critical 'Go-No-Go' decision was made for the astronauts to perform the trans-lunar injection burn. During the trans-lunar coast episode, Carnarvon was able to provide high and low speed tracking data on the command service module, besides providing backup support in case of break-downs on the prime site.

The FPQ-6 radar also beacon-tracked the instrumentation unit on the Saturn IVB section of the rocket, the radar providing positional tracking data on the vehicle.

The station's FPQ-6 is one of two high-precision radar systems in the Manned Space Flight Network and the only one in the Southern Hemisphere. It is one of the most accurate tracking radars in the world.

The equipment includes a computer which is used for predicting satellite orbits and for processing measurements made by the radar. It corrects predictable errors and converts the tracking data into a form suitable for transmission to computers in the United States.

Carnarvon continued to provide back-up and passive support during the rest of the mission, while transmitting scientific data on the lunar surface experimental packages left by previous Apollo missions.

The new packages were also monitored, including the 'particles and fields' sub-satellite, which was placed in a lunar orbit after lunar module lift off from the moon's surface.

The Command-and-Service Module (CSM) was again successfully tracked during the trans-earth coast sequence, with time included to support a non-mission related satellite launching

During the earth re-entry period, Carnarvon was able to acquire V.H.F. downlink voice communications over several periods, coupled with the telemetry and recording of total spacecraft systems parameters from the command service module.

Throughout the whole mission period the station's solar particle monitoring site provided continual data on the sun's activity as part of an early warning network. One of a network of three stations around the world, the Solar Proton Alert Network (SPAN) consists of an optical and radio telescope which is used to monitor solar disturbances. Large flares on the surface of the sun can affect the earth by disturbing radio communications. They also emit high-energy particles which arrive in the earth-moon vicinity from one to two hours after the onset of a flare. This is a potential hazard to astronauts.

TIDBINBILLA

The Tidbinbilla deep space communication complex tracked the Apollo 15 command and service module with teams of technicians working 24 hours a day for the duration of the mission.

A team was also provided to man the special receiving equipment installed for the mission at the Parkes radio telescope, which, whenever the moon was in their view, provided the television received directly from the lunar rover on the moon.

On the second and third EVAs (lunar extra vehicular activities) the television from Parkes was seen around the world.

Expected to become operational in 1973, a 210 ft. antenna is now under construction at Tidbinbilla at a cost of about $10 million. The design is based on the 210 ft CSIRO telescope at Parkes. ●

AWA technicians operate controls of the FPQ-6 tracking radar at Carnarvon station.

The Carnarvon and Tidbinbilla stations are operated and maintained by Amalgamated Wireless (Australasia) Ltd. under contract to the Department of Supply.

NASA's Switching Centre at Deakin was a key link for communications between the Apollo spacecraft, mission control centres in the US and stations in NASA's world-wide network.

The centre also handled communications between other American control centres and unmanned spacecraft via the Australian deep-space stations at Island Lagoon (SA) and Tidbinbilla and the STADAN station at Orroral Valley (ACT).

Operated by the Department of Supply, NASA's TV Control Centre in Sydney accepted the TV signals from the Honeysuckle Creek-Tidbinbilla-Parkes complex and, after processing, transmitted the picture to the Mission Control Centre at Houston. In addition, a "split" of all telecasts received by the complex was made available for use by Australian networks.

Outside USA, Australia has the largest number of NASA space tracking and communications stations in the world. NASA's capital investment in Australia is about $71 million and operational costs are about $16 million a year. ●

SIMPLE DOOR

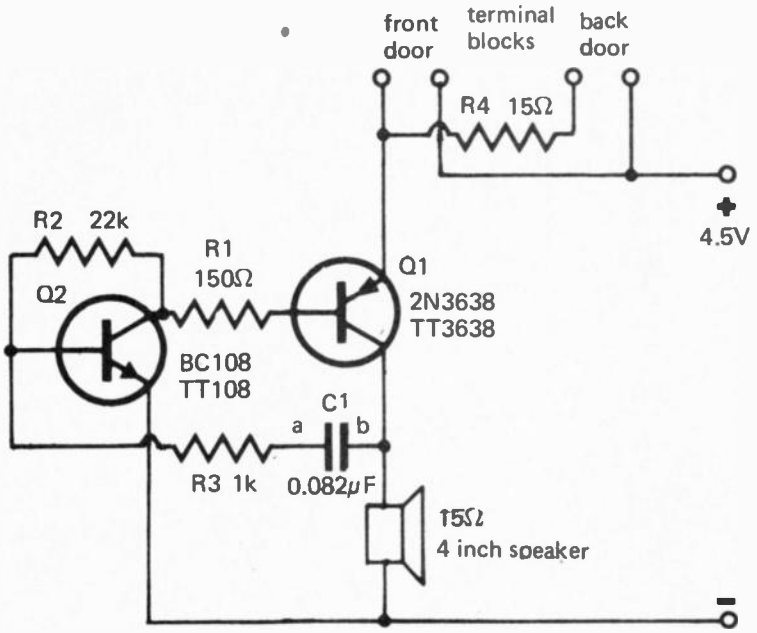


Fig. 1. Circuit diagram of complete unit.

HERE is a simple door monitor that produces a different tone for either of two buttons connected to it.

It is of particular value for houses where callers may announce their presence at either of two entrances.

Basically, it is a multivibrator connected to a small loudspeaker that produces an audible tone whenever a caller presses a button. The circuit is arranged so that the frequency of the oscillator varies depending upon which button is pressed.

CONSTRUCTION

All the minor components may be mounted on a nine-lug tagstrip which in turn is housed, together with the

ET PROJECT

HOW IT WORKS

Transistors Q1 and Q2 form a non-inverting amplifier with a loudspeaker as the load. In the quiescent state, i.e., with C1 and R3 removed, Q1 and Q2 are slightly forward biased.

However, when R3 and C1 are in circuit, the amplifier becomes unstable owing to the positive feedback thus provided, and the circuit goes into oscillation.

The frequency of oscillation is to a large extent dependent on the supply voltage, and this effect is exploited to provide differen tones depending upon which button is pushed. Resistor R4, in series with one line provides this function.

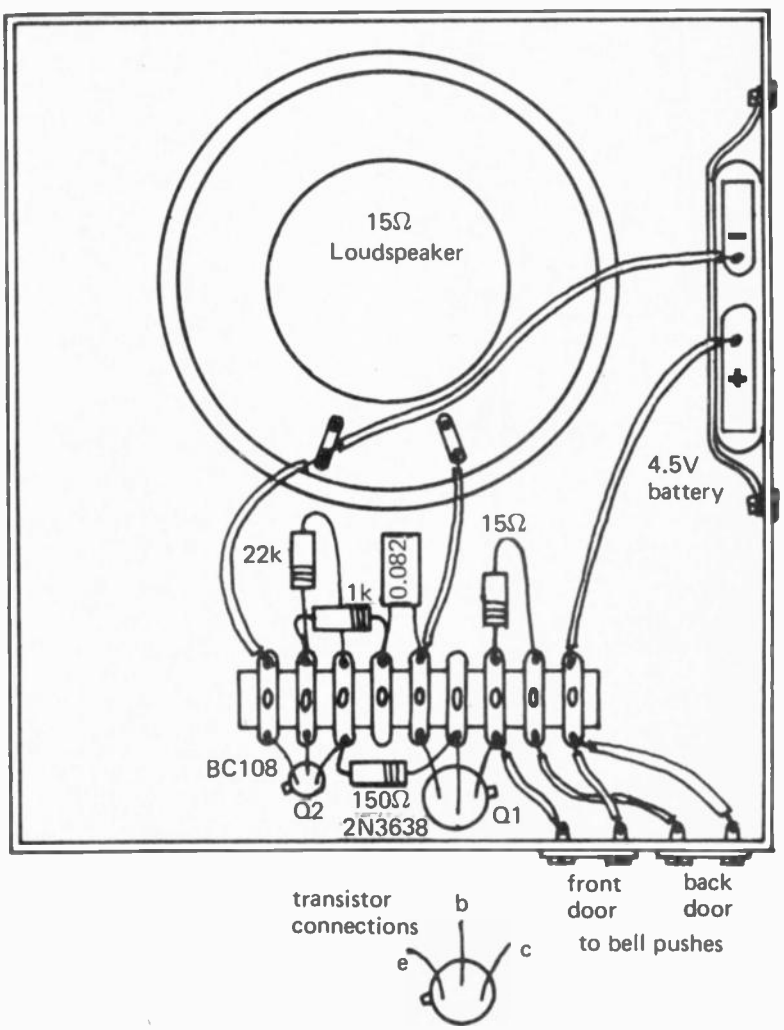


Fig. 2. Wiring diagram showing component layout.

MONITOR

This simple to make two-tone door monitor has many uses.

speaker and battery, in a suitable box.

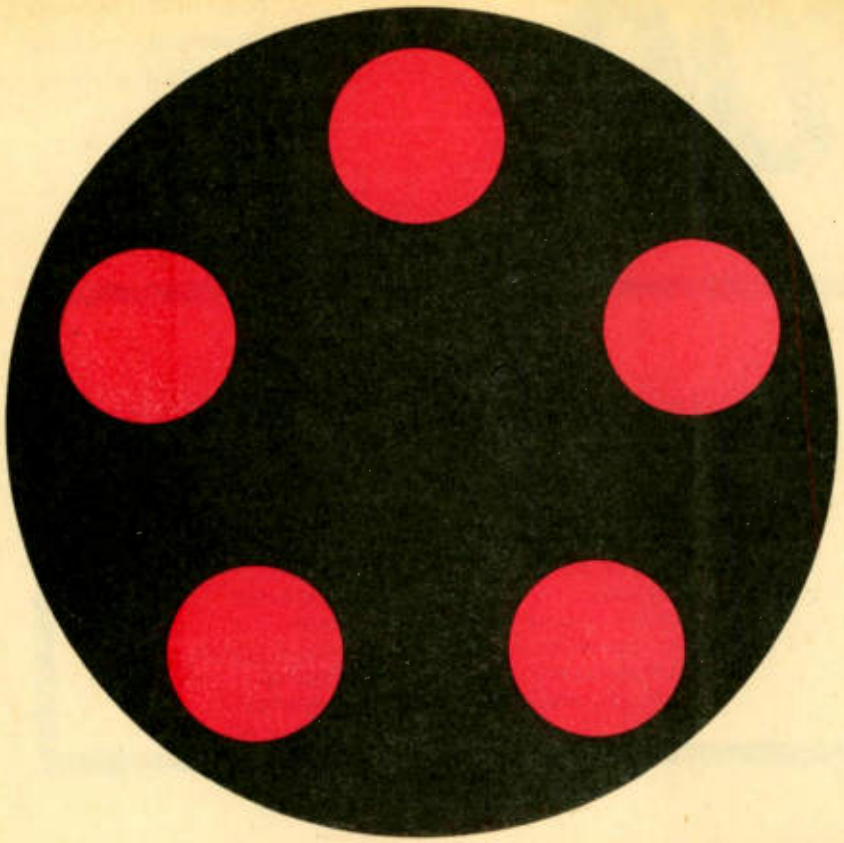
The basic pitch of the unit may be varied by changing the value of capacitor C1. Decreasing the value will increase the pitch, while increasing the value will decrease the pitch.

The difference in pitch between different push buttons may be adjusted by varying R4. Increasing the value of R4 increases the pitch difference, and decreasing R4 decreases the pitch difference.

Ordinary 'figure of eight' flex or bell wire may be used to connect the bell pushes to the main unit. These bell pushes should be of the normal types made for this purpose and available from practically any electrical or chain store. ●

PARTS LIST

R1	resistor 150 ohm ½ W.
R2	resistor 22 k ohm ½ W.
R3	resistor 1 k ohm ½ W.
R4	resistor 15 ohm ½ W.
C1	capacitor 0.082 uF.
Q1	transistor 2N 3638, TT 3638 or similar
Q2	transistor BC 108, TT 108 or similar
Sp.	loudspeaker – 2", 3" or 4" 15 ohm speaker type and size are practically immaterial.
	Two sets of double terminals, nine-lug tag strips, 4.5 Volt battery, two or more bell pushes, connecting wire, small plastic or wooden box.



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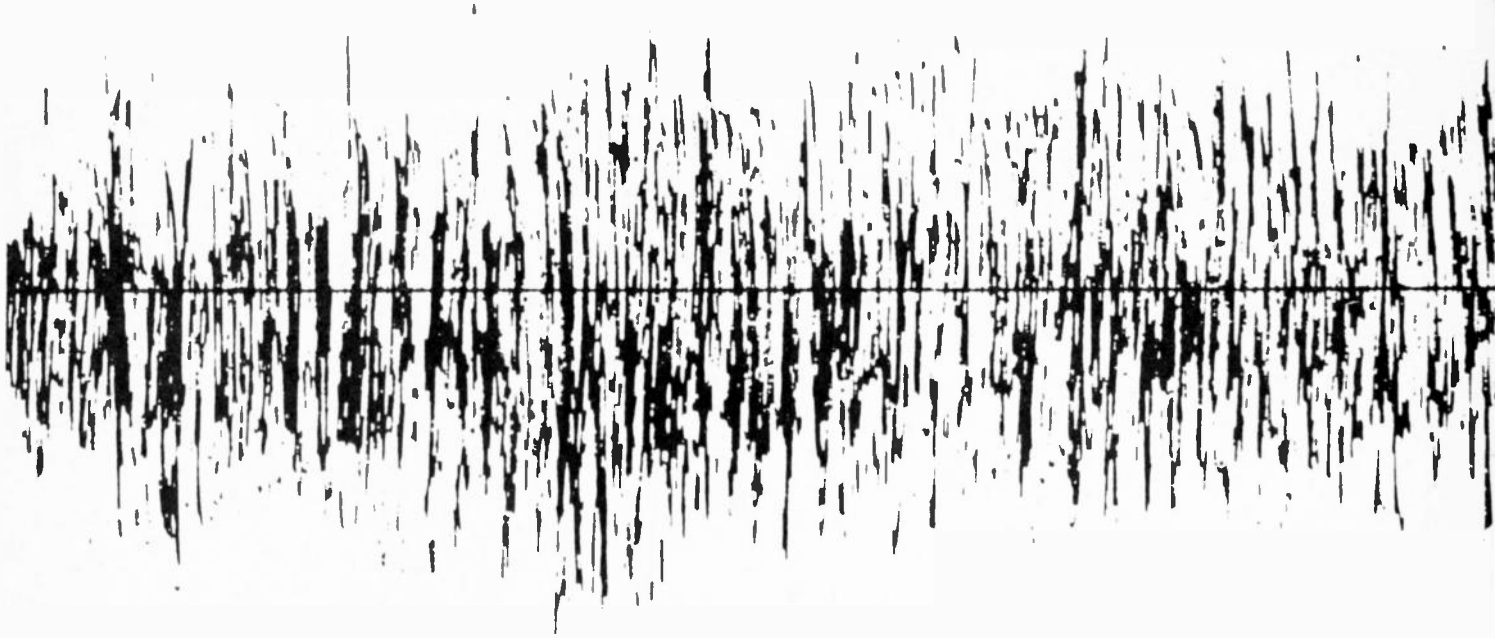


TESTING SPEAKERS WITH RANDOM NOISE

By EDGAR VILLCHUR

THE supposed inability of objective testing to reveal the quality of a loudspeaker has become a first principle among the "hi-fi" writers and dealers who advise the public on the esoteric mysteries of sound reproduction. Explanations usually have to do with hearing differences in different individuals, differences in tasts, and differences in room environment. All of these explanations make good sense once we accept the hypothesis that a loudspeaker is a new musical instrument, a creator rather than a reproducer of sound.

On the other hand, if the function of loudspeakers is merely to recreate with maximum accuracy sounds that have already had an objective existence, the explanations of why loudspeakers cannot be tested appear quite thin.

Differences in individual hearing have no more to do with comparing a facsimile to its original than differences in vision affect the objective accuracy of a matching sample of colour. The same hearing aberrations are brought into play with both the live and reproduced sound, and do not affect the process of matching.

Taste may determine whether a listener prefers one or another symphony orchestra, or a small string group to a large brass band, but it cannot influence objective determination of the simple accuracy of reproduction.

Room environment profoundly affects the final acoustic output of any sound-reproducing system, but this effect might just as well be used to establish the fact that amplifiers, pickups, needles, or turntables are not subject to objective evaluation. If there is to be compensation for room environment, it should not be sought in loudspeakers.

Taste can be a valid element in establishing preferences of one reproducing component over another in two instances:

1. Where the reproduced sound is accepted as an entity in itself, with little relation to the world of live concert music.

2. Where a choice must be made between different kinds of inaccuracy — for example, intermodulation distortion vs transient ringing.

In the late 1930's the Museum of Modern Art in New York had a special exhibition in which American paintings were exhibited next to colour reproductions of the same paintings in the same size. In many cases it was impossible to tell the difference, or the differences were very small. An observer could judge the accuracy of reproduction

Simple method of speaker testing uses a reference sound to ensure reliability.

TESTING SPEAKERS WITH RANDOM NOISE

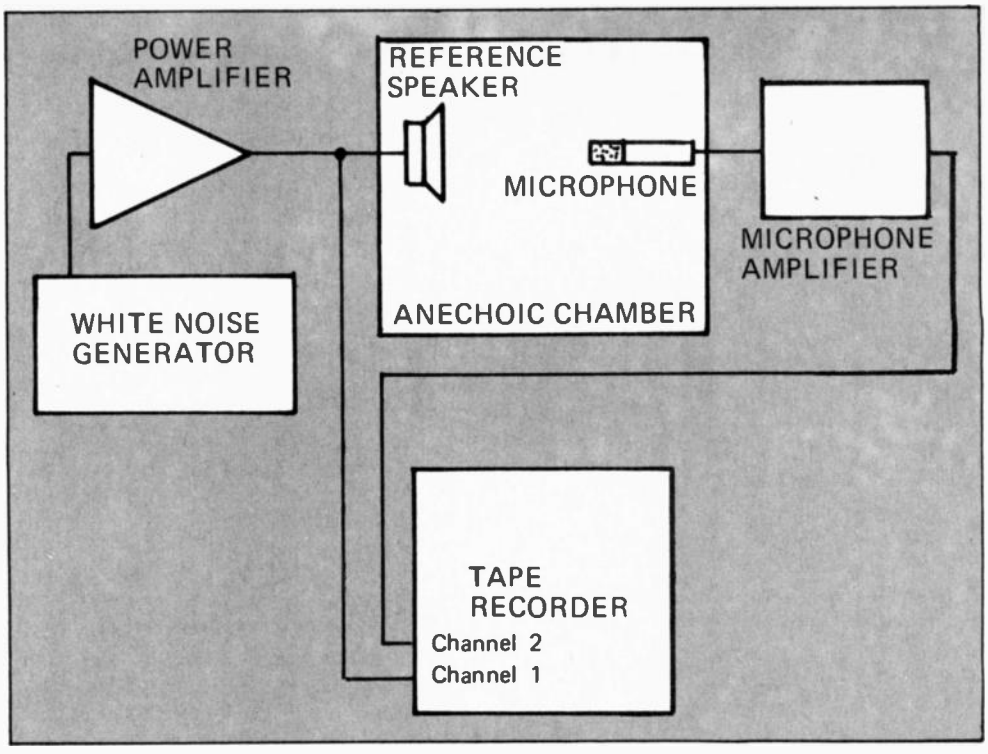


Fig. 1. How the test recording is made. The white noise generator, amplifier, and reference speaker make up a reference acoustical generator, whose sound is recorded in an anechoice chamber.

independently of his artistic taste, the kind of lighting employed, or whether he had astigmatic vision. The kind of evaluation that was called upon was entirely different from that involved in choosing between one painting and another, or between a Stradivari and a Guarneri violin.

The testing method to be described here bears a similarity to the Museum of Modern Art's exhibition efforts. In testing reproducing accuracy, this testing method makes direct reference to the original sound. Its genesis is in two types of experience — the staging of "live vs recorded" public concerts, and the use of white noise input for subjective loudspeaker testing.

In a series of live vs recorded concerts with which the author was associated, a string ensemble would record sections of a movement in a non-reverberant environment. Then, at the concert, live playing would be alternated with electronic reproduction at the same level. This was a direct A-B test between the live music and the reproduced music, with no time lag. Even the musical beat was not interrupted. Small differences in timbre, in transient attack and decay, or in other elements were painfully evident when something was wrong in the record-reproduce chain.

WHITE NOISE INPUT

The use of white noise input, the second type of experience referred to, had been made standard procedure at the author's company (and undoubtedly others) as part of the testing programme for speaker development. Some of the development personnel had worked up to the point where they thought they were experienced enough in listening to white noise to differentiate between "good" white noise and "bad" white noise. Nevertheless, during each test there was doubt and new soul searching in trying to decide which kind of noise best predicted reproducing accuracy. The test signal was, after all, produced by an electrical generator. It started out as a purely electrical signal without independent existence as sound, and there was no sure way of knowing which sound was right.

Each of these test techniques makes up part of a very powerful investigative tool. The white noise technique is able to reveal even subtle distortions in the texture of reproduced sound related to ringing, uneven presentation of acoustical energy in different parts of the frequency spectrum, dispersion, etc. The live vs recorded technique establishes a reference standard, providing validation of the test technique. The two together make up what has proven to be a very sensitive and reliable test for speaker evaluation.

The basic technique is to establish an acoustical reference sound (using a particular white noise generator and a particular speaker), and then to stage a live vs recorded display as was done with the string quartet.

A white noise generator and amplifier provide an input signal which is fed simultaneously to the "reference" speaker (placed in an anechoic chamber) and to one channel of a stereo tape recorder. The acoustical output of the reference speaker is picked up by the microphone and recorded on the second channel of the tape, as shown in Fig. 1. We then have a two-track tape in which one channel represents the electrical input signal that was fed to the speaker, and the other track represents a recording of the sound produced by that speaker.

HOW THE SYSTEM WORKS

In the live vs recorded display the same reference speaker must be employed as standard, mounted on the same baffle. When the recording of the purely electrical input (Channel 1) is fed to the reference speaker, the sound produced is the same sound that had objective existence in the anechoic chamber, before it was picked up by the microphone. It is as though the live quartet performed again, during the live vs recorded display, the music that it had played when the original recording was being made. The system producing the random noise may be thought of as a reference acoustical generator.

The second channel represents a recording of the random noise that existed in the chamber. When the second channel is fed to a speaker under test, at the same volume level as is used for the reference sound, we have a true live vs recorded comparison: The speaker under test is

expected to imitate the reference noise, working from a very accurate recording. If the speaker is perfect the sound will be the same as that from the reference speaker. The other elements in the system, assuming well matched channels in the tape record-reproduce system, will have little effect in creating differences in sound. A diagram of the test display arrangement is shown in Fig. 2.

If, on the other hand, the speaker under test has a particular type of coloration, this will be clearly evident. In the live vs recorded displays with a string quartet it was usually impossible to detect the switch-over from live to recorded sound. The verisimilitude of reproduced random noise, however, was never so close that the difference could not be detected. With the best speakers tested the differences were not too great; with lower quality speakers the differences were so gross that it seemed as though the speaker under test were being fed by a completely different type of noise, sometimes with a concentration of energy at some part of the frequency spectrum that was almost identifiable as a tone.

Once we had familiarized ourselves with the technique we then tried the same procedure with musical programme material for the original electrical input. The results were similar although not quite as sensitive, and the kind of colouration predicted by the random noise comparisons was clearly present.

The above is the bare outline of the test technique, and a few comments on some of the details are in order. For one thing, the entire test relies on the ability to make a recording in a highly anechoic environment. If any reverberation is present in the recording made from the microphone, this will be introduced as a false note in the comparison display, an element not present on the channel that was recorded directly from the electrical generator. The reverberation imposed on the sound during the display must be the same for both the live and the recorded noise. As a matter of fact, the staging of this display in a normally reverberant environment is a distinct advantage in that integration of the sound radiated by the speaker at different angles from the axis is automatically taken into account.

SPEAKER MAY BE OF ANY TYPE

Both tape channels were recorded at the same recording level, and extreme care was taken to keep the playback levels of the reference speaker and of the speaker under test the same. This is not as easy as it sounds, because differences in colouration and frequency emphasis affect the listener's impression of loudness. Actually the level of the speaker under test was adjusted until the sound was most similar to the reference sound.

The two tape recorder channels were matched so that the total record-reproduce differences was no more than ½ dB at any frequency. The matching of these channels is, of course, more important than the range of response, although it is desirable to have the complete frequency range.

The creation by a loudspeaker of an exact facsimile of sound on the spot, as it were, is not an exact test of its total function in home reproducing systems. A home loudspeaker system must recreate, within the home acoustical environment, both the original raw sound and the particular "mantle of reverberation" surrounding that sound in the recording hall, an element involving both time and space.

The listener sitting in his living room will then hear something similar to what he would hear if he were at a concert. Success in anechoic facsimile reproduction does not necessarily solve the entire problem. Our tests indicate that it does, at the least, solve most of the problem, and that success or lack of success in facsimile reproduction, especially of random noise, is an excellent index of loudspeaker quality.

The test described is especially useful in comparing two or more speakers – to assign relative evaluations to each, or to test a particular design variation. The reliability of the test reading is very high in spite of its subjective nature because of the existence of the reference sound, and because of the absence of a time lag between comparisons. The very subjectivity serves to isolate those factors significant to aural perception. ●

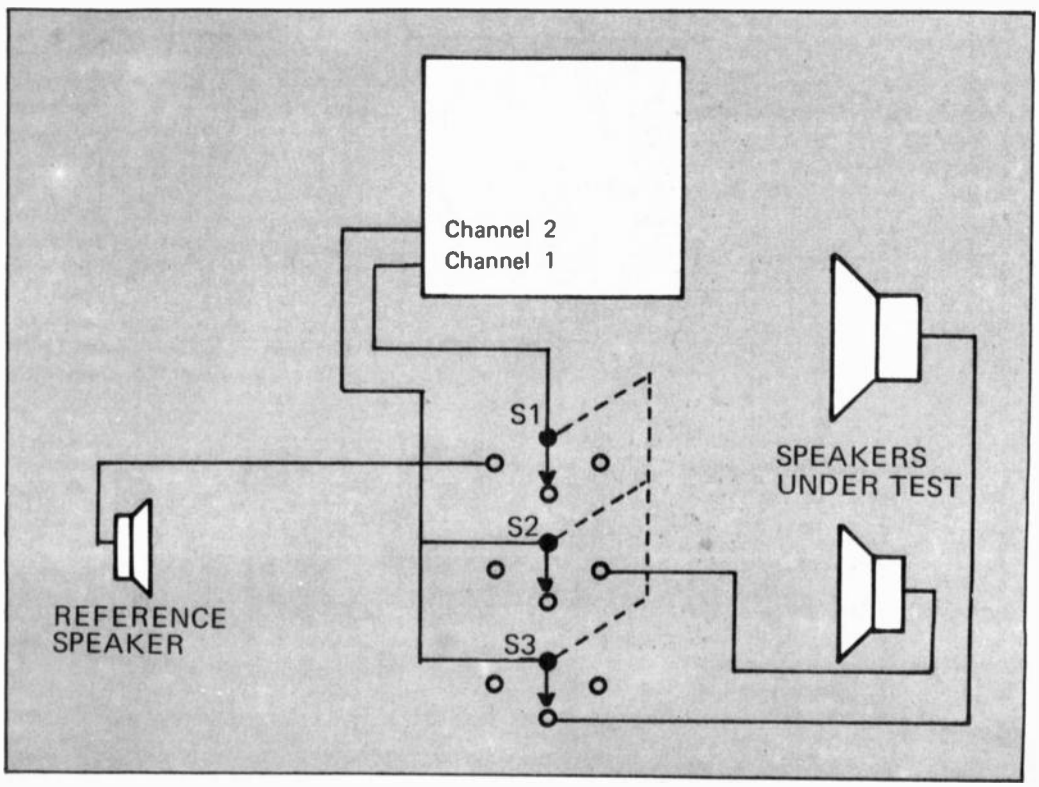
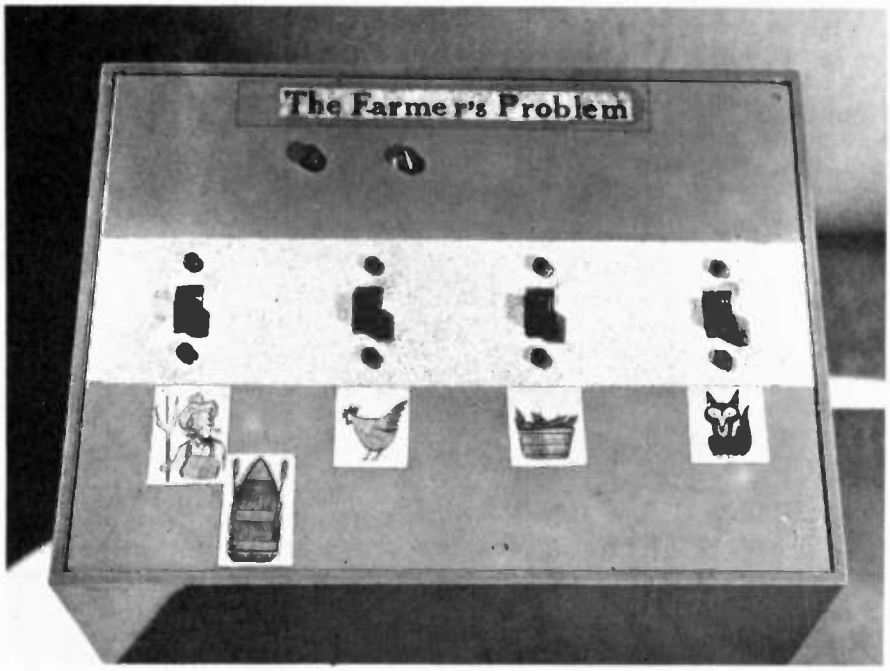


Fig. 2. The live vs recorded test display. The reference sound is recreated by playing channel 1 of the tape through the reference speaker. This is the 'live' display. The speaker under test is then asked to imitate the reference 'live' sound from tape channel 2.

THE FARMER'S



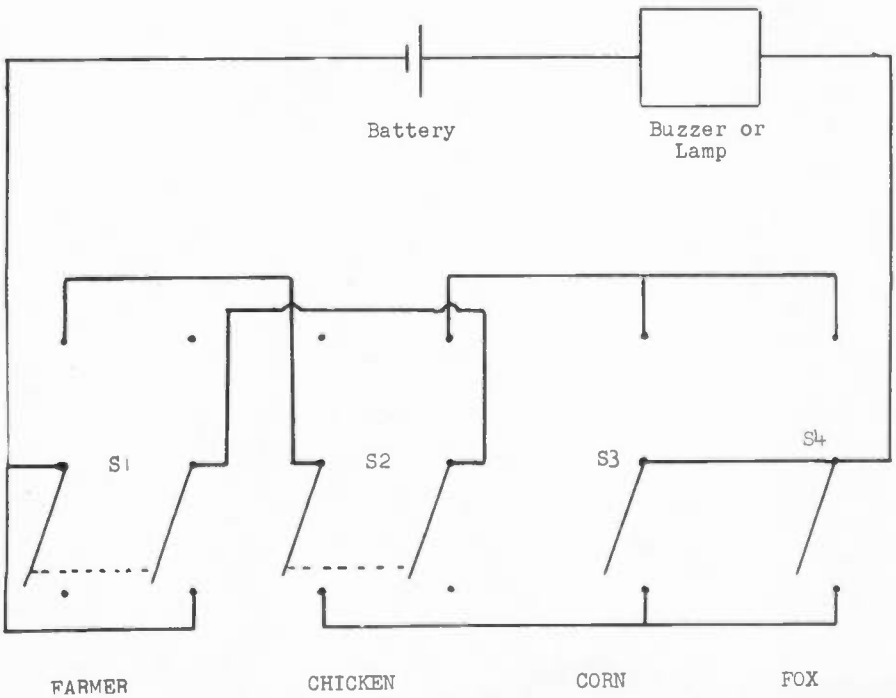


Fig. 2. Circuit Diagram.

DO you remember a puzzle which amused you as a child, (or perhaps it was in your father's day!), about a farmer on his way to market? It went like this:

One day, a farmer went to market with a basket of corn, a chicken and a fox. (Don't ask why he had a fox or you'll spoil the story!) He came to a river where there was a small boat which could carry him and just one other item – the chicken, the corn, or the fox. The problem is – how did the farmer get all his goods across the river, bearing in mind that, if he left the chicken and the fox together, the latter would eat the former; and if he left the chicken and the corn together, the former would eat the latter.

Well, that's the puzzle, and we won't insult the readers of ELECTRONICS TODAY, by telling them how the farmer solved it.

This is a simple little project, which brings the puzzle up to date. It will provide fun for you to make and for youngsters to solve.

The farmer and the three items are each represented by a slide switch (as shown in Fig.1). The nearer side of the box represents the 'starting' bank, and all switches are initially set in this position. The moves across the river are represented by sliding switches from the near side to the far side. Switches are usually moved in pairs, as the farmer takes something with him when he crosses the river. Of course he can row by himself, so the farmer's switch may be moved by itself – but remember that foxes etc, can't row.

The switches are connected to a battery and a buzzer so that if any error is made (for example – leaving the chicken and fox together) the buzzer lets you know about it. The aim is to move all the switches, following the story, and without sounding the buzzer until the farmer, chicken, corn and fox are all on the far side of the river.

PROBLEM

AN OLD PUZZLE BROUGHT UP TO DATE – ELECTRONICALLY – BY A. J. LOWE.

THE CIRCUIT

The circuit diagram is shown in Fig. 2. It needs no explanation. If you follow it out you'll see what happens if any error is made while using the puzzle.

Construction is illustrated in Fig. 3. This shows the underside of the panel. One half of the fox's double pole switch, and one half of the corn double pole switch are not used.

The buzzer used may be any available. The original was the noisy part of a discarded bicycle horn, mounted on a strip of aluminium. If a buzzer is not available, a pilot lamp may be used instead.

The wiring diagram, which is almost a mirror image of the circuit diagram, is included (in Fig. 4) to help those who may have difficulty in wiring from a circuit diagram. Don't forget that, on top of the panel, and in the circuit diagram, the farmer is on the left. This results in his being on the right in the wiring diagram and in Fig. 3, which show the *underside* of the panel – the starting side of the river still being at the bottom of the diagram and photo.

Housing this little project is up to the ingenuity of the constructor. The original was put in a plastic box measuring 5½" x 4" x 3", fitted with an aluminium panel. The panel was painted in two colours to distinguish the river from the banks. ●

PARTS LIST

S1, S2, S3, S4: four double pole double throw slide McMurdo type 1299-02-01 or similar switches.
One buzzer or lamp.
Battery to suit buzzer or lamp,
Wire, box, battery holder, etc.

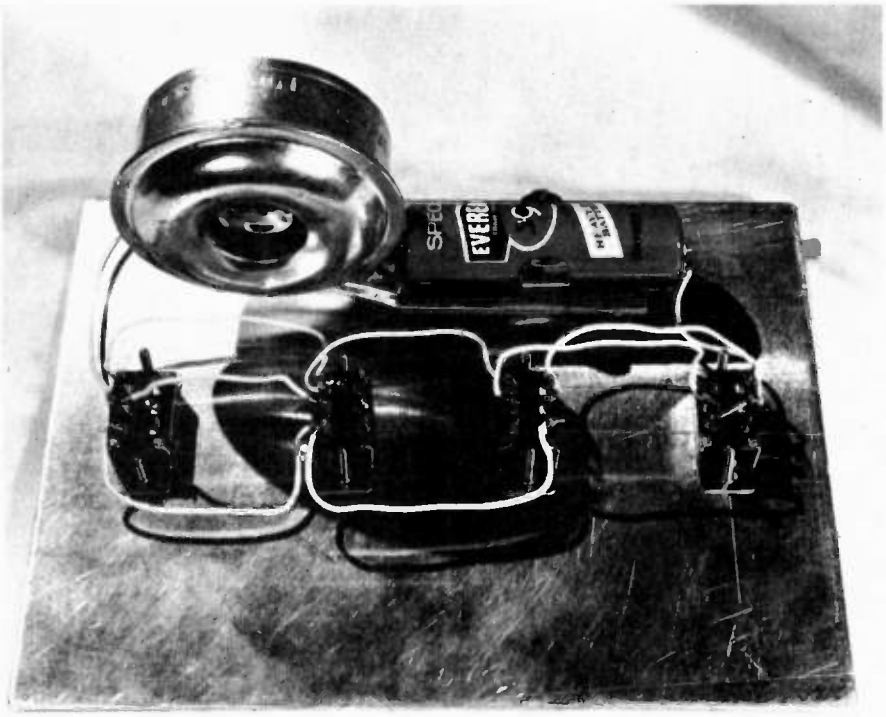


Fig. 3. How the unit is constructed – compare this with the wiring diagram shown in Fig. 4.

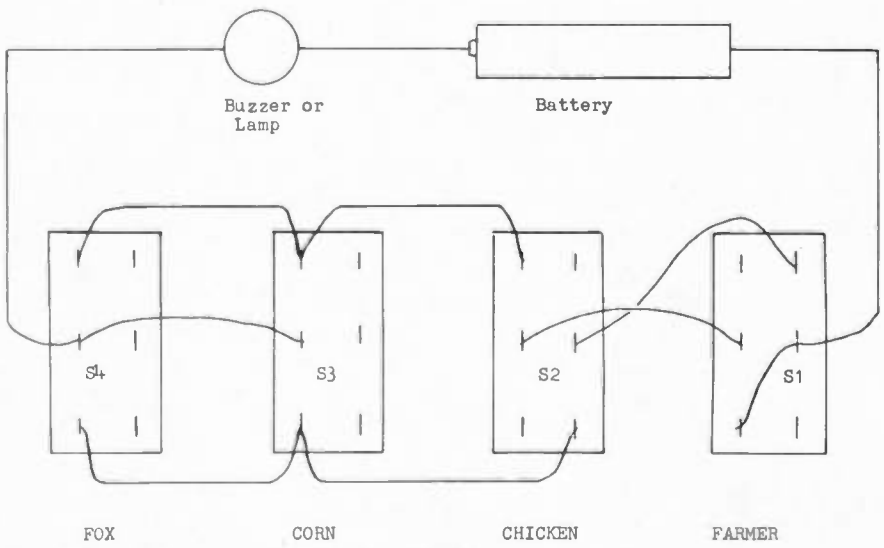


Fig. 4. Wiring diagram, showing back view of switches.

SWIMMING POOL

CONTEST CONDITIONS

Contest winners will be decided by a panel of judges professionally engaged in the electronics industry. Advice will also be obtained from technical experts involved in domestic swimming pool construction.

The judges' decision will be final and no correspondence will be entered into concerning the outcome of the contest.

Judging will take into account:

(a) SENSITIVITY AND IMMUNITY FROM FALSE ALARMS. The unit must respond to an object – roughly spherical in shape, not exceeding 14 lb in weight and having a specific gravity of not less than 1.00 – falling through a height of not more than 12 inches. Under these standard conditions, an alarm must be given when this object is dropped into a pool (not less than 25ft. long by 15ft. wide) at any point around the perimeter. Ideally the alarm unit will have a sensitivity adjustment which will also cater for various size pools.

The unit must not be affected by changes in water level due to rain or seepage, and arrangements must be made to prevent false triggering by wind-induced ripples, thunder, lightning, aircraft, or heavy-vehicle noise.

(b) RELIABILITY. All components must operate within manufacturer's specifications. The unit must be shown to be protected against accidental damage and corrosion. There should preferably (but not essentially) be some remotely operable method of checking operation.

(c) VERSATILITY AND EASE OF INSTALLATION' The unit must be simple to install in any size, shape or type of domestic swimming pool.

(d) MANUFACTURING FEASIBILITY AND COST. Units should have a realistic manufacturing cost and should preferably not incorporate any components requiring special manufacturing methods or techniques.

Entries are acceptable from all readers – amateur or professional – except employees, or families of employees, of Modern Magazines (Holdings) Ltd., Simon Gray Pty. Ltd., and their respective agents, distributors, dealers or associated companies.

Considerable publicity will be given to winning entries. Contestants who foresee a commercial future for their entries should consider provisional patent protection.

In the first instance, entrants should submit full mechanical and electrical details of their entries, together with detailed description of operation. Photographs may be included if required. Every care will be taken to safeguard the entrants' plans, but no responsibility can be accepted in this respect. DO NOT SEND ACTUAL UNITS.

Initial selection will be based on the entrant's description and plans.

Finalists will be asked to submit working prototypes for physical and electrical evaluation.

These prototypes must be soundly constructed, but no marks will be awarded for or against quality of finish.

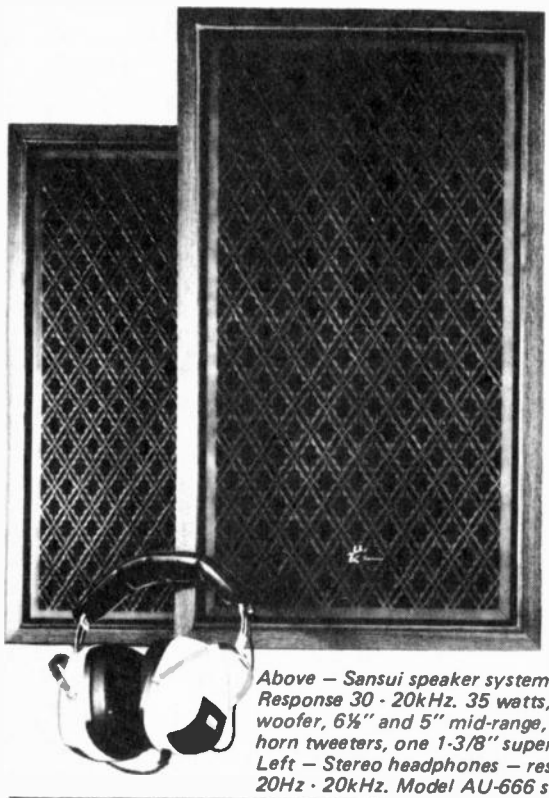
ELECTRONICS TODAY reserves the right to publish details of any entries, whether winners or otherwise.

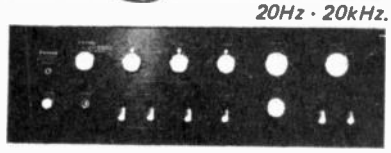
There is no entry fee and entrants may submit more than one design if they wish – but each entry must be accompanied by a coupon from ELECTRONICS TODAY.

Final closing date is November 23, and the results will be announced shortly after.

Entries should be addressed to: Design Competition, Electronics Today, 21-23 Bathurst St., Sydney, N.S.W. 2000.

Make sure your name and address is on each and every enclosure. And please do NOT send actual units unless otherwise advised.





Above – Sansui speaker system. Response 30 - 20kHz. 35 watts, 12" woofer, 6½" and 5" mid-range, two 2" horn tweeters, one 1-3/8" super tweeter. Left – Stereo headphones – response, 20Hz - 20kHz. Model AU-666 stereo amplifier – 10Hz – 40 kHz – 35 watts per channel rms.

Sansui turntable – two speeds, four pole synchronous motor. Magnetic cartridge with 0.5 mil. diamond stylus.

EXAMPLES OF HI–FI EQUIPMENT AVAILABLE FOR THE WINNER'S CHOICE AS PART OF $1000 FIRST PRIZE PRESENTED BY SIMON GRAY PTY. LTD.

SAFETY CONTEST

Can you design an effective and reliable system which will provide audible warning if a child falls into a swimming pool?

If so, you could help reduce the increasingly large number of young children drowned every year in unattended swimming pools.

EVERY YEAR toddlers and small children drown in unattended swimming pools — tragedies that strike swiftly and almost silently, for the splash of a two-year-old is not loud and will rarely be heard more than a few feet away.

This is a serious hazard — becoming more so every year as the number of domestic pools increases — and about which questions are now being asked in State Parliaments.

And so far there is no really satisfactory solution — no alarm system that can be relied upon to operate under all conditions.

That is why we have chosen this problem as the object of our first design competition.

What we are seeking is a system that will provide audible warning if a small child falls into (or is about to fall into) a domestic-size swimming pool.

There are many different approaches to solving this problem, the most common of which is to sense the transient change in water level.

But it must be remembered that the water level in a pool may rise or fall several inches due to rain or leakage, and any system that utilises wave action to initiate the alarm must not be affected by slow changes in water level.

Other factors to consider include:

(a) Wind-induced ripples.
(b) Effect of thunderstorms.
(c) Avoidance of false triggering by birds, leaves, etc.
(d) Effect of constant immersion on components.

It is strongly recommended that the system should be battery-operated and that, if it is, battery drain should not exceed 1½ mA from a 6 or 12 Volt battery. Provision should be made to check battery condition.

Systems in which electrodes detect wave action are not acceptable as entries, unless the electrodes automatically adjust for slow change in water level of at least six inches.

POSSIBLE OPERATING METHODS INCLUDE:

* *Pressure sensing transducers.*
* *Ripple sensing electrodes.*
* *Doppler shift of audio or ultrasonic energy.*
* *Light beams (but remember curved pools). pools).*
* *Detection of high-frequency component of 'splash'.*

FIRST PRIZE

$1000

WORTH OF HI-FI EQUIPMENT FROM

SIMON GRAY

Pty. Ltd.

RUNNER–UP PRIZES TO BE ANNOUNCED LATER

This is the first of a series of design competitions to be run by ELECTRONICS TODAY.

The purpose of the competition is to indicate known problems and to provide publicity, plus material incentive, for successful solutions.

ENTRY COUPON

ELECTRONICS TOOAY DESIGN COMPETITION
21, Bathurst Street, Sydney 2000

Herewith my entry in your swimming pool alarm design competition. I have read the contest conditions and agree to abide by the judge's decision.

SIGNED.....OATE.....

NAME (block letters).....

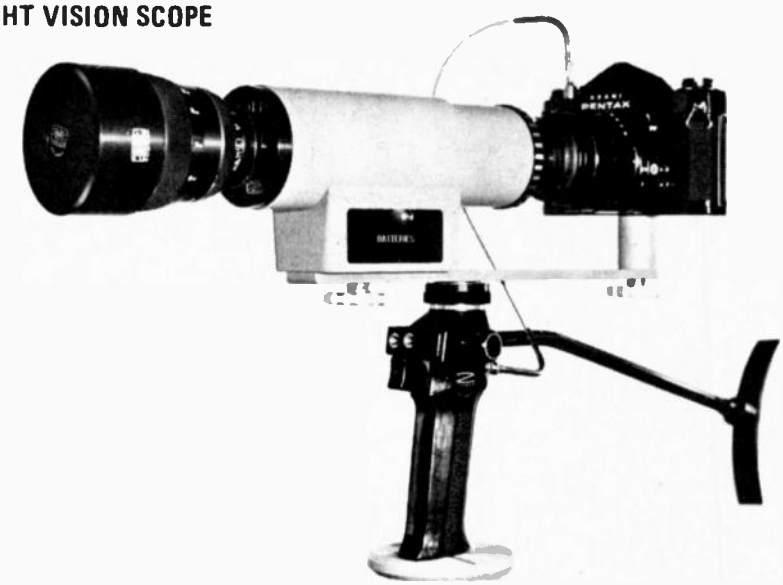
ADDRESS.....

.....

A separate coupon must accompany each entry.
Closing date for this contest is November 23rd, 1971.

EQUIPMENT NEWS

NIGHT VISION SCOPE



The Zoomar Night Vision Scope is a unique device for visual observation under low light level conditions.

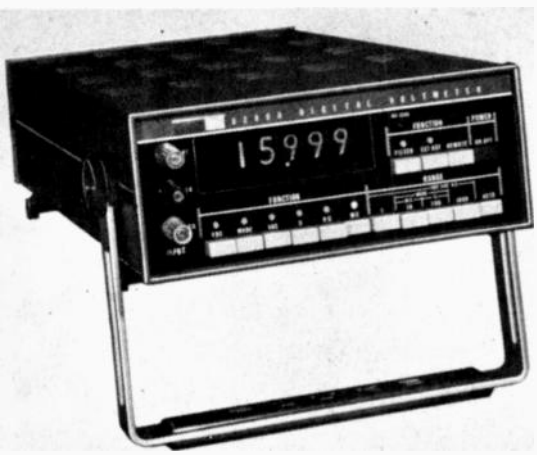
Designed by Zoomar Inc. of New York, the device will operate even under starlight conditions. It can be used in total darkness with the addition of an infra-red light source.

An unusual feature of the Scope is its ability to accept lenses of any focal length from ultra-wide-angle to telephoto. It can be used as a direct viewing device, or close-coupled to a 35mm. S.L.R. camera, C.C.T.V. camera or 16mm. cine camera.

The device has been produced to meet the requirements of law enforcement agencies, surveillance groups, and scientists and nature study organizations. Where light levels are too low to permit observation with the naked eye, the device allows the user to see clear images of otherwise invisible objects.

Details from John Hadland (Aust.) Pty. Ltd., 28 Chester St., Oakleigh, Melbourne, 3166.

PORTABLE DVM



A recirculating remainder DVM by Fluke Instruments is being released in Australia by Elmeasco Instruments Pty. Ltd.

Designated Model 8200A, the instrument is a rugged, low priced four digit DVM, measuring dc voltages on four ranges with claimed 100μV resolution and 60% overranging.

The unit features all push-button selection, autoranging, automatic polarity selection and display as well as a one thousand volt guard facility.

Optional circuit boards can extend the instrument to a full systems multimeter.

Further details from Elmeasco Instruments Pty. Ltd., P.O. Box 334, Brookvale, N.S.W. 2100.

NEW CONCEPT IN INTERFERENCE CONTROL

Claimed to represent a new concept in interference control in that it achieves inductance and capacitance in integrated form, a British suppressor absorbs, rather than reflects, unwanted interference energy and converts it to heat.

The elimination of discrete inductors and capacitors, and the use of suppressor rather than filter techniques has resulted in a space-saving, low cost product which can be applied to most of the usual configurations. It has been designed to meet the latest developments covering thyristor and triac suppression, and equipment used in computers, data logging and communications.

Conventionally or toroidally wound to give designable values of inductance and capacitance, the suppressor is grommett shaped which lends itself to low-profile mounting in military, aircraft, and consumer applications.

A standard range has rated voltages of up to 250 ac (50 Hz), rated currents of 0.5 to 15 amps, and cut-off frequencies from 5 to 50 kHz.

Designs are possible for cut-off frequencies as low as 2 kHz, but it is expected that the most frequent applications will be in the 20-100 kHz region. Initially, these designs are being made available in 2, 3, and 5 section styles, depending on the rate of cut-off required.

The suppressors are broadband units, and should not be confused with purely R.F. rejection suppressors.

Full details from McMurdo Australia Pty. Ltd., 17-21 Carinish Road, Clayton, Vic. 3168.

INDIVIDUAL CLEAN ROOMS

An inexpensive individual clean room facility is now available from Plessey to provide the clinically sterile and dust-free environment required for many processes in the electronics, precision engineering, medical and pharmaceutical fields.

In its standard form this portable clean room is a lightweight unit which can be moved around easily and may be set up in any room or work space.

Elimination of crevices and ledges in the one-piece moulded cabinet, which has rounded corners throughout, makes it impossible for mould spores, dust or other contaminating materials to lodge within the working area.

A dust-free, germ-free, clean atmosphere in the working area is provided by the positive pressure, filtered, laminar flow, air circulation system. This features an absolute type filter which is claimed to remove particles down to 0.3 microns rendering the air within the unit 99.97 per cent clean.

Other standard fittings include a night closure panel to provide complete protection when the cabinet is not in use, together with internal built-in fluorescent lighting and multi-point electrical outlets for power tools, etc.

There is also a range of optional features such as an ultra-violet light source, an irisport glove panel, a side pass-through for assembly line work and a microscope port.

Further information from Plessey Telecommunications Pty. Limited, Industrial Electronics Unit, Faraday Park, Railway Road, Meadowbank, N.S.W. 2114.

NEW EDUCATIONAL/SERVICE OSCILLOSCOPE

Extensive use of "automation in operation" facilities and full overload protection of inputs are important features of an easy-to-use 50 mV/cm dual-trace oscilloscope just introduced by Philips.

This portable 10 MHz instrument, designated the PM 3110, has been designed for simplicity of operation with the minimum number of controls and easy trace viewing.

The instrument is designed to be used by students (to university level) and servicemen.

Important for simplicity of operation is elimination of loss-of-trace. In the PM 3110 this is achieved by the instrument's time base being automatically triggered to the free-running state under "no signal" conditions so that a bright trace is always available. When a signal is applied, then the circuit automatically switches from the free-running to the triggered state. Triggering is from the signal's top or peak and can be in normal, T.V. line/frame and ac mains triggering modes. It can be on positive or negative polarity signals, and the trigger signal is derived via either input channel or from an external signal.

With T.V. line/frame triggering, the trigger circuit automatically ensures that frame triggering is employed at sweep speeds between 50 ms/div and 60 μs/div, and that line triggering is automatically selected on the subsequent faster sweep speeds. In this way a completely stable display of both line and frame information can be provided. When ac mains triggering is employed, the trigger circuit's operation is synchronised to the mains frequency. This mode of operation is particularly useful in thyristor and SCR work where device operation is related to the mains frequency.

Another "automation in operation" feature ensures that selection of the chopped or alternate trace mode of operation is determined automatically by the time-base setting in use. For L.F. signals the chopped mode is employed as flickering is minimized, while at H.F. frequencies the alternate mode is preferred, as any interference from the chopper frequency is eliminated.

The manufacturers claim that input overload protection on the PM 3110 is such, that on the most sensitive input setting, continuous overloads of up to 500 V and short term overloads of 1000 V can be applied. Also important is the instrument's large 8 x 10 cm. screen which permits both traces to be displayed over a reasonable amplitude, and its X-Y measurement facility that can be used at frequencies up to 1 MHz. With the PM 3110's educational applications in mind, a booklet can be provided with each instrument that enables students to familiarize themselves with basic oscilloscope operation principles and actual instrument operation.

Further details from Philips Industries Holdings Ltd., 69-79 Clarence St., Sydney, N.S.W. 2000.

HOT PANTS?

A British firm, Junex Electrix, has introduced an electrically heated coat for use in cold climates or work situations.

Battery powered, the coats have a soft, lightweight inner lining of conductive material which heats up when current is passed through it. The temperature is limited to 44.5°C (112°F) and it is claimed that there is no danger to the wearer should the garment become wet.

Two types of coat are available, one for general purpose use giving complete mobility, and a plug-in version that works from a vehicle electrical system, and is suitable for drivers.

Batteries are provided with the general purpose coat. These batteries last for 5½ hours before recharging is necessary. The batteries which weigh only 1¼lb, are claimed to be leak-proof. They are worn in a shoulder holster.

Full details from Junex Electric Ltd., 56 Queen St., Glasgow C1, UK.

EQUIPMENT NEWS

RF OSCILLATOR

Pushbutton selection, from 22 kHz to 70 MHz in seven ranges is one of the main features of a new RF oscillator from Hewlett Packard.

Seven output levels can be selected by push button, or continuously varied as required.

The model 8651A oscillator is all solid-state. Applications include antenna testing, filter and amplifier testing, and provision of calibration signals for wideband test equipment.

The manufacturers claim that leakage is less than ten microvolts thus enabling the instrument to be used with sensitive equipment.

Measuring 6½" x 11" x 7¾", the unit is suitable for bench use, rackmounting or field use.

Details from Hewlett Packard Australia Pty. Ltd., 22-26 Weir St., Glen Iris, Vic. 3147.

RADIO TELEPHONE

Weston Electronics have announced their new model 101 HF Radio Telephone for use in small craft such as runabouts, trailer sailers, etc., and, indeed, larger boats where economy is of primary importance.

The manufacturers state that this unit eliminates difficulties associated with installing radio transceivers in small craft.

The new unit has three channel capability, broadcast and loud hailer facilities. Unless otherwise ordered, it is supplied ready for single channel operation on 2524 kHz.

The quick release mounting, plug-in connections, and carrying handle, enable easy removal of the set for storage, or use ashore.

Full details from Weston Electronics Pty. Ltd., 376 Eastern Valley Way, Roseville, NSW 2069.

INTERMEDIATE POWER LASERS

A series of internal mirror He-Ne lasers with three, four and five mW power output specifications has been added to the Spectra-Physics range. The output power is guaranteed stable and expected tube lifetime is said to be over 10,000 hours.

Potential applications for the new lasers range from label reading for package identification and control, holographic data display and alignment applications.

Two models of the new lasers are available. The 134 series has an integral power supply designed for those who need single-unit portability; the laser head and power supply are separate in the 135 series for maximum versatility. Plasma tubes are also available with the same power ratings for systems use.

Details from Austronic Engineering Laboratories Pty. Ltd., 452 Victoria Street, Brunswick, Vic. 3056.

SUPERSENSITIVE CAMERA TUBE

A new intensifier vidicon camera tube, the Ebitron, with over 250 times the sensitivity of a conventional 1" vidicon is claimed to produce television pictures at illumination levels ranging from full daylight to part moonlight conditions.

This makes it ideally suited to closed circuit systems operating on a 24 hour basis. Applications include surveillance schemes in railway marshalling yards, docks and other large industrial and storage installations.

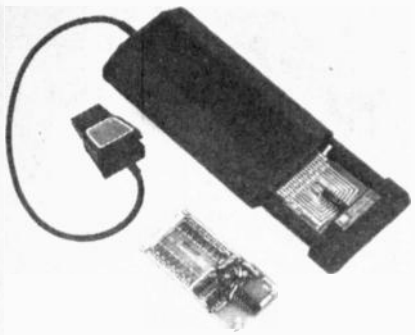
The tube employs electron-bombardment-induced conductivity in a zinc sulphide target, together with a high sensitivity photocathode. The image section is all electrostatic and the scanning portion is similar to a conventional 0.5 inch magnetic vidicon.

The length, 6.28 inches, and maximum diameter, 2.50 inches, of the Ebitron

including scan and focus coils, are no greater than a conventional 1 inch vidicon and coil assembly; it is therefore possible to fit the new tube into an existing camera.

Some additional circuitry is required for the image section but, as the image areas are the same, the existing lenses can be retained.

Further details from EMI (Australia) Ltd., Commercial & Advanced Electronics Division, 14-18 Parramatta Road, Homebush, N.S.W. 2140.



IC LOGIC COMPARATOR

A device that should be very useful in design, production and servicing of digital IC equipment is Hewlett Packard's newly released Logic Comparator.

Designated the 10529A, the logic comparator is used for locating faulty integrated circuits in malfunctioning equipment as quickly as possible. It's simple to use, self-powered, adjustment-free and requires no tools.

The logic comparator clips onto powered TTL or DTL integrated circuits and identifies any pins where the logic states don't match those at corresponding pins of a known-good reference IC. Logic differences are indicated on the comparator's display of 16 light-emitting diodes.

The logic comparator eliminates the need to correlate oscilloscope or voltmeter readings with logic diagrams.

When the comparator is clipped onto the test IC, it first connects the inputs of the two ICs in parallel. Then it compares outputs. A difference in logic states that lasts more than 100 nanoseconds, causes a diode to light. Power comes from the test circuit's power-supply pins. To tell the comparator which pins are inputs and which are outputs, the reference board containing the good IC is programmed by breaking one printed-circuit trace for each output pin. Ten blank reference boards are included with the comparator and more are readily available.

Full details from Hewlett Packard Australia Pty. Ltd., 22-26 Weir St., Glen Iris, Vic 3147.

VERSATILE REVERSIBLE COUNTER

A new electronic counter that counts forward and backward is expected to have a wide variety of industrial and laboratory measurement, data-logging, and automatic control applications, including measurements of coordinates, angular position, speed, rpm, flow rate, and temperature.

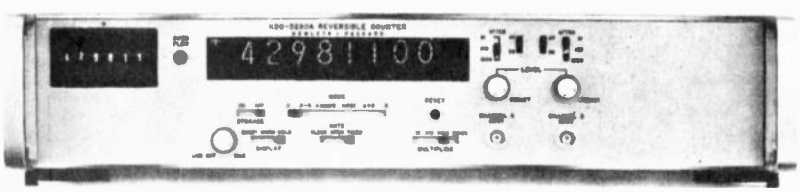
High performance and many options make Hewlett-Packard's Model K20-5280A Reversible Counter a very flexible unit. Among its options is a crystal time base with gate times of 0.01 to 1000 seconds, useful for measuring frequency (rate) and frequency difference. There's also a preset time base, useful for normalizing data to obtain readouts in gallons per minute, feet, feet per second, or other units. A third option, 'readout on the fly,' allows a measurement to be recorded while another is being made.

For limit testing and automatic control applications, Model K20-5280A can be ordered with two 7-digit thumbwheel-switch limit settings. Lamps and electrical outputs indicating whether the displayed count is between the limits (IN), above the limits (HI), or below the limits (LO) can be used to control other devices or issue warnings. Still another option provides a seven-digit thumbwheel switch for presetting an offset to be added to or subtracted from the displayed count.

The counter makes an excellent readout for linear and angular digital transducers such as optical tachometers, generator tachometers, magnetic pickups, swirl flowmeters, turbine flowmeters, proximity detectors, pressure-to-rate converters, voltage-to-frequency converters, and temperature-to-frequency converters. It has many standard features not found on most reversible converters, such as 10 MHz counting rate, built-in input attenuators, adjustable trigger levels, seven-digit display (8 optional), digital BCD output for recording measurements, front and rear inputs, six operating modes, an anti-coincidence feature to prevent loss of counts, programmable gate, remote reset, and A and B channel markers.

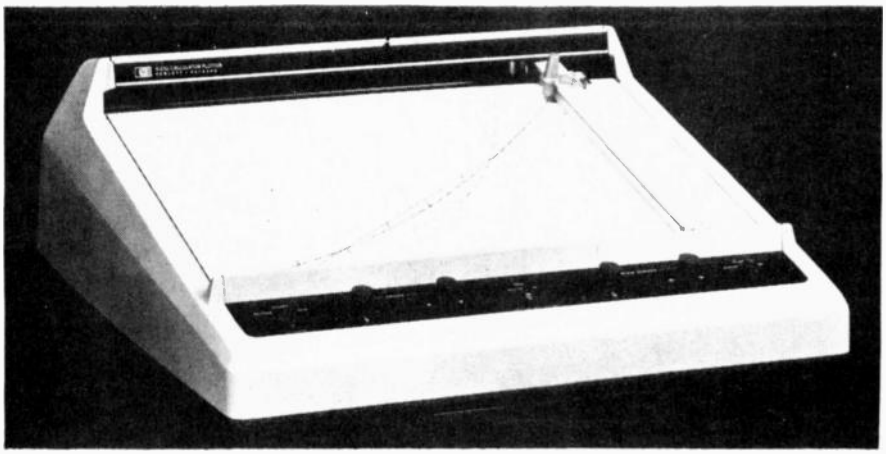
The counter has two input channels and several ways of counting the two inputs. It can count either input, or add the counts in the two channels, or subtract one from the other, or count one input with the direction of count determined by the polarity or phase of the other input. With its ability to count in both directions it can, for example, measure total flow in a system that flows both directions. Or, when measuring liquid level in a tank, it can count up and down as the tank is filled and emptied, giving a running account of the level.

Details from Hewlett Packard Pty. Ltd., 22-26 Weir St., Glen Iris, Vic. 3147.



EQUIPMENT NEWS

HIGH-SPEED GRAPHIC PLOTTER



Designed to interface with Hewlett-Packard desktop calculators, a new X-Y recorder, the HP Model 9125B, plots points faster than its predecessor, the Model 9125A. The manufacturers claim this new X-Y recorder takes only 400 milli-seconds to plot each point, resulting in significant savings of computation time.

In addition to more rapid plotting, the new Model 9125B also uses new throw-away cartridge pens. They come in several colours and are easily changed.

The X-Y Recorder uses silent electrostatic paper hold-down, which allows the use of paper of any size up to 11 x 17 inches. Continuous lines, dashed lines, dot-dash lines can be drawn on any type of plotter paper, including Smith charts, log-log or semi-log. Resolution is 500 points per inch on both axes. Plotting accuracy is claimed to be within 0.03 inches.

Flexibility of control, such as the ability to place the origin anywhere on the paper, or quickly set the scale factor, is identical with the previous Model 9125A.

Plotting programmes and a diagnostic card to check Calculator-Recorder operation are supplied. The Model 9125B plugs into the back of any Model 9100A or Model 9100B Calculator.

Details from Hewlett Packard Australia Pty. Ltd., 22-26 Weir St., Glen Iris, Vic. 3147.

PORTABLE 1500 MHz SPECTRUM ANALYZER

The 1401A-1 Module, used with the 8-pound portable Sony Tektronix 323 or 324, or most other oscilloscopes, provides complete facilities for television spectrum analysis in the 1 MHz to 500 MHz spectrum.

Amplitude and frequency calibration with intermodulation distortion of less than 60 dB of full screen is featured. A gated mode allows the 1401A-1 spectrum analyzer to be used in viewing time related signals, such as TV sync and VITS. A built-in calibrator furnishes both frequency and amplitude reference for calibrating the associated oscilloscope.

The oscilloscope portion of the 1401A-1/323 or 1401A-1/324 system retains its full usefulness, providing the user with both a calibrated spectrum analyzer and an oscilloscope system combined into a single, portable, dc powered measurement system, weighing only 16 pounds.

Design of the system provides for easy carrying and convenient viewing and access. Power may be obtained from the normal ac line, 6 to 16 Vdc, or internal rechargeable batteries. Power packs are easily interchangeable. While the 1401A-1 is specifically designed to combine with the 323 or 324, it can also be used with other oscilloscopes having a 0.2 V/div vertical deflection factor and a 0.5 V/div horizontal deflection factor.

Among the features of the 1401A-1 Spectrum Analyzer is automatic center frequency positioning in a "search" mode. At 50 MHz/div frequency span (dispersion), the center frequency automatically becomes 250 MHz, preventing an erroneous display. In "search", the center frequency control positions a negative marker to indicate that part of the spectrum which will appear at center screen when the frequency span is reduced to less than 50 MHz/div.

Details from Tektronix Aust. Pty. Ltd., 80 Waterloo Road, North Ryde, N.S.W. 2113.

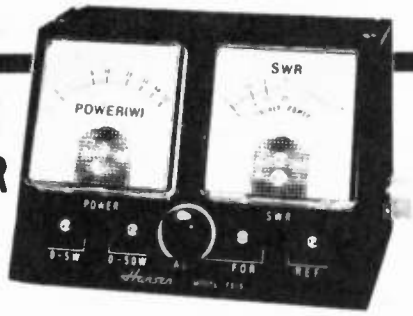
HIGH capacities... a WIDE range... AND HANDSOME cases with clear controls

THE WORLD FAMOUS RANGE OF MULTIMETERS BY Hansen

Model S-100 Tr —

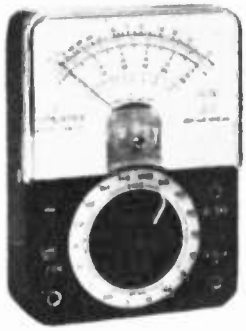
Measures AC/DCV, DC current, resistance, level & transistors • DC 100,000 o.p.v. • 3" anti-parallax scale • Shock-proof suspension & full overload protection • DC voltage 0-600V • AC voltage 0-600V • DC current 0-12A • Resistance 0-1,600 mΩ • Transistor tester measures a, β, Ico • Size 2½" x 5 1/16" x 6⅞" • Weight 2 lbs. $38 plus Sales Tax [1]

Also available: SWR-3 STANDING WAVE BRIDGE AND FIELD STRENGTH METER • Measures output power and standing wave ratio • Sensitive microammeter • Wide freq. band • Usable as field strength meter. $12 plus Sales Tax. [2]



Model FS-5 Power-SWR METER

A power and standing wave ratio measuring instrument. Measurement ranges: RF power—0-5, 0-50 watts. SWR—1-3 VSWR • Frequency response—3 mHz-55 mHz • Meters—Power, 100μA DC F.S.D. SWR, 50μA DC F.S.D. • Dimensions—6⅜" (W) x 3⅞" (H) x 4⅛" (D). • Weight 2 lbs. $28 plus Sales Tax [3]

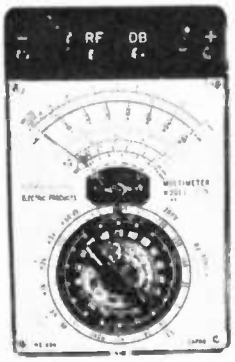


Model SU-22L [5]

Measures DC volts & current, AC volts, resistance & audio level. DC voltage 0-5000V (20,000 o.p.v.) in 7 ranges *DC current 0-500 mA in 5' ranges *AC voltage 0-1000V (10,000 o.p.v.) in 6 ranges *Resistance 0-12M ohms *Level −20 to +62 dBs. $14 plus Sales Tax.

Model ZQM-2 Transistor Checker

Tests character of all receiving transistors in ranges of a, β and Ico by direct reading scale. Suitable for PNP, NPN, RF audio switching, general and power transistors, silicon and germanium diodes. $20 plus Sales Tax [4]



Model FN MULTI-TESTER

• 20,000 o.p.v. • DC & AC to 700V • Probes to 28 kV • RF to 40V pk. DC voltage—0 to 700 • AC voltage—0 to 700 • DC current—0 to 140 mA • Resistance—OK to 0-50 mΩ. Size—6½" x 4" x 2½". $27 plus Sales Tax [6]

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MAIL THIS COUPON TODAY

Jacoby, Mitchell & Co. Pty. Ltd., 469 Kent St., Sydney, N.S.W. 2000.

Please send me details of the following instruments (place circle round applicable square).

[1] [2] [3] [4] [5] [6]

NAME.....

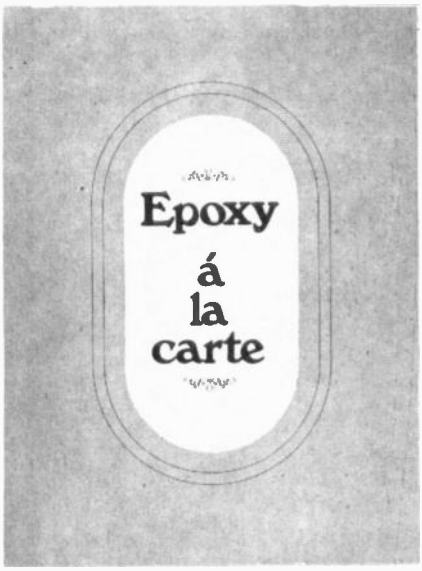
ADDRESS.....

POSTCODE.....

JM/5070ET971

COMPONENT NEWS

EPOXY A LA CARTE



Fairchild have a new menu! Featuring all those delicious epoxy dishes so popular in the past, Epoxy a la Carte lists seventeen transistors (both PNP and NPN) under the headings of General Purpose Audio Amplifiers and switches, High Speed Switches, RF Amplifiers and Audio Amplifiers.

Prices are down so that you don't have to be a gourmet to afford them.

The 'menu' is obtainable from Fairchild Australia Pty. Ltd., 420 Mt. Dandenong Road, Croydon, Vic. 3136.

ELECTROMETER AMPLIFIER

Burr-Brown have released a new line of electrometer amplifiers.

Models 3430 and 3431 are designed to minimize input bias current (0.01 pA) and input noise current through the use of a varactor diode bridge technique.

The inverting models, 3430J and 3430K, are designed for use with current signal sources where the signal is applied directly to the inverting input terminal and a feedback resistor determines the input-current-to-output-voltage gain factor.

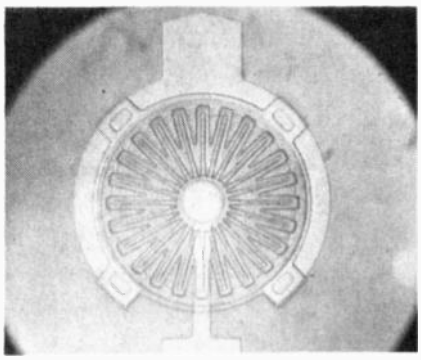
Extremely small input bias and noise currents of these amplifiers, extends their effective resolution well below the picoamp range. Typical signal sources requiring such resolution are photomultiplier tubes, radiation detectors, and flame detectors.

The Models 3431J and 3431K also use a varactor modulation principle, but are designed for noninverting applications where the signal is from a high impedance voltage source. Input impedance at the noninverting terminal is extremely high and capacitance is low. This ensures negligible source loading. The noninverting configuration is also used for long-time track/hold applications where the voltage signal source is a charge stored on a capacitor.

All models are packaged in a small, cast aluminium enclosure which provides the necessary shielding, measuring only 3.06" long x 1.65" wide x .670" high, and weighing only 3 ounces. Small quantities can be delivered from stock.

Further details from Kennelec Imports, 142 Highway Road, Burwood, Vic. 3125.

FOUR-GHz HALF WATT TRANSISTOR



A new series of transistors from Hewlett Packard combine good power output and gain, in the gigahertz region.

The new transistors, which feature a unique STAR geometry are useful in narrowband amplifiers or oscillators (common base configuration) or broadband applications (common emitter).

The manufacturers claim that the transistors exhibit unusually small variations in impedance with changes in frequency.

Full details from Hewlett Packard Australia Pty. Ltd., 22 Weir St., Glen : Iris, Vic. 3147.

HEAT CONDUCTING COMPOUND

Jermyn Thermaflow 2001 Heat Conducting Compound, can be used to provide an efficient thermal conductor between SCRs, Triacs, Power Transistors, etc., and heat sinks.

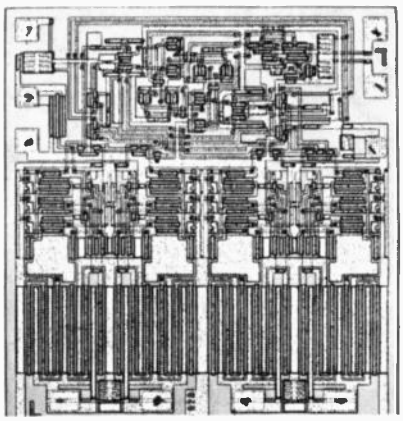
The compound, applied as a thin film between the device and heat sink, is claimed to reduce the thermal resistance by as much as 50%.

Electrically non-conductive, the manufacturer's claim it will withstand a temperature of 200°C for 24 hours with a volatility of only 1%.

Thermaflow 2001 is available in disposable syringes containing 0.5 oz or in jars containing 5 ozs.

Full details from McMurdo Australia Pty. Ltd., P.O. Box 321, Clayton, Vic. 3168.

FOUR-PHASE CLOCK GENERATOR



Societa General Semiconduttori (SGS) has produced and is marketing a new 4-phase clock generator, designated M002.

The four phases are available in a single TO-5 can, and the device offers three different, selectable modes of operation – major-major, major-minor, minor-minor.

Operating with a standard supply voltage (-27V) the M002 features high frequency (500kHz) high output voltage swing without external components and is suitable for use with either dynamic or static devices.

Full details from Warburton Franki, P.O. Box 182, Chatswood, N.S.W. 2067.

NEW LOW-COST POTENTIOMETERS

New low-cost versions of existing high specification potentiometers, a micro-miniature potentiometer for professional equipment and a commercial unit for industrial and laboratory type environments, have been introduced by Plessey.

The professional potentiometer, known as Type 94W, is only three-eighths of an inch square and is rated at one watt at 70C°. Resistance range is from 10 to 50,000 ohms.

Three printed circuit pin versions are available each having a single central hole for screw mounting. Positive end stops are provided at both ends of the travel and the wiper has a clutch to prevent damage from forced adjustment.

The new low cost commercial potentiometer, Type 32W, is rated at one watt at room temperature, derating to zero watts at 105 C°, and is of miniature size and space saving configuration.

Terminations are by printed circuit pins and a 22-turn self-locking screw-driver adjustment gives precise and stable electrical setting. Standard resistance range is 10 to 50,000 ohms.

Full details from Plessey Ducon Pty. Ltd., Christina Road, Villawood, N.S.W. 2163.

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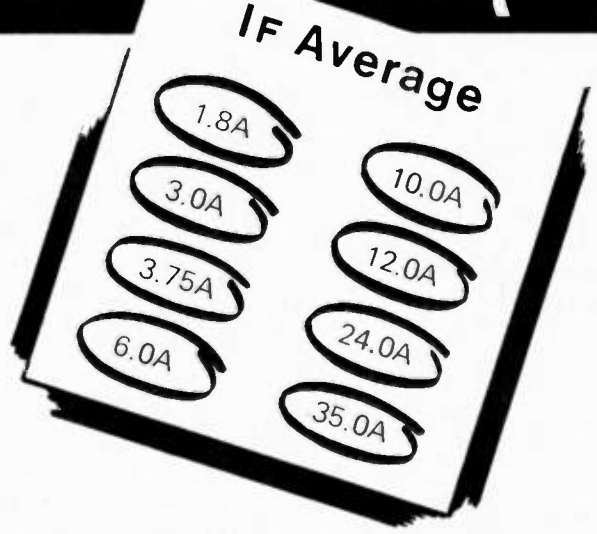
I_{FM}(Surge—Max. peak one cycle surge current (A)	40	70	200	150	300	–	–	–
I_{FM}—Max. repetitive peak current (A)	5	5	20	–	60	–	–	–
T_A—Ambient Operating temp (°C)	−40° to 140°	−40° to 140°	−20° to 140°	−65° to 150°	−65° to 150°	–	−65° to 180°	−65° to 180°
Case(pp.13-15)	D-2	D-12	D-13	D-14	(2)	D-10	D-10	D-10

(1) — Suitable safety factors — both voltage and current — commensurate with individual application conditions must be applied to the absolute maximum ratings to safeguard against voltage transients and current surges.

(2) — For D-4 Case, use "P" suffix. For D-5 Case, change suffix to "L".



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WF 1371

AUDIO NEWS

PLESSEY TAPE RECORDER EXPORT ORDERS

Additional impetus has been given to the Plessey Electronics export drive by the introduction of CT80 cartridge recorders into a further two countries in the European area.

Sales to Scotland and Holland follow closely on a recent order from Radio Hong Kong for CT80's to be used in Hong Kong's Radio City.

Designed and manufactured in Melbourne, the CT80 recorders are marketed through Plessey outlets all over the world.

These extremely flexible units are used in radio and television for pre-recorded announcements of all types.

The order from the Dutch Broadcasting Foundation in Hilversum came after successful trials arranged by the local Plessey office. Similarly, the Scottish Television order was received through Plessey in the United Kingdom, following widespread adoption of CT80's in the studios of the BBC, ITA and ATV.

PYE IN THE SKY

Pye are reported to be developing a high quality sound and vision TV receiver operating at 12 GHz (that's right – 12,000,000 MHz – !). The receiver will pick up signals directly from synchronous satellites.

The antenna system will be a simple fixed parabaloid about 18" in diameter mounted on the roof of one's home.

One single satellite would provide coverage for an area nearly the size of Australia.

EIGHT HOUR CASSETTES?

Video and audio tapes running at one fifth of present day speeds and without degradation of quality may soon be available.

They will be possible following the development of a new magnetic particle called 'Cobaloy' which the manufacturers, Graham Magnetics of Texas, claim can be applied directly to the tape.

It is believed that the new tape will cost the same as existing high quality chromium dioxide tapes – i.e., about one and a half times the price of standard iron oxide tapes.

NEW MEDIA

The recording society of Australia, now in its sixth year of existence, has produced a 'talking magazine'.

The magazine contains a balanced content of technical and general news items, reviews, club news, record reviews, a sprinkling of advertisements and advice to the tape recorder owner to assist him in obtaining optimum performance from his machine.

Editor is Harry Jay of Black Rock who is well known in Australia and overseas for his animal recordings.

Circulation is currently restricted to members and friends of the Recording Society of Australia.

The magazine which is called 'Tape News Talking Magazine' is believed to be the first of its kind in the world.

Information about the society may be obtained from Harry Jay, 5 Iona Street, Black Rock, Vic. 3193.

DIGITAL TAPE RECORDING

Auriema (Australasia) Pty. Ltd., have been appointed Australian agents for the Samuels Engineering ADAmag digital tape recording system described on page 43 of our August issue.

The system is unique in that employs an analogue to digital conversion process resulting in previously unobtainable performance levels.

AUDIO NEWS

DRAFT STANDARD FOR SOUND SYSTEM EQUIPMENT

The Standard Association is seeking comment on the first part of a draft Australian standard specification on Sound System Equipment, issued as Doc. 1798.

This draft is similar in approach and technically identical with Publication 268-1 issued by the International Electrotechnical Commission (IEC). It is to be part of a comprehensive standard on sound system equipment to be issued progressively by the Association.

The purpose of this draft is to assist in the determination of the electro-acoustic quality of audio-equipment, the comparison of various types and the determination of their practical application. The draft specifies uniform methods of defining useful characteristics and uniform methods of measurement for them.

Copies of Doc. 1798 may be obtained without charge, from the various offices of the Standards Association of Australia in all capital cities and Newcastle.

Comment on the provisions of the draft is invited from persons or organizations experienced in the manufacturing, use and testing of sound system equipment, and should reach the head office of the Association, 80 Arthur Street, North Sydney, NSW, 2060, or any branch office, not later than 31 October 1971.

ORGAN SPECTACULAR 1971

As in 1970 The Theatre Organ Society of Australia has been asked to present an ORGAN SPECTACULAR at the SYDNEY TOWN HALL as part of the WARATAH FESTIVAL.

The function to which admission will be FREE will be held on Wednesday 6th October 1971 at 7.45 p.m., and will feature the latest models of six makes of ELECTRONIC organs on stage, to be played by six top class organists.

The organs to be played will be:

BALDWIN supplied by McFarlands, Marrickville.

CONN supplied by W. H. Elvy, Sydney.

LOWREY supplied by Rees Wills, Sydney.

THOMAS supplied by Winton Music Centre, Sydney.

WURLITZER supplied by Wadsworth, Parramatta.

YAMAHA supplied by Rose Music, Marrickville.

Well known ABC TV personality JAMES DIBBLE will compere the night.

James Dibble has a keen interest in Organ Music, he owns an electronic organ and has been taking lessons from a well known Theatre Organist for some time.

Each organist will play for approximately 20 minutes and it can be expected that a wide variety of music, ranging from Pops to Classical, will be played and that there will be something to please everyone.

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5 CRO WIDE BAND PREAMP CATH/FOL
6 1966 — 3" CRO
7 1968 — 3" AUDIO CRO
MULTIMETERS & VTVM'S
8 METERLESS VOLTMETER
9 SOLID STATE M/VOLTMETER (A.C.)
10 NOISE, DISTORTION, M/VOLTMETER
11 1966 VTVM — 5%
12 1966 VTVM — 1%
13 1968 SOLID STATE VOM — 5%
14 1968 SOLID STATE VOM — 1%
15 VTVM — DIODE PROBE
16 VTVM — X10 AUDIO PROBE
17 VTVM — EHT PROBE
BRIDGES
18 1966 R.C. BRIDGE
19 1968 R.C. BRIDGE & SIG/INJ
TV INSTRUMENTS
20 WIDE RANGE PULSE GENERATOR
21 SWEEP GEN RANGE EXTENDER
AUDIO INSTRUMENTS
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23 SOLID STATE AF GEN
24 DIRECT READING AF METER
25 SQUARE WAVE GEN. 10HZ 1MHZ
26 1968 SOLID STATE AF GEN
27 ADDITIVE FREQUENCY METER
28 AF TONE BURST GEN
29 SOLID STATE AF GEN 1968
30 SCALER DIVIDER UNIT
31 CRYSTAL FREQUENCY CALIBRATOR
32 1970 HIGH PERFORMANCE AF GEN
R.F. INSTRUMENTS
33 CRYSTAL OSCILLATOR UNIT
34 S.W.R. INDICATOR
35 1966 BASIC TEST OSCILLATOR
36 SIG/INJ & R.C. BRIDGE
37 1969 SOLID STATE DIP OSC
38 SOLID STATE TEST OSC
39 "Q" METER
40 LASER UNIT (Laser Tube $178)
41 DIGITAL FREQUENCY METER — 200KHZ
42 DIGITAL FREQ. METER — 70MHZ
43 1970 GENETRACER (Combined Generator/Sig. Tracer)
44 OSCILLATOR CALIBRATOR
45 I.F. ALIGNMENT OSCILLATOR
46 100KHZ CRYSTAL CALIBRATOR
47 1MHZ CRYSTAL CALIBRATOR
48 SOLID STATE GATE DIPPER
49 HARMONIC SPOTTING GENERATOR
50 V.H.F. DIP OSCILLATOR
51 V.H.F. POWERMATCH
52 POWERMATCH FIELD/S DET
53 SIGNAL INJECTOR & TRACER
54 R.F. DETECTION UNIT
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62 TRANS-STAB UNIT
TRAIN CONTROL UNITS
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64 1967 MODEL TRAIN CONTROL with SIMULATED INERTIA
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66 POWER SUPPLY — MODEL TRAINS
67 SCR-PUT CONTROL UNIT. 1971
68 SCR-PUT CONTROL UNIT. 1971 with SIMULATED INERTIA
VOLTAGE/CURRENT CONTROLS
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93 TRANSISTOR TEST SET
94 ELECTRONIC THERMOMETER
95 FLASHER UNITS
96 SOLID STATE VARIAC UNIT
97 LIE DETECTOR UNIT
98 METAL LOCATOR
99 STROBOSCOPE UNIT
100 ELECTRONIC CANARY
101 240 Volt LAMP FLASHER
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110 INTERCOMM. UNIT — 4 STATION
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112 10 WATT BASIC AMP — S/STATE
113 25 WATT BASIC AMP — S/STATE
114 50 WATT BASIC AMP — S/STATE
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117 10 WATT SOLID STATE
118 25 WATT SOLID STATE
119 50 WATT SOLID STATE
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123 PHILIPS — 10-10 — SOLID STATE
124 PLAYMASTER — 113 — SOLID STATE
125 PLAYMASTER — 115 — SOLID STATE
126 PLAYMASTER — 118 — VALVE
127 PLAYMASTER — 3+3 — SOLID STATE
128 PLAYMASTER — 10+10 — SOLID STATE
129 PLAYMASTER — 10+10 — (Protected)
130 PLAYMASTER — 128 — 20+20W — S/S
131 PLAYMASTER — 128 — 60+60W — S/S
132 PLAYMASTER — 129 — 3+3 — INT/CIRC
133 PLAYMASTER — 130 — H/Phone Amp
134 PLAYMASTER — 132 — 45+45 or 23+23W
PUBLIC ADDRESS UNITS
135 10 WATT STANDARD — SOLID STATE
136 25 WATT STANDARD — SOLID STATE
137 50 WATT STANDARD — SOLID STATE
138 PLAYMASTER STEREO P.A. UNIT
139 PLAYMASTER 30 WATT P.A. UNIT
140 PLAYMASTER 12-240 P.A. UNIT
141 50+50 WATT P.A. UNIT
GUITAR UNITS
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143 PLAYMASTER 117 — 60 WATT
144 PLAYMASTER 125 — 50 WATT
145 GUITAR FUZZ BOX
146 GUITAR WAA WAA UNIT
147 GUITAR REVERB UNIT
148 GUITAR TREBLE/BOOST UNIT
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150 PLAYMASTER 132
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160 PLAYMASTER 120
161 PLAYMASTER 127
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163 SOLID STATE 4 CHANNEL HI-IMP
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169 S/S DYNAMIC MIC — STEREO
170 PLAYMASTER 115 — FET. STEREO
171 PLAYMASTER 118
172 SOUND PROJECTOR PREAMP
173 BALANCED MIC PREAMP
TAPE AMPLIFIER UNITS
174 SOLID STATE PREAMP
175 PLAYMASTER 110 — MONO
176 PLAYMASTER 110 — STEREO
177 PLAYMASTER 110 — POWER UNIT
178 PLAYMASTER 110 — MONO/STEREO ADAPTOR/POWER UNIT
179 SOLID STATE V.O.X. UNIT
180 TAPE ACTUATED RELAY
TUNER UNITS
181 PLAYMASTER 111
182 PLAYMASTER 114
183 PLAYMASTER 122
184 PLAYMASTER 123
185 PLAYMASTER 131
MUSICAL INSTRUMENTS, ETC.
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187 ELECTRONIC AUTO DRUMS
188 ELECTRONIC CONSOLE SOUND EFFECTS SYNTHESISER
189 TELEPHONE AMPLIFIER
190 ELECTRONIC MEGAPHONE
RECEIVERS
191 SYNCHRODYNE UNIT
192 DELTAHET — VALVE UNIT
193 ABC—3
194 ABC—4
195 ABC—5
196 3 BAND D/CHANGE SUPERHET
197 3 BAND 2
198 3 BAND 3
199 1967 ALL WAVE 2
200 1967 ALL WAVE 3
201 1967 ALL WAVE 4
202 1967 ALL WAVE 5
203 1967 ALL WAVE 6
204 1967 ALL WAVE 7
205 FET TRANSISTOR 3 — BROADCAST
206 FET TRANSISTOR 3 — ALL WAVE
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208 TRANSISTOR 1
209 TRANSISTOR 2
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217 110 Communications RX
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CONVERTERS
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REVIEWER: John Araneta

VAUGHAN WILLIAMS — ON WENLOCK EDGE; TEN BLAKE SONGS FOR VOICE AND OBOE; THE NEW GHOST; THE WATER MILL. Ian Partridge (tenor), The New Music Group of London Janet Craxton (oboe), Jennifer Partridge (piano). HMV HQS-1236. Stereo.

It is difficult to resist the haunting quality of the Vaughan Williams 1909 cycle 'On Wenlock Edge'. The songs are simply beautiful, especially 'Bredon Hill'.

Impressionistic these songs certainly are, but to me the conviction with which the composer approached these poems makes little matter of any outside musical influence on the composer's idiom. I cannot take to the 'Blake Songs', mature and more expert they may be. They seem just facile, and there is something very comfortable, even Victorian in these settings. Or perhaps it is because I much prefer Britten's own cycle of Blake songs and cannot accept Vaughan Williams' way. The texts to 'The New Ghost' and 'The Water Mill' are bad but Vaughan Williams' settings are certainly in par with 'On Wenlock Edge.'

Ian Partridge sings movingly although he does bring off some inaccurate vowels. This, however, is a minor quibble in the face of distinguished work from everyone concerned.

Recording is good except for slight distortion in 'On Wenlock Edge.' – J.A.

VERDI-LA TRAVIATA. Soloists, Chorus & Orchestra Rome Opera, Monteux (cond.) RCA Victrola 6004. Mono.

At the time of its first issue in the fifties, this set seemed the best available of four existing Traviatas. The Tebaldi (DECCA) boosted splendid singing from the soprano, good recording, but a woeful Germont (Poggi). Maria Callas on CETRA seemed miscast to many, and in case you did not think so, the rest of the production was less than routine. Another RCA effort, the Toscanini Traviata was usually considered the best set to have were it not for its Studio 8-H sound. With this set one could at last have good sound, a fine Metropolitan cast, and the rare privilege of a great conductor at the helm.

Some twenty years after, we can no longer afford to be as generous about this recording when the Caballe, de los Angeles, Moffo, Sutherland sets are around. There is, after all, some very strained singing here, specially from Rossana Carteri (Violetta). Leonard Warren (Germont pere) sings beautifully it is true, but as with the rest of the production, there is a very crude and unsubtle idea of the opera, that governs every performance in this set. It is noisy in an old-fashioned opera way. I feel the newer sets are not without their own kinds of vulgar feeling, but they also display a greater overall care and a subtler sense of drama.

RCA has managed to reissue the set on just two records, with box and text and at a very low price ($2.55 a record). The sound is very fine straight monophonic (Why are the older Toscanini sets in stereo?) It does seem unkind to quibble further and this is the best Traviata at a reasonable cost. – J.A.

JOHN TAVENER — THE WHALE. Anna Reynolds (mezzo-soprano), Raimund Henricx (baritone), Alvar Lidell (speaker), John Tavener (organ & Hammond organ); London Sinfonietta & Chorus, David Atherton (cond.). APPLE SAPCOR-15. Stereo.

Very good. But having listened to this record just six times now I still cannot resist the thought of finding something wrong here. Is it because there is just nothing notable here? Everything just right. John Tavener is certainly aware of every technique and device that can be used to good effect. Penderecki, Webern, anything you please, even Vaughan Williams. This is the sort of piece a conservatory dreams of getting from some graduating student. It would be unfair of me perhaps to say I should wait and see if Tavener's other work is as good. Again, lest I be mistaken there is nothing extraordinary here.

If this piece is an indication, Britain has once more produced a good eclectic, conservative composer. Tavener uses the fashionable device of combining different layers of sound. Nothing scientific here except perhaps the spoken introduction. No real whale sounds. Jonah in very high Anglican Latin. Performance is very good. Recording is fine but three copies I heard had surface noise always in the same spots. – J.A.

NEW MUSIC OF CZECHOSLOVAKIA Lubos Fiser — 15 Prints after Durer's "Apocalypse" Jan Klusak — First Invention Vladimir Sommer — Vocal Symphony. London Symphony Orchestra, Igor Buketoff (cond.) (in the Sommer: Nancy Williams (mezzo) Peter Ustinov (narrator) Ambrosian Singers. RCA LSC-3181. Stereo.

Nothing on this record is new in the sense of a Cardew and only one piece is good, but that piece, Fiser's '15 Prints After Durer's Apocalypse' is well worth the price of this record.

To judge from '15 Prints', Fiser (b.1935) is what one could call a conservative modern, showing especially the influence of Honegger and Webern. But this piece is very effective indeed, and frightening. It would seem that no matter how many times one listens to it everything "happens now" and there is still an inevitable feeling to it all. Igor Buketoff's performance is superb.

Jan Klusak's 'First Invention', like everything on this record displays the notable influence of Honegger. Unlike the Fiser and despite its brevity, this Invention is tiresome and trite.

Vladimir Sommer's Vocal Symphony is "protest", morbid, violent, too long and bad. Its first movement, a setting for mezzo of Kafka's "Nachts" is not notable and unfortunately sung in an English which makes obvious nonsense of rhythms patterned after Mussorgsky. A setting for narrator and chorus of Raskolnikov's Dream follows: "Harsh, inhuman reality" a la films these days, corny and again not helped by the English and by having recorded an Ustinov bored and loud enough to eliminate orchestra and chorus.

But it really is the music which sounds astonishingly puerile. Sample: "Raskolnikov has a horrible dream!" (Ustinov) as the chorus shouts: "Dream, dream!". This stupidity is followed by another mezzo setting of Pavese's fine poem "Death will come" which turns out to be pure mush.

Mezzo Nancy Williams sings well while the chorus I suppose could not help sounding silly. Recording is excellent except in the narrator/chorus section of the Sommer.– J.A.

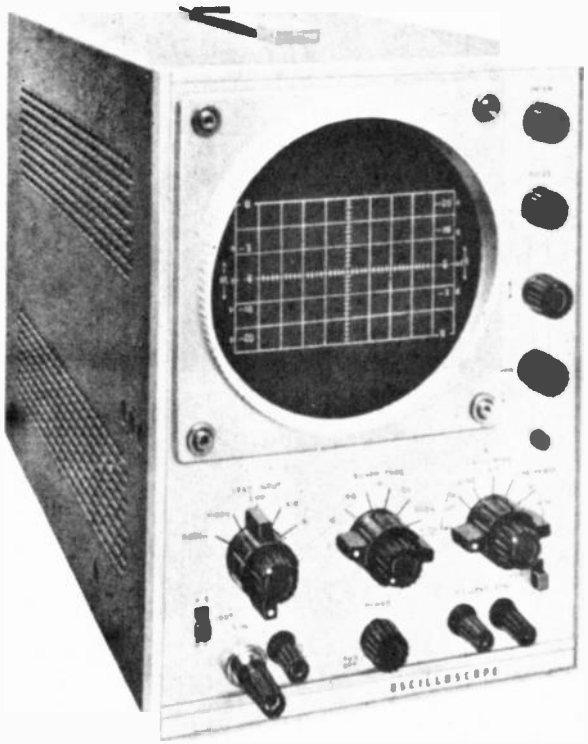
TCHAIKOVSKY — SYMPHONY No. 4 Barenboim, New York Philharmonic CBS SBR-235432

In its original American and English format this record comes with "conductor's", actually a miniature score of the Tchaikovsky Fourth Symphony. We are mercifully spared that in this country.

Barenboim conducts the New York Philharmonic. There should be nothing strange about instrumental virtuosi taking to

University

INTRODUCES THE NEW MODEL UC 5 OSCILLOSCOPE



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CLASSICAL

the baton – the entire history of conducting is replete with examples. One thinks of Bulow and Liszt for instance. Nor is Barenboim's age the problem here. Bulow was even younger when he commenced his career and this is true of most conductors.

The New York Philharmonic, like the Vienna, has always had a reputation for arrogance and hostility towards conductors, and not even a seemingly exceptionable Bruno Walter was safe from occasional flippancy from both orchestras. But after all, taking up the baton is an act of superiority, a challenge to musicians of an orchestra. An orchestra may play under anyone, it means money, especially during recording sessions, but as one member of the New York Philharmonic put it, "It took four or five years for Bruno Walter to realize he had nothing to teach us." The fact that Walter could make the New York Philharmonic play superbly is beside the point. Under a lesser man results may hardly be dazzling.

It is often hair-raising to know about orchestras' opinions of the so-called great conductors. There are perhaps a handful of conductors today who are exempt from condescension from orchestras. Stokowski, strange as it may seem to most listeners, is one such.

Well, here is Barenboim and the New York Philharmonic in the Tchaikovsky Fourth. It need hardly be said that we have little need of another Tchaikovsky Fourth, and pace the advertisers I have several and do not need another second rate one. True, there is no great Fourth on records, and a pity, because it is an important work.

This is quite simply a pretentious performance. To begin with, why Tchaikovsky? Well Tchaikovsky is very virtuoso and any conductor worth his salt would love to do some, especially the Fourth Symphony.

It is the sort of work that can have an audience cheering spontaneously at the end because it is exciting, colourful, and like a great deal of Tchaikovsky, difficult. Indeed few conductors today do it justice. Either Barenboim, or the producers concerned with a new "image" for classical artists, has succumbed to the lure of conducting Tchaikovsky.

This record certainly accentuates Barenboim's image as a conductor and as an artist of many parts, but at least from the evidence of this record, Tchaikovsky for him does not mean the originator of a unique sonata form in music, but merely moods and languors strung together.

Listening to this record I felt the New York Philharmonic had once more condescended to play a Tchaikovsky Fourth with Barenboim. Note how off, orchestral balance is, in even the opening motto statement. Trumpets too loud, timpani almost always imprecise. Comments have, of course, abounded about how like Furtwangler this or that section is handled. Yet, the opening of the Moderato con anima in the First Movement has all that quiet quality in the strings that Furtwangler used to achieve, but where else is it? There is not even a consistency in this performance of mannerisms belonging to this or that conductor. Most animated passages are carelessly played and a listening of both First and Fourth Movements will clearly show how amateurish Barenboim's sense of rubato is. Only one movement is done fairly well and that is the second movement. Elsewhere it seems Barenboim has not had the time to see the Symphony as a whole,if very contrasted,work. A dash here, cantilena there, and finally the rush to the finish.

Once again Tchaikovsky has been cavalierly treated, and Barenboim seems one of those many these days who think Tchaikovsky is fun to do and display for their private purposes, and never mind the music that a Stravinsky could hold very highly. – J.A.

GLUCK — ORFEO ED EURIDICE: Complete Orchestral Music Rome Opera Orchestra, Pierre Monteux (cond.) RCA Victrola VICS-1435.

The performance here of orchestral excerpts from Orfeo (including the Act III Ballet) is presumably taken from the complete recording of the opera once available on RCA, featuring in addition to Monteux, Rise Stevens (Orfeo) and Lisa della Casa (Euridice).

As in the case of their later recording of Orfeo, RCA has wisely chosen to issue a separate disc containing the orchestral sections of the opera, including the overture and Act III Ballet. This serves two purposes: first, quite a number of people do like sections of the opera such as the Dance of the Blessed Spirits and do not necessarily wish to take the opera; second, a number of fine recordings (the DGG for example) omit various orchestral numbers, while the Third Act Ballet is even more rarely included in performances or recordings of the opera.

With two recordings of the orchestral music on RCA, I must regretfully say that neither this Monteux performance nor the later one under Fasano can serve as more than a stopgap in the catalogue. To tell the truth, Monteux's conducting on this record belies his reputation: there is far too much ragged playing and the final sections of the final ballet are beset by unbelievably bad intonation from the strings. Recommended only for those who must have this music at any cost. The Victrola transfer is very good indeed. – J.A.

MONTEVERDI — Combatimento di Tancredi e Clorinda, 5 Madrigals. Soloists, Leonhardt Consort, Gustav Leonhardt. TELEFUNKEN SAWT-9577-B. Stereo.

Performance of early music on original instruments can be not only revealing but very successful indeed as the TELEFUNKEN recordings of the Bach Musical Offering, Monteverdi Orfeo and Vespro clearly show.

Performed with original forces, a fine Combatimento would have given us a better picture of why this work is so important historically. I wish I could say this performance was in the same class as any of the above recordings. Director Leonhardt at the cembalo is merely content to outline his part and while the singing is mostly accurate enough, one must also admit that it is also quite apathetic. The very character of the voices employed here contributed to the colourless quality of this performance.

Nelly van der Speeke as Clorinda has a darkish hue to her voice which I find inappropriate to the music: note how ordinary the work's sublime ending sounds here. Nigel Roger's voice (Tancredi) is not very unlike Max van Egmond's, whose singing of the all-important Testo or narrator is just straightforward.

Combatimento is a dramatic work, it is also Italianate but this performance seems unaware that Monteverdi proudly talked of this work as being capable of depicting "wrath and indignation" where music previously seemed "an imperfect art-form, for only the gentle and the moderate could be expressed." TELEFUNKEN engineers have not helped matters by giving this disc a muffled acoustic and not inconsiderate amount of distortion.

Curiously enough, the performances of the Madrigals on the reverse side with no string accompaniment (is this perhaps significant?) are more enthusiastic and stylish, and at the end of the side is the finest performance I know of the Lamento della Ninfa, really the beautiful "Amor, dicea, e'l ciel" from the eighth book of the Madrigals, performed here with the original prologue and ending, the words of which are curiously not included in the texts enclosed with the record. – J.A.

VAUGHAN WILLIAMS — A Sea Symphony. Isobel Baillie, John Cameron, Sir Adrian Boult. London Philharmonic Choir and Orchestra. DECCA ECLIPSE ECS-583.

The Sea Symphony is not exactly a work I would recommend someone spending close to twelve dollars on, not even myself, and I do have a very soft spot for it. I quite remember growing up with the original pressings of this performance and over the years I have never been able to forget various sections from the work, in particular, On The Beach at Night Alone. Nevertheless, having lost those records, I have hesitated acquiring either this same performance even in its Ace of Clubs incarnation or the really splendid recording again by Boult on HMV ASD-2439/40. (The single disc Previn performance on RCA I cannot consider in the running at all.) Let us face it: Parry's, or rather Vaughan Williams; setting of Whitman is hardly on the same level as Delius in Sea Drift. Not the same texts you might say, but there is a greater subtlety about in Delius' work, a closer affinity to Whitman's intentions and spirit. Also, to be quite honest, this Sea Symphony, whatever fine moments it has, does sound like something by Parry, albeit Parry's finest effort.

At $2.59, however, and in really skilful electronic stereo I cannot possibly resist this record. The performance stands up very well alongside the same conductor's more recent recording and has even, it seems to me, a greater gusto. Both these performances are very fine and for those more completely sympathetic to this music I suppose the finer stereo on the HMV discs will mean much more than it does to me. This performance was originally coupled in its two disc form with the Overture and Incidental Music to the Wasps. Wasps, also coupled with the Sea on HMV is truly fine Vaughan Williams, certainly finer than Sea. Let us hope DECCA will give it back to us on some label like ECLIPSE. – J.A.

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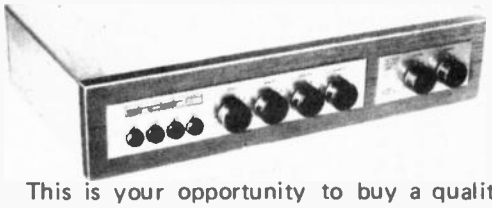

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RECORDINGS... JAZZ

REVIEWERS: John Clare, Merv Acheson.

'Live At Redlands University'. Creative World Inc. Hey Jude, Artistry In Rhythm, Here's That Rainy Day etc. Stereo ST1015.

Stan Kenton sent us this double album for review. It can only be obtained through the CREATIVE WORLD, Box 35216, California 90035. There are a lot of Kenton fans in Australia, and news of other available Kenton albums, of which they are starved at the moment, can also be obtained from the above address.

It was recorded at Redlands University before an audience of music educators. At first listening it knocked me right over, so much so, that I wrote back to say how much I liked it, which puts me in a slightly embarrassing position right now. It's not quite as good as it seemed on first hearing. The excitement tends towards the 'surfacey' quality which makes Benny Goodman's 'Sing Sing Sing' for instance sound pretty farcical these days, while good Andy Kirk or Basie or Ellington of that period astonishes with its immediacy and strength.

To put the record straight there is nothing here anywhere near as bad as the terrible solos Goodman and James take on 'Sing Sing Sing' (one wonders even as Goodman gets through his snake charming waffle and James his disjointed collection of devices from an advanced trumpet tutor when they are going to get into it) nor as superficial as the Broadway-Jazz sound of the Goodman Brass. It is probably the loosest and at the same time the most intense Kenton band on record, and it gets as near to really swinging as practically any white band I have heard.

Stan Kenton has done some pretty uninteresting things in the past: ridiculously heavy and exaggerated climaxes at which one can only raise an eyebrow and say "Very clever, Stan." There were things which really impressed me as a lad – the way he had of making the trombones play a line staccato and then repeat it legato – which now strike me as superfluous demonstrations that there are more ways than one to play a phrase. Perhaps a feeling of being fooled made many of us turn vindictively against Stan Kenton. I think the time has come to have another look at everything he has done. I think we might find that it has quite an important place.

Many of the old sounds are on this recording, and how pleasing some of them are. The cool vibrato-less reeds, alto-led, melancholy, peaceful and singing on 'Here Comes That Rainy Day'. Tenor-led, languid and ominous, almost feverish on 'Artistry In Rhythm'. The huge-toned yawn of the trombones. The deep still pools of harmony and the almost terrifying swell of the band as dissonance mounts on dissonance.

The recording has an open air feeling, although the cover shots indicate that it was made in an auditorium, and the trumpets have that particular search that they take on when blown flat out from the diaphragm in the open. They are also a deal less precise than some of Stan's old trumpet sections. Top notes of a chord which Ferguson, Candoli or Childers would have knocked off with no trouble at all, here squirm around a bit before finding the slot. This could have something to do with that open air feeling which makes pitching a little difficult. At the same time they are more voicelike, more like a wild gospel choir, more jazzlike – even employing the loose falling glissando of the Count Basie trumpet section, although they are a long way from getting the beautiful limp fall of Basie's men (I remember watching the two trumpeters on the end of Basie section sitting down together in slow motion at the end of each brass passage as the glissandi rained down about them).

One thing that struck me was the slowness with which this presumably very musical audience identified 'Artistry In Rhythm' from Kenton's piano introduction, which dropped plenty of clues. Then, they are a very young audience, and this is one of the heartening things about the recording. Apparently Stan is doing very well on the college circuit, and small wonder. Apart from his own energetic and intense presence and the truly devastating sound of the band, they do things with such tunes as 'Hey Jude' which make the original versions seem insipid. This is the most exciting track rhythmically. The bass player alternates between the rock idea of repeated riffs and the high tension continuous walk of late jazz. The percussion often gets into a Latin thing and it really begins to hum in a few places. They employ the four bar, four chord repeating figure at the end, against some wild collective improvisation by trumpet, trombone and occasionally, tenor.

There are some really great sounds on these two recordings, and a lot of excitement, even if it is not to my mind the deep rhythmic excitement of great jazz.

For a live concert the sound is exemplary. I commend it to the Daly Wilson band. – J.C.

CHARLIE PARKER 'Jazz at Massey Hall' Liberty. Charlie Parker, Dizzie Gillespie, Bud Powell, Max Roach, Charlie Mingus. "Salt Peanuts, Hot House, Night In Tunisia, Wee Perdido, All The Things You Are." Stereo SLYL - 934073.

Subtitled 'The Greatest Jazz Concert Ever' this remarkable recording has been available in mono on the SAGA label.

At the same time of its previous release I wrote in Music Maker magazine about the surprising lack of interest in it shown by Australian jazz writers. Festival, perhaps sensing that these writers would not want to be caught with their pants down a second time, have reissued it on the Liberty label, and it has so far received the acclaim it deserves. However, it seems that it's almost impossible to procure wide sales these days for any recording that does not bear the magic word 'stereo'. Accordingly it has been rechanelled. The recording level is now higher so that it will have more impact than the original recording played at the same volume (turn the original up and you cancel that out); the trumpet and alto have been given a false overbrightness which slightly obscures true instrumental timbre. One other factor should be noted. Charlie Mingus recorded the concert, which took place in Toronto's Massey Hall in 1953, on his own tape recorder. He recorded it very well too, all except for his own bass part, which he re-recorded and dubbed in at a later date.

The main thing is that you can clearly hear everything that is going on, and it is all well worth listening to again and again. I don't know about its being the 'greatest ever' but it certainly has some towering moments. The least exciting track is 'Perdido' on which ironically, Dizzy Gillespie resorts to the most unsubtle crowd-stirring devices. Parker's solo is full of odd gaps of about two bars duration, and it keeps fluctuating in intensity, giving the impression that he is going off into his own little world. Dizzy picks up Parker's last phrase and does not develop it. Bud Powell is by far the most interesting soloist on this track.

'Salt Peanuts' is a different story. The classic bop unison passages are played rather raggedly, but the whole thing is terrifically aggressive and exciting. Parker just bristles through his eight bar break and tears into his main solo using his dirtiest and edgiest sound to shake off Dizzy's vocal interjections. "Salt Peanuts! Salt Peanuts!" Dizzy yells and Charlie stabs variations of the phrase back at him before taking flight. Listen to Max Roach kicking away at his bass drum – tromp tromp bam! – while his cymbals race. The bass drum cuts out during Bud Powell's solo. Bud is doing all that with his left hand while his right piles phrase after phrase up on top of the beat until it

JAZZ

threatens to collapse. Dizzy follows Parker and it is to his credit that he does not lose any of the intensity. Now that Louis, the King is dead, Dizzy is probably the greatest living jazz trumpeter. He articulates here with bewildering speed and accuracy, building up all the momentum possible at one level. then without setting himself, without a fraction of a second's pause, leaping up more than two octaves to continue flying at that level.

'Wee' and 'Hot House' are less aggressive, but just as intense and satisfying. Listen to Parker, Gillespie and Powell in turn moving through the harmony. There is an extraordinary moment near the end of 'Wee' when, after Max Roach's long and complex drum solo, Gillespie and Parker drop out of the blue back into the theme in perfect unison. Gillespie takes Parker's quote from 'Carmen' in 'Hot House' and hurls it at the sky before spilling down in a graceful accelerating cascade. Rather like a man who throws a handful of coins into the air and catches them as they fall, thrusting them with ever increasing rapidity into innumerable vest pockets.

I suppose the highlight of the record is Charlie Parker's four bar lead-in to his solo on 'Night In Tunisia'. The rhythm section drops right out while Charlie describes a beautiful arc, first accelerating and then retarding the beat, but landing in the right spot at exactly the right time. Max Roach's socking accent comes as a delicious release.

'All The Things You Are' is a rather intriguing performance. The piano sounds at first as though it is out of tune to itself, but it is really in very tenuous relationship to the other instruments. Sometimes Powell plays chords which are related both to the key they are in and another key, so that it sounds as though he will modulate, but he stays as it were in no man's land for a while and the effect is almost atonal. There is some quite insane interplay between Gillespie and Parker near the end, sometimes quarrelsome, sometimes showing great rapport. What's going on? Who knows?

A great record. – J. C.

NANCY WILSON "But Beautiful"; Hank Jones, piano; Ron Carter, bass; Grady Tate, drums; Gino Bertachini; guitar. 'Happiness Is A Thing Called Joe, Oh! Look At Me Now, Glad To Be Unhappy, Do It Again, But Beautiful, Prelude To A Kiss, I Thought About You, For Heaven's Sake, Supper Time, I'll Walk Alone.' Capitol, Stereo ST-798.

As the fame of the ELECTRONICS TODAY review section spreads, we find ourselves the grateful recipients of recordings which are yet to be released in this country and others of which we would otherwise never hear.

This recording was given to us personally by Nancy Wilson while she was in Australia, and it is probably still the only copy in the country. It will definitely be released here, and if I can speed the process up in any way, I will. Keep an eye out for this, and we will give you a reminder when it appears. Sure, there are lots of Nancy Wilson albums about, but not like this one. For the first time in ages Miss Wilson is singing with a small group of top jazz musicians, and she is infinitely more relaxed and inspired than she has been on her more commercial recordings.

There are no bad tracks, but two stand above the others. On 'Supper Time' and 'I'll Walk Alone' (undoubtedly the definitive version of a song I'd previously thought little of) she shows that she has the ability to consume the listener with her power, imagination and feeling.

Nancy Wilson has first and foremost the most extraordinary sense of dynamics.

What fails to come over on most of her records is the use of crescendo and diminuendo which is so striking in her live performances. Add to this an almost peerless control of intonation: I love the way she holds those long notes as tautly as the prolonged tines of a tuning fork, sharpening the note gradually until it snaps and she spills out the top of it with a little gasping crying curlicue.

What finally sets her apart from almost all dramatic and emotional singers – apart from the absolute greats like Sarah Vaughan, Carmen MacRea and Nina Simone – is her economy of means. She does not just throw it around. She doesn't overdo it.

Sound is excellent. I hope the same can be said for the Australian pressing. Great record. Watch out for it. – J. C.

CANNONBALL ADDERLEY QUINTET "The Price You Got To Pay To Be Free" Stereo. Soul Virgo, Rumplestiltskin, Inquisition, Pra Dizer Adeus, Exquisition, Painted Desert, Directions, Alto Sex, Bridges Etc. Double Album. Capitol SWBB 636.

You can expect a Cannonball record these days to contain something borrowed, something blue, literally, a bit of hokum, some fine happy jazz from Cannonball, some very black piano from the white Joe Zawinul and sometimes some very mean and exciting trumpet or cornet from Cannon's brother Nat.

On this double album there is a little bit too much hokum, some poor vocals from Nat's son (Nat Jr.), who may yet develop into a singer, too many Miles Davis imitations and not enough Nat from Nat, and some towering jazz from Cannon, Joe Zawinul, Roy McCurdy and sometimes Walter Booker, which makes up for everything. Let's forget the vocals, though Cannon and Nat, particularly Cannon, give some indications that they could be very good singers if they really concentrated on it and gave some thought to what they really wanted to sound like. Cannon cannot make up his mind between Nat King Cole and Johnny Mathis, and he's terrifically erratic in the upper register. Sometimes he had me rolling about the floor. On 'Together' Cannon and Nat are supposed to be singing harmony behind Nat Jr., and I think it is Cannon who misses by a mile at one point. Bad luck Cannon. If you want to sing well you've got to put a lot of work in on it, just as you do on saxophone.

Back to the jazz, 'Soul Virgo' is pretty typical of what the Adderleys do these days. They start with a repeating bluesy figure in the bass, the drums keeping up a steady medium fast ching chuka chooka Chuka CHANG chuk a chooka chuka, the electric piano drifting over this funky shuffle with both earthy and ethereal chords, little clusters of notes of indeterminate tonality which distract from the repeating thing going on beneath, occasional accents which emphasise both the repeating harmony and the rhythm. They hold this long enough for it to be established in your head and then the bass and drums begin to get as free as the piano until Nat and Cannon come in with a unison-harmony riff on alto and trumpet to smooth over the brief turbulence. Then they each have a solo. It's a more limited, more 'commercial' if you like, version of what Miles Davis has done on 'In A Silent Way' and 'Bitches Brew'. However, it's highly enjoyable: a continuous flow of both harmony and dissonance of the earthy and ethereal.

Cannonball's solo is by turns fiery and relaxed, loose and precise. Just when you think he's going to ride the rest of the way on nice easy, very danceable blues phrases, he snaps it all together and executes a few razor sharp rapid fire figures which quicken the pulse. A buzzing soprano sound creeps into his low notes and he plays the soprano quite nicely elsewhere.

Nat plays a cadenza which leads into the next track 'Rumplestiltskin', on which he imitates Miles Davis from the 'Sketches Of Spain' and 'Porgy and Bess' period to the point of embarrassment. Actually it's quite enjoyable, but a little pointless if one has the originals on hand. A few phrases of Nat's own crop up, reminding us that he has got something distinctive to say, and when it comes to blowing trumpet in a spontaneous, swinging way, he is one of the best.

His sound on this recording is not so fine as it can be, so all in all I don't think that it was Nat's day. He is obviously trying to get a certain sound quality by letting a lot of air escape through his nose, but it probably got to be too much of a habit on the day and he never seems able to seal it all off and smack those brassy notes right down the middle.

If Nat is off, Cannon is right on, larger than life, on 'Alto Sex' and 'Out and In'. He is nothing if not eclectic. Traces of Roland Kirk and Ornette Coleman have now entered his playing, but he still sounds like Cannonball. What a sound he gets. He swings like all get out, and he has that quality I can only describe again as larger than life.

Bassist Walter Booker impresses at first with his flamenco figures, cross rhythm popping and long elastic slurs, but one begins to wish that he would walk a bit from time to time right on the beat.

I suppose you would have to call this a pretty mixed bag, but it all has a good funky atmosphere, and there are parts which are very good indeed. The sound is very good for a live recording. There is just a hint, particularly through earphones that some resonance may have been added, though this could be explained by the 'live' ambience. – J. C.

BOB DYLAN BRINGS IT HOME

ACOUSTICALLY, it's a mess, like Sydney's old Stadium. And for the same reasons; too much corrugated iron and too many watts output for the good of the music itself.

On Musseltree Street on the outskirts of Tamminyville, Tennessee, there's an old shed-like structure that looks as if it might collapse under the weight of a full-width sign stretching across the sagging roof: THE ORIGINAL JUKE'N'JIVE JOINT. A half-sane hairy WASP gorilla serves coffee with his bunioned elbows and greasy outlook and swaps rotton-toothed grins and chuckles with the local cats who come in to talk about the good old days when "Nigras knew their place".

He's white, but his soul's still black — in a sense.

Just down the road about a country mile, is a badland farm with thirty sickening chickens and a dozen memories of travelling salesmen and a dozen vanished daughters and a couple of broken-stringed guitars and an autoharp lying on the back porch of the shack.

In the other direction, up by the bend of the river where the riverboats used to pass there's a place called Golddust, a very myopic settlement squinting over the Mississippi at Arkansas. A little man sits in his backroom late at night flipping through a bundle of wafer-thin single-play records he's just received from the agency in Memphis, downriver a few miles. He's got the general store with three revolving racks of Top 100 hits. They come in covers with coloured pictures of the artists on front and back. They wear out after about a hundred playings, reducing to a constant SSSCCRRTTCCHH. But he doesn't give a goddam. Most of them get sold, and anyway if they don't he's got 'em on sale-or-return and the man from Memphis'll come 'n' pick 'em up . . .

This is Dylan country now.

Zimmerman rides again.

Robert Allen Zimmerman, as you may have read in TIME magazine recently, is considering changing his name back to the original. He was born in surrounds like Tamminyville and Golddust, only farther north, in Minnesota in a little mining town, thirty years ago. He went out in his teens, a sort of folk singer, and took New York by storm at the rise of the protest song movement in the very early 60's. He went up and down and in and out of studies, concerts, tours, quotes, reports, songs, poems, instruments, mythology, a motorcycle accident, seclusion in the country, and burst back into the cities a little while back. But when he rejoined the urban scene he was singing and writing songs of strong country flavour, just like the old days. Bob Dylan has really brought it all back home.

And yet, about eight years ago, with songs such as "Blowing in the Wind", "Oxford Town" and "The Lonesome Death of Hattie Carroll" to his credit, he would have been lynched by the gorilla of the JUKE'N'JIVE, the chicken farmer, and the Golddust storekeeper.

As it is; gorilla whistles flat to the choruses of "Lay Lady Lay" from Dylan's "Nashville Skyline" album as he washes the coffee cups in yesterday's sink water. The jukebox runs hot and loud.

And from inside the chicken shack, as he unhitches the leather strap securing the gate, travelling salesman number thirteen hears strains of homegrown music — old Dad Foster is sitting in his rocker by the stove, strumming a debro and singing in broken tones and broken lyric lines, "Days of '49", a song from Dylan's recent double album, "Self Portrait". The song reminds him of his own father who really did live that song, around the Yukon in the rush days of 1896. This old farmer is *identifying* with a Bob Dylan song! He's just 'poor white trash', the kind of man epitomised in Dylan's song, "Ballad of Hollis Brown" from his album, "The Times They are a-Changin'", back in 1964. Hollis Brown was so poor he was reduced to a wealth of seven shotgun shells and a dead farm. He took down the shotgun and killed his five kids, his wife and himself — to keep them from starving.

The Golddust storekeeper has, without even knowing it, put two new Dylan singles into his stock out in the racks. Lester Maddox was such a man — probably still is. Maddox hit Negroes on their backs when they wouldn't get out of his store back in the days when sit-ins and freedom buses rode the highways of the South.

He became Governor of a whole state! About the time everyone was singing Dylan's "Oxford Town", a song of indictment of the treatment of blacks below the Mason-Dixon line.

Though many have scoffed at Dylan's oft-quoted album title, "The Times . . .etc", it's true. They have. Actually his album titles tell many tales in themselves. He really has led a "Freewheelin'" life through popular music, drawing on whatever source, whatever influence has involved him or interested him at any particular stage. The choice of material on his second CBS album, "The Freewheelin' Bob Dylan" did indicate that he was unafraid of being labelled.

In 1965 he came onstage at the Newport Folk Festival and started a whole new generation of Dylan lovers with his "folk-rock" music — his new songs no longer screaming at prejudice and inequity quite so bluntly, and backed by strong electric instruments, where earlier he had stuck mostly to his own acoustic guitar with little support from others.

He lost a lot of fans that day too. Far from being deterred by that he forged on, won many of them back, and broke through several more barriers to reach the point where he could sing, write, record what he liked with no fear of reprisals from critics or fans.

When he reached the end of his folk-rock after "Blonde on Blonde" had been recorded and he had toured the world, including Australia, Dylan took to the hills. We don't hear too much about it, but we've been able to piece it all together anyway. He had a bad accident out on some highway and bought some property up in New York State in a town called Woodstock. There he settled with his wife and children (we don't hear too much about them either, a credit to him that there has been no capitalisation here) on a small farm, not far from "Big Pink", a modest pink house that contained a studio, and the home of five men who trade under the name of The Band.

And this is where Dylan — or Zimmerman — we knew today really

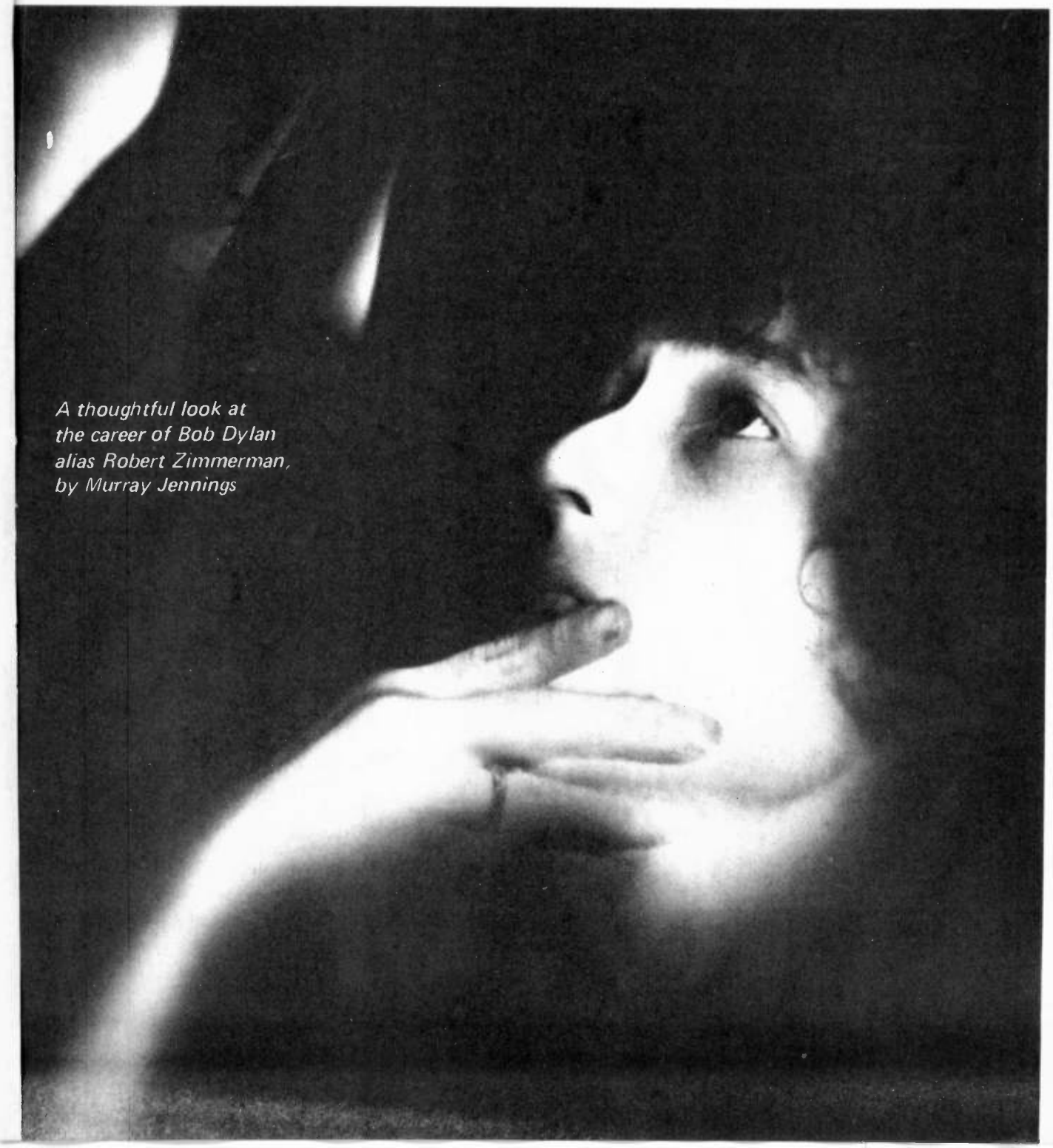
started out. There are so many temporary truths about Dylan that it is foolish to state too much about him today for fear that one's descriptions and critiques look ridiculous next year. He keeps changing course midstream. If he were to do it maliciously though, I could understand the vehemence with which certain immovable writers, critics, reviewers, et al have attacked him at every turn. The total unpredictability of Dylan and his work makes him the true "enigma" that those people criticise. To me it is this that renders Dylan fascinating, sometimes infuriating, human (with the ordinary failings of all of us), often sad, often happy, but always one step ahead of trends and emulators, and certainly three steps ahead of the knockers.

What knockers? What do they say?

Well, they say he can't sing, that his voice sounds like a squeezed racoon in agony, that he's a phoney because he turns his back on fans and does what he likes; they say he's a neurotic. And kinds of "mean and nasty things", as Arlo Guthrie might say. These people usually stand to gain publicity, press space, inverted glory, or just a big warm glow — Like the telly, if you don't like Dylan, you can always just turn him off. So what's their kick?

The emulators? Heck, there's a million of 'em.

Donovan Leitch was the first to reach prominence. He later did the right thing; his own. He's better now than he ever was trying to catch the wind, anyhow. The Byrds were so busy worshipping Dylan and singing his songs (they did them very well indeed, and helped Dylan's career enormously with their version of "Tambourine Man") that they didn't seem to notice how much Roger (then calling himself Jim) McGuinn actually



A thoughtful look at the career of Bob Dylan alias Robert Zimmerman, by Murray Jennings

BOB DYLAN BRINGS IT HOME

sounded like Dylan. I think McGuinn knew all right ... listen to his solo vocal on Dylan's "It's Alright Ma, I'm Only Bleeding" from the soundtrack of "Easy Rider". Listen to the Sydney groups that do Dylan material, and those that don't, too. Every third outfit is singing Dylan. Thousands of squeezed racoons, all over the world!! It's wild.

Back to Woodstock.

If Dylan nearly died when his chopper left the road in 1966 it probably necessitated a long recuperative period. The results could have been read as some weird pre-frontal lobotomy. The raging had gone, and we were greeted two years later with Dylan (hair cut short, the beginnings of a beard) grinning and squinting into the camera for the album cover of "John Wesley Harding". Hell! Dylan didn't even smile, before – well, hardly ever. When you're being angry it's not easy to laugh.

He may not be a true genius but he has the talent to drop his anger and retain the full force of his incisive imagination. His lyrics on "J.W.H." were just as far out as ever, but they were closer to American musical roots. The country and folk-blues influences of Dylan's early life were flowering again. There were stronger-than-ever Woody Guthrie influences – and when I met Dylan in 1966 in Perth he was playing the game of denying that he had been influenced by anybody, let alone Woody Guthrie. But he was right of course – "Highway 61 Revisited" and "Blonde on Blonde" had no recognisable individual influences. Dylan's wailing harmonica against the heavy Harvey Brooks bass, the electronic organ of Al Kooper, and the lead guitar of Robbie Robertson (member of The Band), to name a few, merely told of Dylan stretching his wings just that little bit further on the winds of rock change.

In the specially-built studio in Big Pink, Dylan and Robertson, Garth Hudson (organ), Richard Manuel (piano and most vocals), Rick Danke (bass guitar), and Levon Helm (the only American, and the drummer) produced some very fine Canadian-American roots music, but with some very exciting new ideas of their own. Dylan influenced The Band and they influenced him. I doubt that he would bother denying that ever again. Any way you listen to them all today it is obvious.

The Band burst on to the international scene in 1968 with their first album, "Music From Big Pink"

which included three Dylan songs; "I Shall be Released", "This Wheel's on Fire" (co-written with Danke) and "Tears of Rage" (co-written with Manuel). If you want to bother you can find remarkable similarities in the writing styles of Robertson and Dylan on such numbers as "The Weight", "Chest Fever" and "Caledonia Misson" by Robertson on "Big Pink", and "The Ballad of Frankie Lee and Judas Priest", "As I Went Out One Morning" and "Dear Landlord" from Dylan's "John Wesley Harding" album. If you are familiar with both Dylan's and The Band's records you could have no trouble imagining one singing the songs of the other. As a matter of fact, I have long thought The Band could do a great job with "Lee and Priest", "Landlord" and another cut from "J.W.H.", "Drifter's Escape". They sort of married their styles and ideas up on that Woodstock mountain.

At this point I'd better mention that Woodstock is not the place where the legendary "nation" was formed; although the name of the Festival venue came from the organisers having tried originally to hold it near to where Dylan and The Band were living.

Another thing to come out of this "marriage", is the sudden and dramatic change for the better in Dylan's diction, his presence, his clarity of phrasing, and the general quality of his recordings. It is said that Robbie Robertson has had a lot to do with this. I believe it. I watched Dylan onstage at a concert in Perth when his guitar fell out of tune and he seemed to be a bit confused by the drop in balance of the instruments. He went back to where Robertson stood near the rear of the stage (The Band was supporting Dylan at that point, but they hadn't got a new name for themselves yet). Robertson quickly tuned Bob's axe, then moved briskly about the stage tuning the amplifiers, and conferring with Danke and Helm regarding the rhythm sound. It appeared from out in the audience as if the nod had to come from Robertson before things were agreed to be set to go again. Indeed, the mutual respect Dylan and Robertson shared was evident from the way they talked after the show, during a publicity conference, and back at their motel. It certainly flows freely in their music.

However, whatever happened inside that little studio on the mount, what was happening right outside in the clean country air, was equally as important to all six men. The fact that the birds wuz cheepin', and the grass wuz risin', and peace wuz reignin' supreme all around their watchtower meant that they were very much at peace with themselves and one another. Out of inner peace usually flows all kinds of magic.

The magic of Woodstock continued to flow and flower as Dylan made his Nashville album, "Nashville Skyline" and The Band went into their second L.P., "The Band". Both were superb. Dylan recorded with the best musicians Columbia could find in Tennessee (Pete Drake steel guitar, Kenny Buttrey drums, and guitarist Charlie Daniels, to name a few) and astounded everyone who heard the album: his voice had changed! For the better, we all agreed. That clarity and diction. Not only that but he was so relaxed and his songs spoke of love, forgiveness, and getting it all together again. The cover bore a beautiful coloured shot of him ... yes, smiling again! And looking really genuinely happy. The frowns had gone from Dylan's work. He was freer than he'd ever been.

"The Band" was an explosive album, revolutionary in style and ideas and execution. If you require labels, it blended so smoothly Folk, Rock, Rhythm & Blues, Country and even some smatterings of Jazz influences. Admittedly, a lot of the credit for this album had to go to John Simon, a sort of unofficial sixth member of The Band, who engineered the whole thing, mixed, produced, and even played tuba and electric piano on it. But Robertson, Hudson, Danke, Manuel and Helm are no slouches. They'd been working as a professional unit for years, mostly doing sweaty roadwork between one-nighters, whistle-stop tours that took them into the skungiest niteries in Texas and the roughest Friday night hops in the South. "They'd flick cigarette butts at you," said Robertson of those days, "and steal your things, and if you got past all that, they'd listen to you. They didn't come to hear us, they came to mess with us." Most of those years were spent with Rockabilly country boy, Ronnie Hawkins. The

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BOB DYLAN BRINGS IT HOME

Band was called The Hawks. They left Hawkins finally and became Levon and the Hawks. Somehow, Dylan heard about them and invited them to tour with him. None of them has looked back since.

With Dylan's and The Band's new recordings came a sudden wave of new interest in Country music. But country music with a difference. Not Country-and-Western. More like Country-rock. At least that's what label-attachers have been calling it. Of course, they weren't the first really. When Buffalo Springfield and a handful of other groups had tried to move new country-influences into the pop fields a couple of years earlier nobody paid much attention. There are many sorry ears now. B.S. broke up and went their separate ways. Neil Young and Stephen Stills finally got together again in the now-famous group, Crosby, Stills, Nash and Young. Not to say Dylan and The Band are doing anything that is even remotely like the B.S.'s material. Theirs still remains totally different.

And if you think Blood, Sweat and Tears is a good rock band with a solid sound, listen to The Band! Dylan is back in New York now, but The Band blasts on, still resident (when they're not touring) in the Woodstock region, although I hear they outgrew the little house on the hill. The Band's third album, "Stage Fright" was yet another extension of what they have been doing these past four years. Dylan though – well, he made another turn. He stayed in the area of his country influences, but came out with a blockbuster – "Self Portrait", a two record album on which, for the first time, he sang other people's songs. For the first time, that is, since his very first Columbia album; and excepting "Corinna Corinna" on "Freewheelin'" and the occasional sly 'pinch' from traditional folk songs of the British Isles, during his early folk era.

"Self Portrait" was even freer than "Skyline" had been because he did exactly what he wanted to do with a programme for the sessions. He sang Gordon Lightfoot's "Early Morning Rain", Paul Simon's "The Boxer", Gilbert Becaud's "Let It Be Me", Boudleaux Bryant's "Take Me As I Am Or Let Me Go" – a very strange potpourri, even for a straight artist, even stranger for Dylan. Add to that, the old evergreen, "Blue Moon", and you can imagine the uproar in the music columns: "Dylan's finally lost his marbles – singing Rodgers and Hart!"

But "Self-Portrait" was an experiment for Dylan; admittedly, one that almost did not come off. He set out to indulge his frustrated urges to get into other people's music. Over the years of his solo successes, singing only his own material most of us tended to forget that he was human, with tastes of his own. He had acquired broad tastes, in fact, by the time he was seventeen. He loved folk blues and this led to his meeting Big Joe Williams and learning a trick or two. He also owns to admiring Scrapper Blackwell, Leroy Carr, Champion Jack Dupree, Lonnie Johnson, Jelly Roll Morton, Buddy Bolden (although he can't have *heard* Bolden unless *Dylan* has the legendary and probably mythical cylinder record made by the early New Orleans cornetist who stuck his horn through the fence to call his chillun home), Ian and Sylvia, Hank Williams, Elvis Presley, Charlie Pride, Leadbelly, Muddy Waters, Tom Rush, Porter Wagoner, The Clancy Brothers and Tommy Makem . . .

Dylan got together a lot of fine people for the "Self Portrait" album (the cover of which bore an impressionistic self portrait in oils by Dylan) and the list of names is another indication of his widening musical interests, as are the styles on the recordings themselves. All the members of The Band appeared, Lousiana Bayou, fiddler Doug Kershaw, Bob Moore the Nashville bassist and band leader, Al Kooper, Pete Drake, Kenny Buttrey, Charlie Daniels . . . mostly country music people but most of them individualists.

The main reason the album almost didn't make it is its terrible programming. It is as if the song titles were shuffled in a hat and some office boy pulled them out one by one and they just bunged them on the two records one after the other in that order. Another reason is that some of the songs are just plain tuneless and shockingly recorded – these are the live tracks, "She Belongs to Me", "The Mighty Quinn", and "Like a Rolling Stone", recorded with The Band at the Isle of Wight Pop Festival. But sheer weight of numbers (pardon the pun) got him through and the overall effect is; the variety and honesty (nearly too much honesty) making up for the low points. Dylan had made sure though, that everyone knew where he was at the moment. Still up to his knees in cowdung and new-mown hay. Upstate New York.

When "New Morning" eased itself onto the scene some months ago nobody was surprised to hear the third album in a row steeped in country music. This one turned out to be one of the best albums he'd ever done. For my money it *is* the best. On it Dylan is back to singing all his own songs. He brought in Al Kooper yet again, to help out. Together with Bob Johnson (Dylan's producer since the heavy rock days of "Blonde on Blonde", etc.) Kooper, who played organ, piano, guitar and french horn on the session, moulded Dylan's latest efforts into a remarkably tasteful jelling story.

The album itself comes over almost as a long ballad. Like "Nashville Skyline" its main themes are love, peace, honesty, family, and even a smattering of old time religion. But through it all is a very mature awareness of the need for clear-thinking and sanity in a very confused world. Dylan's maturity of lyric lines expresses through implication, as usual, rather than the baseball-bat-over-the-head techniques used so often by pop song-writers of lesser talents, an almost alive set of simple principles. And the simplicity of itself, along with the superbly *real* recording quality of the album, brings out vivid pictures of the Dylan mind today.

The only anger in the entire album is a muted annoyance in "Day of the Locusts", a thinly-disguised commentary on his trip to Princeton University, New Jersey in June last year to accept an honorary Doctorate of Music. It seems Bob wasn't at all satisfied he was doing the right thing in accepting it. Way back when, before it all started, he had dropped out of the Minnesota University at the age of nineteen, and after only six months

BOB DYLAN BRINGS IT HOME

study. It wasn't his scene then, and is probably less his scene today.

However, along with Coretta King, Walter Lipmann and a handful of others, he donned the traditional academic gown and stepped up to receive the degree. But he wouldn't don the mortar board and he did slip on a white armband, thus lending his support to those graduates who had declared themselves for peace; the peace symbol was engraved on the band.

This role of quiet revolutionary is Dylan's most effective yet. Though it is said that he has been running about of late in support of oppressed Jews, his priorities appear to be very strongly rooted in his wife and family. Perhaps the entire album "New Morning" was for them. Certainly he has always kept Sarah and the kids out of the limelight.

> "Build me a cabin in Utah,
> Marry me a wife, catch rainbow trout,
> Have a bunch of kids who call me Pa,
> That must be what it's all about."

This section of "Sign on the Window" from "New Morning" is fast becoming Dylan's most often-quoted. It's certainly what that album is all about. And for those of us who have comfortably crossed the thirty-line, as Dylan did recently, it's probably the most peaceful form of protest with which we can identify.

Not too many wars are fought successfully from conjugal beds and rocking chairs.

He's talking to all of us now, not just the *youthful* majority. That's why you find him in Tamminyville, Golddust, Nashville, London, Sydney, Port Au Prince, and Katmandu. ●

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"ANOTHER SIDE OF BOB DYLAN"	SBP 233161
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"HIGHWAY 61 REVISITED"	
"BLONDE ON BLONDE" (Two Record Album)	
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"JOHN WESLEY HARDING"	
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"SELF PORTRAIT" (Two Record Album)	S2BP 220057
"NEW MORNING"	SBP 233887

(The above are all above-board authorised CBS recordings)

Sundries:

Numerous Extended Play albums with tracks pulled from the L.P. albums.

Numerous single-play records, most of which were also culled from the L.P. albums — one notable exception was the track, "Can You Please Crawl Out Your Window?" which was written and recorded in the era of "Blonde on Blonde" when Dylan seemed to be avenging injustices perpetrated upon him by the fair sex; although the lyrics of "Window" weren't entirely putting the girl (to whom the song was directed) down. Rather, they seemed to say what Scott McKenzie said about the same time (1966) in the first of his trilogy, "What's the Difference?" — ". . . pick up a toothbrush, sneak down the stairway . . . who's gonna miss us in a year or so . . ."

Before Dylan got going on the American Columbia label (CBS Australia), he recorded some songs (some his, some trad, some oddments) on an album for Broadside called "Broadside Ballads — Vol. 1 — A Handful of Songs About Our Time" (still available on import in Australia). This album was done under the pseudonym of Blind Boy Grunt, because he had actually just *signed* with Columbia.

In addition to the latest and greatest from Mr Zimmerman, there have been at least three "bootleg" albums available in the U.S.A.; several copies of the most famous — "The Great White Wonder" — having found their way to Australia a couple of years ago. "Wonder" comprised two albums of concert recordings, backroom tapes with members of The Band, old tracks from the abovementioned Broadside album, and so forth. For those of us used now to a reasonable recording quality, these sides were abominable. In many cases recorded on home machines and obviously not channelled professionally anyway, the end results were painful. Only Dylanophiles amongst us could say 'Yeah, I enjoyed that'. Even the music wasn't always terribly good, with Dylan often in dire vocal straits too.

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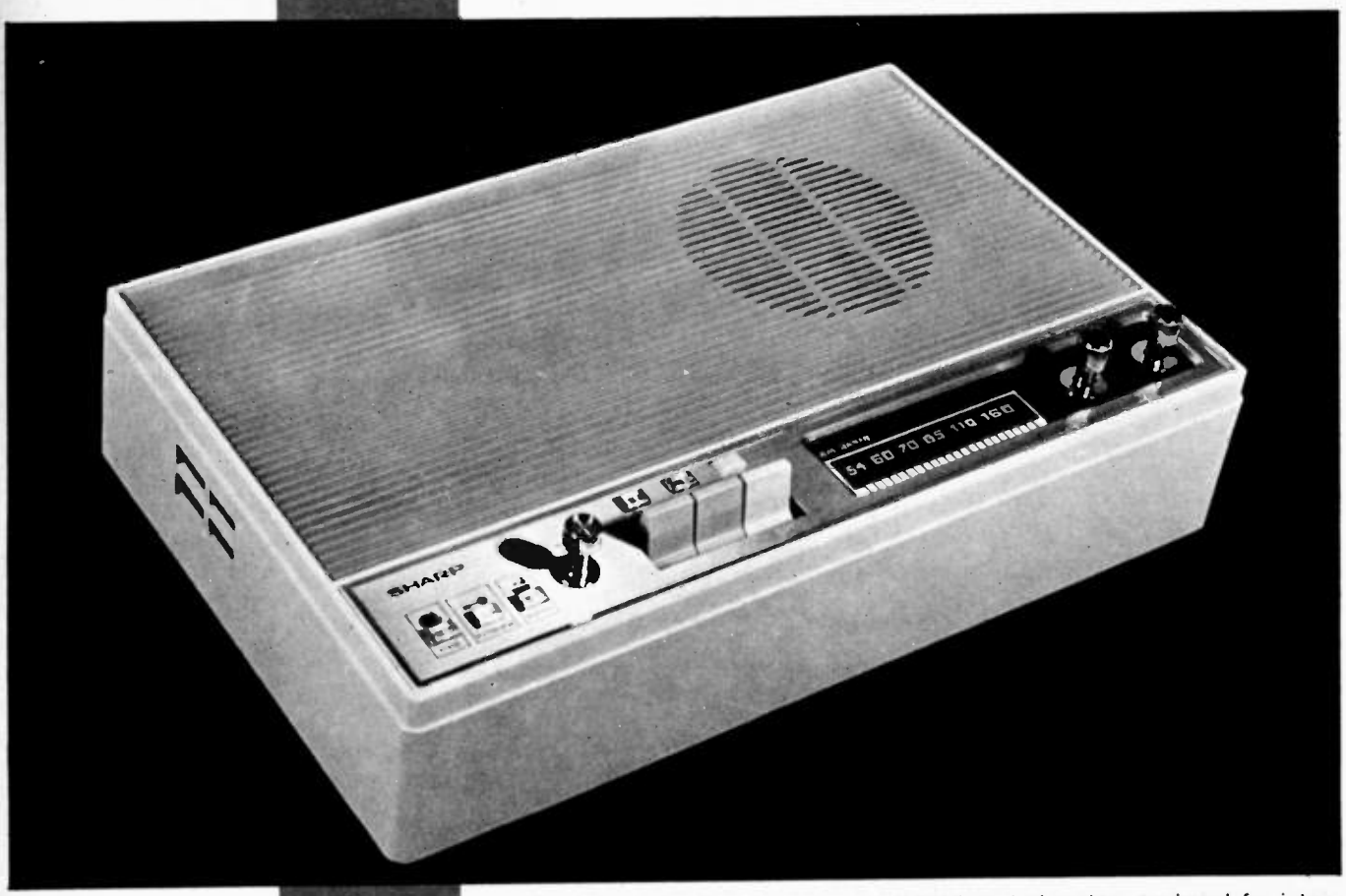

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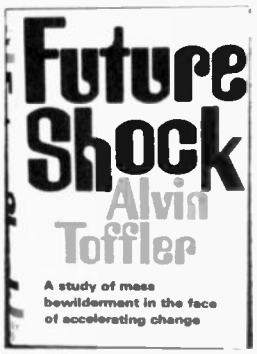

FUTURE SHOCK — By Alvin Toffler, published by Bodley Head, London, 1970. Hard covers, 504 pages. $6.20. Obtainable in Australia from Modern Books and Plans and other booksellers.

Our world is changing at an ever increasing rate.

If the last 50,000 years of man's existence were divided into lifetimes, each of approximately 60 years, there have been about 800 such lifetimes. Of these, fully 650 were spent in caves.

Only during the last 70 lifetimes has it been possible to communicate effectively from one lifetime to another – as writing made it possible to do. Only during the last six lifetimes did masses of men ever see a printed word. Only during the last four has it been possible to measure time with any precision. Only in the last two has anyone used an electric motor.

And the overwhelming majority of all the material goods we use in daily life today have been developed within this – the 800th lifetime.

FUTURE SHOCK, says Alvin Toffler, is about change and the way we adapt to change, and the way in which many people are disturbed by change.

Toffler gives many examples of the changes that have taken place in technology and our way of life in recent times. He makes predictions of the many changes soon to be experienced by our society.

We are – he says – speeding toward a rendezvous with super-industrialism.

We will be able to control weather and our environment, replace organs, grow new limbs, select the genetic endowment of our children. We will have colonies beneath the sea, and scientific cultivation of the ocean's food resources will take its place alongside agriculture.

New drugs will be found to cure illness or alter mental states.

Developments in microbiology mean that man is on the path towards integrating living tissue in the processes of physical mechanisms. We shall have in the near future, machines constituted at one and the same time, of metal and of living substances.

Even the human body can no longer be regarded as fixed. Man will be able within a reasonably short period, to redesign not merely individual bodies, but the entire human race.

We are – he says – creating a new society – more than a changed society or an extended larger-than-life version of our present society. It will be a *new* society.

From this statement follows his warning that many people who do not understand what is happening will feel as lost and alienated as they would if they moved to another culture with very different habits and customs from their own.

But there will be no comforting reassurance that the change is temporary. They will not be able to return to their accustomed culture.

It will no longer exist.

These people will suffer what Toffler calls 'future shock' – it is, he says, the human response to over stimulation.

The symptoms of future shock range from anxiety and senseless violence to physical illness, depression and apathy. Toffler contends that these symptoms can already be seen among the people of the technology-rich nations.

Toffler sees in our society "a growing weariness and wariness, a pall of pessimism, a decline in our sense of mastery; more and more the environment comes to seem chaotic, beyond human control."

One widespread response to high-speed change is outright denial. The Denier (as Toffler calls an unknowing victim of future shock) "blocks out" unwelcome reality and finds comfort in such cliches, as "young people were always rebellious", or "there's nothing new on the face of the earth", or "the more things change the more they remain the same."

The Denier's inevitable encounter with change then comes in the form of a single massive life crisis, rather than a sequence of manageable problems.

Another common response to future shock is 'obsessive reversions to previously successful adaptive routines that are now irrelevant and inappropriate'.

Shocked by the arrival of the future the 'Reversionist' demands a return to the glories of yesteryear.

The older reversionist dreams of reinstating a small-town past' – the youthful left-wing reversionist dreams of reviving an even older social system. Hence the hippies fascination with rural communes, the veneration of pre-technological societies, and the exaggerated contempt for science and technology.

Rapidly accelerating change is a very real danger and by blindly stepping up the rate of change, the level of novelty and the extent of choice, we are condemning countless millions to future shock.

But Toffler does not suggest that we halt technology or return to an earlier stage of human existence. Future shock, the disease of change, can be prevented but, says Toffler, it will take drastic social and even political action.

'Forewarned is forearmed' says the author, and in most situations we can help individuals adapt better if we simply provide them with advance information about what lies ahead.

Our current methods of education require reappraisal, less time should be spent studying history, and more time spent in imaginative discussions of the future.

Society must so organize itself that a proportion of the very ablest and most imaginative of scientists are continually concerned with trying to foresee the long term effects of new technology.

Toffler proposes that we develop a new profession of 'value impact forecasters' – men and women trained to use the most advanced behavioural science techniques to appraise the value implications of proposed technology.

Most importantly we must stop being afraid to exert systematic social control over technology. And responsibility for doing so must be shared by public agencies and the corporations and laboratories in which technological innovations are hatched.

This is a fascinating book, colourfully written. Despite the warnings about the consequences of rapid change, the general tone is optimistic. Toffler does not see the human race as ineffectual, but as intelligent and adaptable, and able to control its destiny.

Perhaps Toffler could be criticised for suggesting certain social changes without offering details of how these changes can be brought about. Still, Toffler says his purpose is to create the *consciousness* needed for man to undertake the control of change, the guidance of his evolution.

We cannot and must not turn off the switch of technological progress, says Toffler.

Only romantic fools babble about returning to a "state of nature". A state of nature is one in which infants shrivel and die for lack of elementary medical care. One in which malnutrition stultifies the brain, one in which, as Hobbes reminded us, the typical life is 'poor, nasty, brutish, and short'.

To turn our backs on technology would not only be stupid but immoral. – JV.

BOOK REVIEWS

125 One Transistor Projects by Rufus P. Turner. Published by TAB books. First edition, first printing August 1970. 192 pages, 8½" x 5½" soft covers. Australian price $3.95.

One hundred and twenty five (although the title on the spine insists there are 104!) simple one transistor projects with a simple description and practical details for each one included in this book. Categories of experiments are as follows:–

1. Audio Amplifiers
2. RF, IF and DC amplifiers
3. Oscillators
4. Control and Alarm Devices
5. Test Instruments
6. Power Supply Application
7. Receivers, Transmitters and Accessories

An ideal book for the young experimenter with limited funds. A relatively small collection of components would allow most of the projects described to be built. A young reader would gain an excellent foundation in what electronics is all about and how easily fascinating devices can be made. So go to it lads, have fun. – B.C.

Understanding Solid State Circuits by Norman H. Crowhurst Published by TAB books. First edition 1970. 189 pages, 5½" x 8½", soft covers. Australian price $4.95.

An easy book for the beginner, written in plain language for those without any mathematical background.

Subject matter is divided into nine chapters as follows:–

1. Semiconductor Devices
2. Linear Amplification
3. Power Amplification
4. Feedback
5. Sinusoidal Oscillators
6. Function Generator Oscillators
7. Gain Controlled Amplification
8. Control of Logic circuits
9. Integrated circuits

As can be seen the main emphasis is on circuitry associated with transistorised amplifier and radio equipment. The treatment of transistor amplifier theory is shorn of all complication, and the practical aspects of bias arrangements and device operating characteristics and limitations are handled well and should be of much assistance to experimenters and newcomers.

However a book published in 1970 should not have so many analogies to valve circuitry.

Valves are dead – and the new generation of amateurs and experimenters are probably only confused by comparisons with devices that they have never seen and will most likely not ever see except in certain high frequency, high power applications. There cannot be too many old timers around now who have not already made the effort to learn all about these new fangled devices. So please fellows give up on the valve analogies.

The final two chapters on logic and integrated circuits are far too brief to convey very much information, and one wonders whether it was worth including them at all. Quite a lot of similar books do the same thing – cover too great a field in too limited space, with the result that there just is not enough information included to give the reader a worthwhile introduction to the subject. One could finish up with shelves full of similar books without really getting a complete well-rounded description. In this case however, the criticism only applies to the last two chapters which could have well been replaced by other material more in line with the rest of the book.

In general, worthwhile reading for the beginner on the principles of transistor circuits as contained in radio and amplifier equipment. – B.C.

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EARTHQUAKES AND EARTH OSCILLATIONS

A gravimeter is, of course, an instrument that will record any vertical acceleration that lasts long enough for the gravimeter to respond. One advantage of the Aberdeen gravimeter is that its response time can be very short – if necessary, no more than one-fifth of a second. Usually, this is a disadvantage, since we do not usually wish to record short sharp accelerations when observing the long-term effects of gravity; a further disadvantage with our particular design is that the overall movements are so very small that we have to take more than usual trouble to overcome the instability of materials mentioned in the preceding paragraph. The speed of response of the gravimeter is however, useful if we wish to record vertical accelerations arising from specific forms of ground disturbance such as earthquakes; and, for example, we were able to observe the Rayleigh waves from the Portuguese earthquake of February 1969 encircling the world several times (Fig. 4); these waves travel on the surface of the Earth and take about three hours to complete a great circle.

In the last ten years, short period gravimeters have been found useful in studying the bodily oscillations of the Earth that are stimulated by the shock due to large earthquakes; these make the whole Earth "ring" like a bell. An example, observed with the Aberdeen gravimeter after the Peru earthquake of 31 July, 1970, is shown in Fig. 5; the Earth was "ringing" for nearly two days after the original shock.

Gravimeters made in the United States were the first to be successfully used for detecting Earth oscillations, and two recent designs, at La Jolla in the United States have proved particularly suitable. One of these instruments has much the same design philosophy as ours at Aberdeen, but it may well be better in that it depends on the torsional deflection of a quartz fibre, rather than on the deflection of metallic springs, and quartz seems to be considerably better as regards its resistance to "creep". Another instrument dispenses with mechanical springs and uses the force of repulsion of a magnetic field to levitate a superconducting sphere; any change in the force of gravity pulls this sphere slightly downwards, and its movement is sensed by a capacitance micrometer.

The Aberdeen and La Jolla gravimeters have about the same sensitivity and it has been suggested that some interesting information might be obtained by comparing records taken simultaneously. American scientists at La Jolla have shown that one great advantage of gravimeters with the new order of performance is that they can be used to observe considerably smaller oscillations of the Earth than had been previously possible, so that an earthquake of magnitude 6 may be sufficient, instead of magnitude 8 (about one hundred times bigger), as was previously necessary. It seems that a particular earthquake only excites certain modes of oscillation, and any one mode may be detectable at some point on the Earth's surface and undetectable at others. If, therefore, records from well-spaced gravimeters are compared, Earth modes may show up preferentially on one instrument from earthquakes in one region and on the other instrument from other regions. Such comparisons probably represent the next phase of gravimetric investigation. ●

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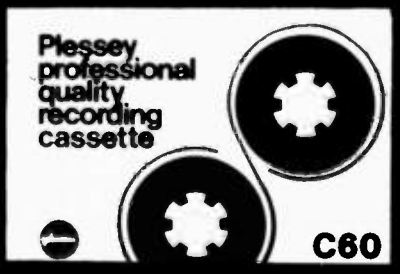

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INPUT GATE

LETTERS FROM OUR READERS

BETTERING KETTERING

Will a high voltage coil increase the power output of a normal car engine that is in good condition? — A.F., Auckland, N.Z.

• No.

WASTE OF TIME

I think it is a waste of time writing letters to the editor. — F.L., Padstow, N.S.W.

• Mmmmm.

COMPONENTS

Your intruder alarm project seems to be just what I need but I am finding it difficult to obtain some of the components — can you help? — D.D., Footscray, Vic.

• We are concerned that many of our readers are having these problems. With the co-operation of a number of kit part suppliers, Electronics Today is taking positive steps to ensure that, as far as is reasonably possible, project components will be available. Full details next month.

POLISHED JOB

I make my own pc boards using nail polish to cover the copper tracks; after etching, the polish is easily removed with nail polish solvent. The results are excellent. — R.H., Cohuna, Vic.

INTEGRATED CIRCUITS

Why do you specify integrated circuits in some of your projects — these are very complicated devices and are not for the experimenter. — B.D., Wellington, N.Z.

• A brief search through electronics magazines of the early 1950s revealed a number of almost identical letters complaining about transistors. There is absolutely nothing strange or mysterious about i/cs. In many respects they are easier to use than discrete components. How's the sales of cat's whiskers in Wellington, B.D.?

HOW WE TEST

May I compliment you and your staff on the objective manner in which you review equipment. It is quite refreshing not to have to 'read between the lines' to find out what a reviewer really thought. I am also surprised that sometimes your review shows that certain parameters exceed the manufacturer's claims.

I have never read such forthright positive statements in any other magazine — I would be very interested to know how you can be so definite about some of the statements in the reviews. — S.W., Perth, W.A.

• Thank you — we have passed on your remarks to the people concerned.

Our product reviews are performed and written by professionally qualified engineers working in a National Association of Testing Authorities laboratory and using some of the world's finest equipment — for instance over $20,000 of Bruel and Kjerr equipment may be used for a single test. As required by the NATA regulations, this equipment is checked against National Standards at regular intervals.

For these reasons our testing equipment and resultant measurements are almost invariably more accurate than those that a manufacturer can perform himself.

And so we can state unequivocably that if say, a manufacturer's specification claims that total harmonic distortion is 1% at 10 watts, yet we find that it is in fact 3% at 10 watts, then our figure will be correct (to within a known order of accuracy — typically 0.1%). Thus, in the hypothetical example quoted, the actual figure will be somewhere between 2.9% and 3.1%.

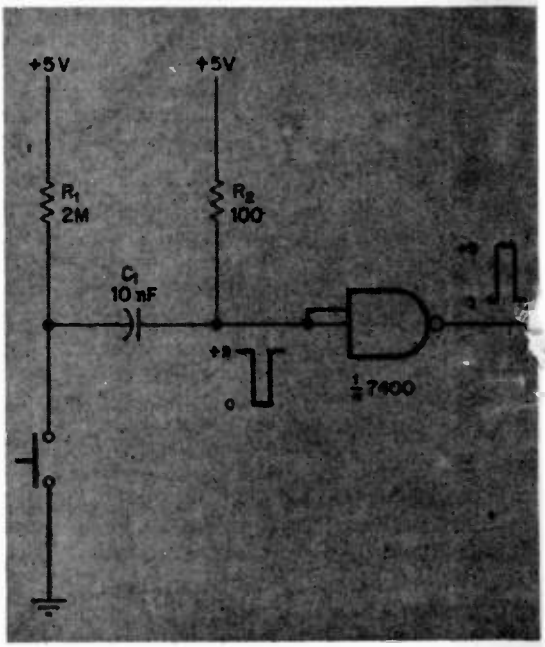
Readers may be interested to learn that in the only case so far where our test of a speaker's performance differed considerably from a manufacturer's graph — the manufacturer accepted our findings as correct.

BOUNCING CHECK

I am having a lot of trouble with an electronic batch counter — something is causing spurious counting. The unit is set up to count objects moving down a production line at the rate of about ten a second, I am using a micro-switch and a five volt supply to trigger the batch counter. Everything seems to be working OK but the counter clocks up anything between three and five counts per object. — J.S., Townsville, Qld.

• This is a very common problem J.S. Nearly all mechanically operated switches, relays, etc, bounce as they close. Your counter is faithfully totalling all contact closures!

This bounce time is usually between one and ten milliseconds. All you need is a device that passes the initial contact closure and then blocks off subsequent pulses for longer than the bounce period. The accompanying circuit should do this nicely. The delay is about 20 milliseconds with the circuit values shown.



THOUGHTS AND CROSSES

Your circuit diagrams follow British Standard 3939 except that you show lines crossing as ⊣⊢ instead of + as per the Standard. Why? — T.B., Seven Hills, N.S.W.

• Whilst the Standard is fine for professional engineers the recommended practice tends to mislead novices. Many other electronic journals apparently think likewise. Would any readers care to comment?

DOLLARS DILEMMA

I have around a thousand dollars to spend on hi-fi equipment, could you suggest how much should I spend on each item. — T.O., Canberra, A.C.T.

• Approximately 50% on the two speakers, and the balance split more or less equally between amplifier and turntable, but don't make any firm decisions before discussing your requirements with a reputable hi-fi dealer.

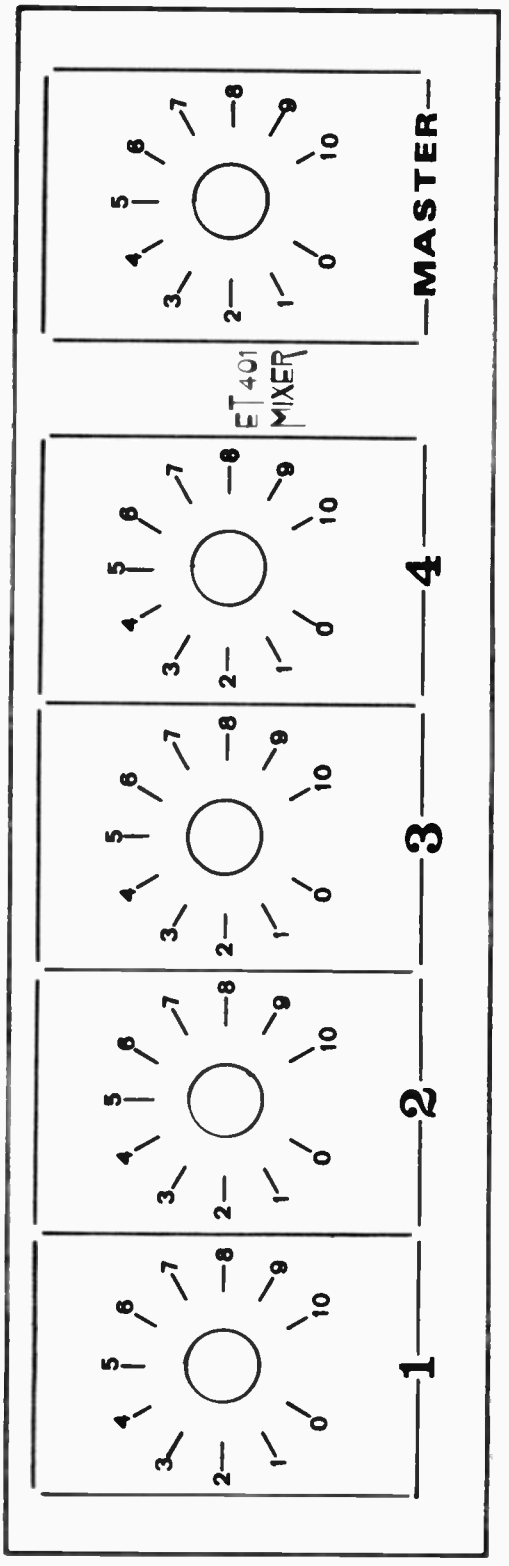
STAFF DRESS

I am surprised to see that your projects manager does not wear a tie. — J.E., Perth, W.A.

• You should see our secretary!

FET-FOUR INPUT MIXER

(Continued from page 54)



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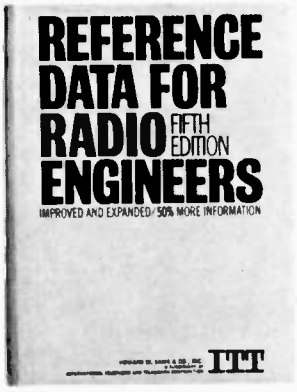

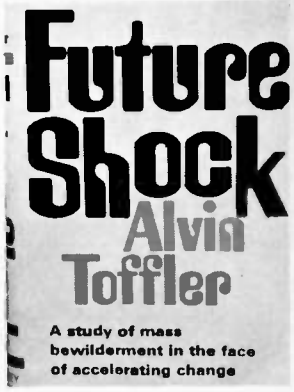

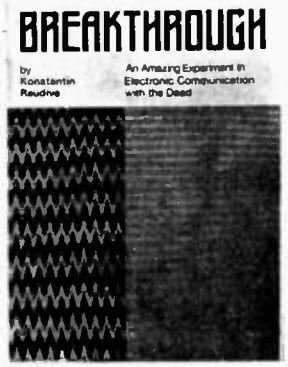

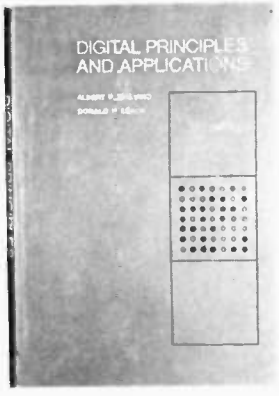

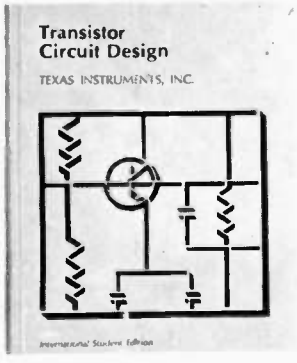

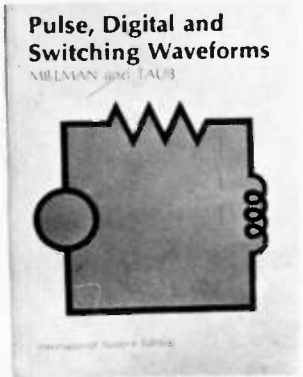

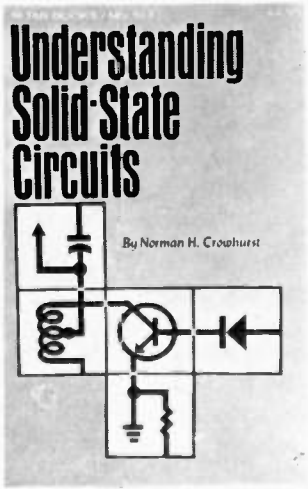

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There are many ways of implementing a pulse or digital system designed to perform a particular function. It is hoped that through a study of this text and the experience gained for solving problems the reader will develop facility with these circuits and sharpen his creativity and ingenuity.

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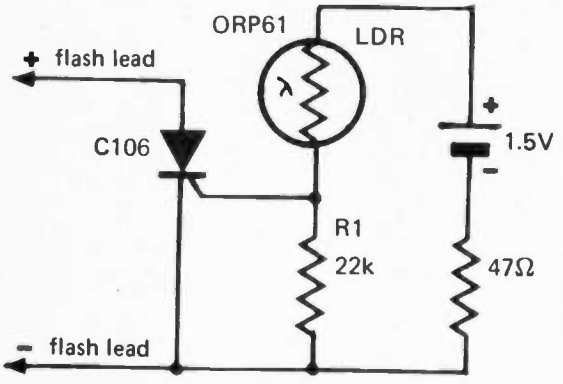
This book was compiled for the practising circuit design engineer. It offers solutions to a wide range of basic engineering problems ranging from transistor numbering systems and specification to digital servo systems.

E18. 125 ONE TRANSISTOR PROJECTS — R. P. TURNER. 192 pp. 8½" x 5½" Soft cover $4.95
One of the many virtues of the transistor is its ability to function single handedly in all kinds of circuits. The 125 one-transistor circuits shown in this book are examples of this usefulness. The reader should be able to set up and test the circuits with little effort and equipment.

E19. UNDERSTANDING SOLID-STATE CIRCUITS. N. H. CROWHURST. 190 pp. 8½" x 5½" Soft cover $6.15. Hard cover $9.95
To stay reasonably current and to serve tomorrow as well as today, a presentation must provide the information necessary to utilize the devices that have not yet been born, those that have recently appeared, as well as the ones that are familiar. This book does just that.

TECH-TIPS

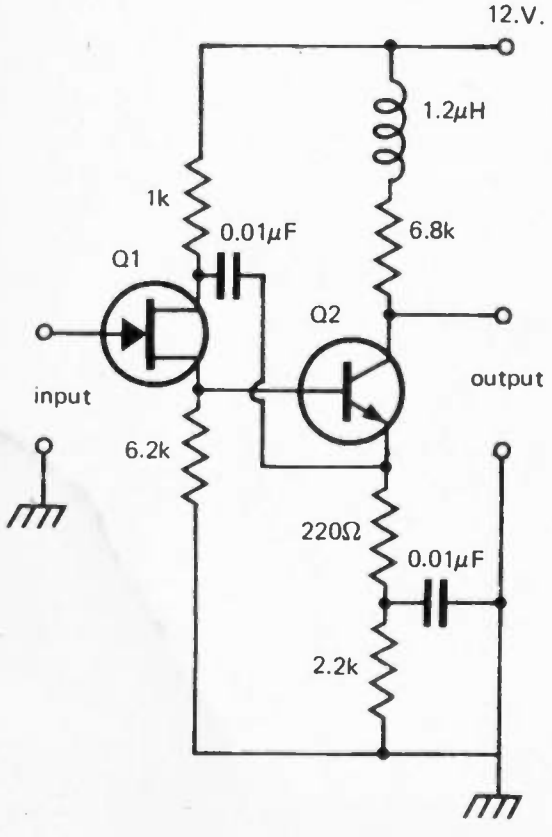
FLASH SLAVE DRIVER



In photography, a separate flash, triggered by the light of a master flash light, is often required to provide more light, fill-in shadows etc.

The sensitivity of this circuit depends on the proximity of the master flash and the value of R1. Increasing R1 gives increased sensitivity.

BROAD BAND AMPLIFIER



This circuit has a typical gain of 10db and bandwidth of 90 MHz.

Input impedance is around 10 megohms in parallel with 1.0pf. Output impedance is reasonably high and depends

(Turn to page 124)

CAREER OPPORTUNITIES

EMPLOYERS — Seeking Staff? Electronics Today is read by the very people you seek! (and our copy deadline is only 10 days). Managers, Engineers, Technicians, Draughtsmen, Salesmen, etc. • You already have a good job but seek a better one. Here they are.

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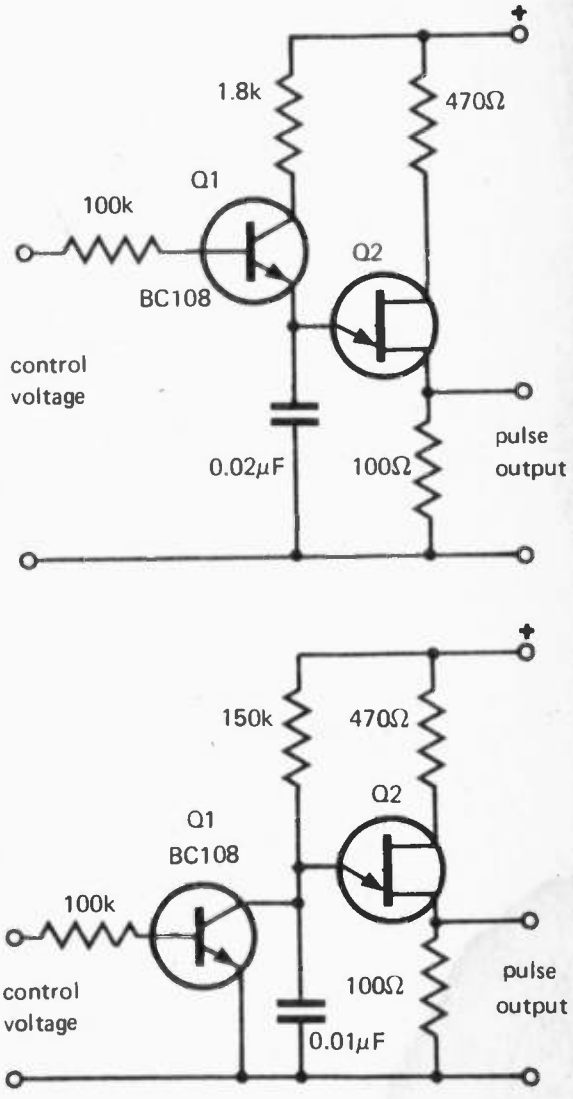
TECH-TIPS

mainly on Q2; output capacitance will be around 2 to 3pf with careful construction.

FET, Q1, should be an n-channel type with low gate source capacitance and a high cutoff frequency.

The Transistor, Q2, should have a high gain-bandwidth product and low collector-emitter capacitance. Careful selection can extend the bandwidth beyond 100 MHz.

SERIES AND SHUNT UJT CONTROL



Voltage controlled pulse oscillators find a wide variety of applications in telemetry, SCR control systems, analogue to digital converters etc.

Two different methods are shown above. In the series control circuit, (top) increasing the control voltage will *increase* the pulse rate, while in the shunt circuit increasing the control voltage will *decrease* the pulse rate.

A control transistor with good constant-current collector characteristics will give a good linear response.

A Darlington pair may replace Q1 to increase the sensitivity and the input impedance.

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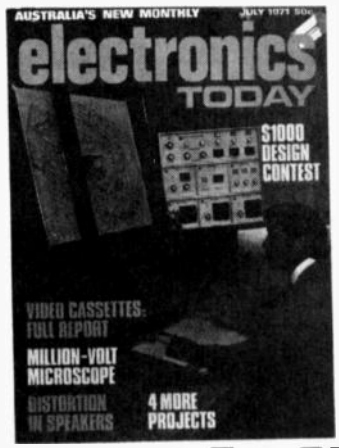

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Absolutely!

Your eardrums and your bankroll.

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What sounds best to your ears and what feels comfortable to your budget.

And the TEAC system pictured here can probably satisfy both.

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The model AG-3000 AM/FM stereo receiver puts out the needed power for this system. A big 180 watts. FM front end with a 4-gang variable capacitor and use of FET and low noise transistors produce a high sensitivity.

TEAC's LS-30 speakers put it all together into a system with big sound. Designed specifically for tape, by the people who know tape best. The LS-30 speakers have a wider dynamic range, in which to match the wider range of tape.

There it is.

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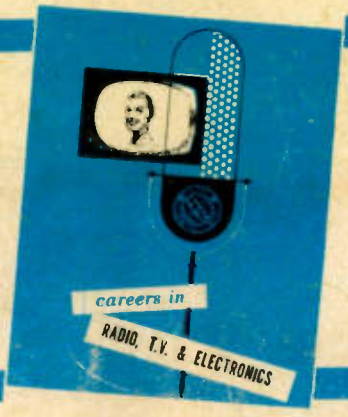

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