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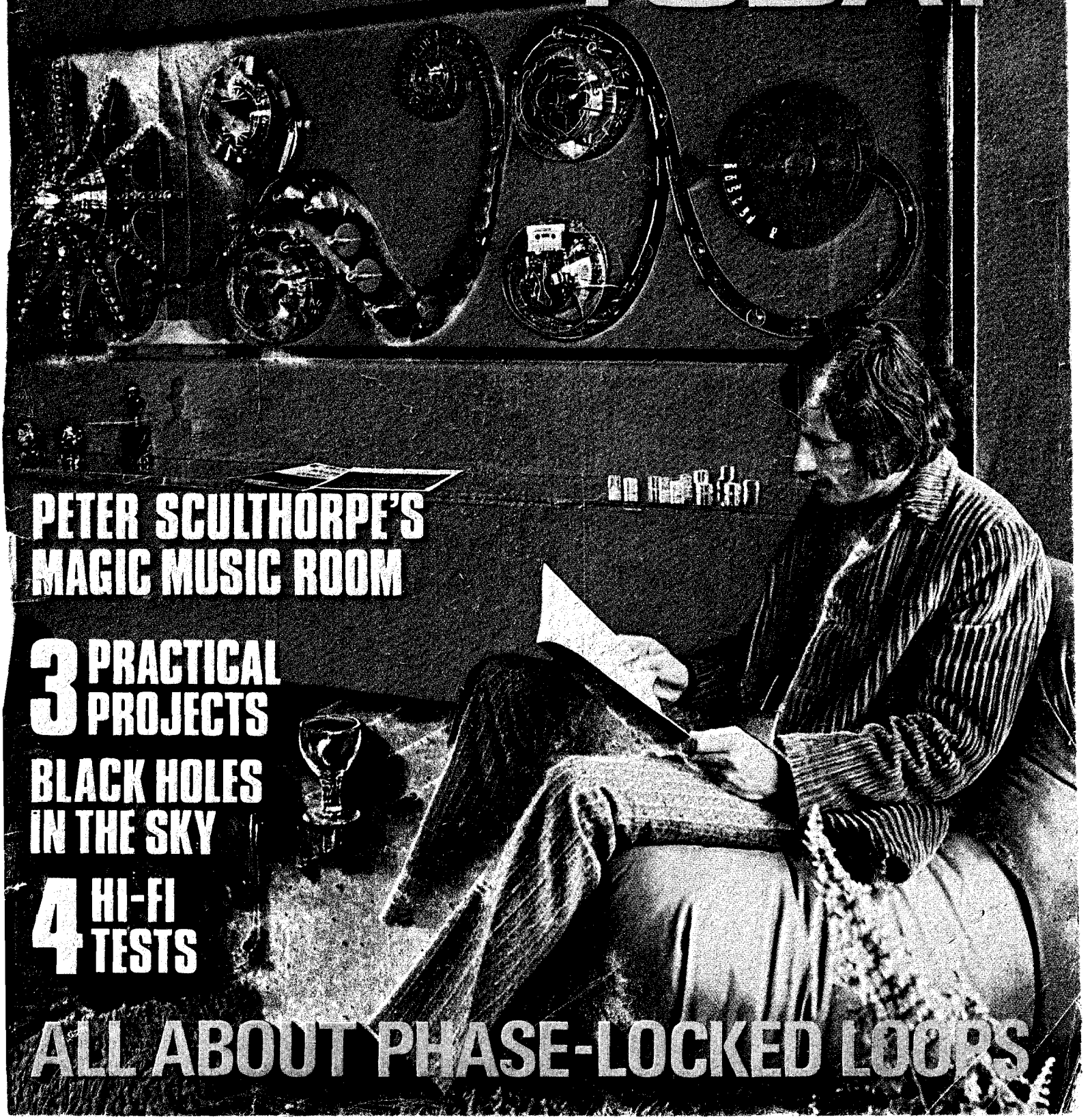


PETER SCULTHORPE'S MAGIC MUSIC ROOM

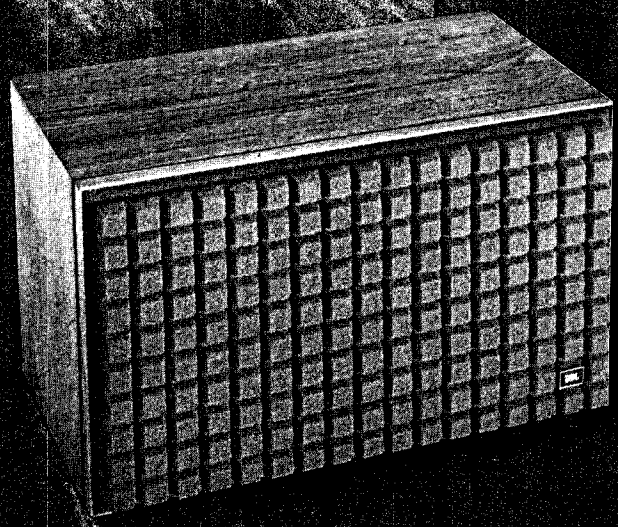
3 PRACTICAL PROJECTS

BLACK HOLES IN THE SKY

4 HI-FI TESTS

ALL ABOUT PHASE-LOCKED LOOPS

the century L100



specifications

eat
your
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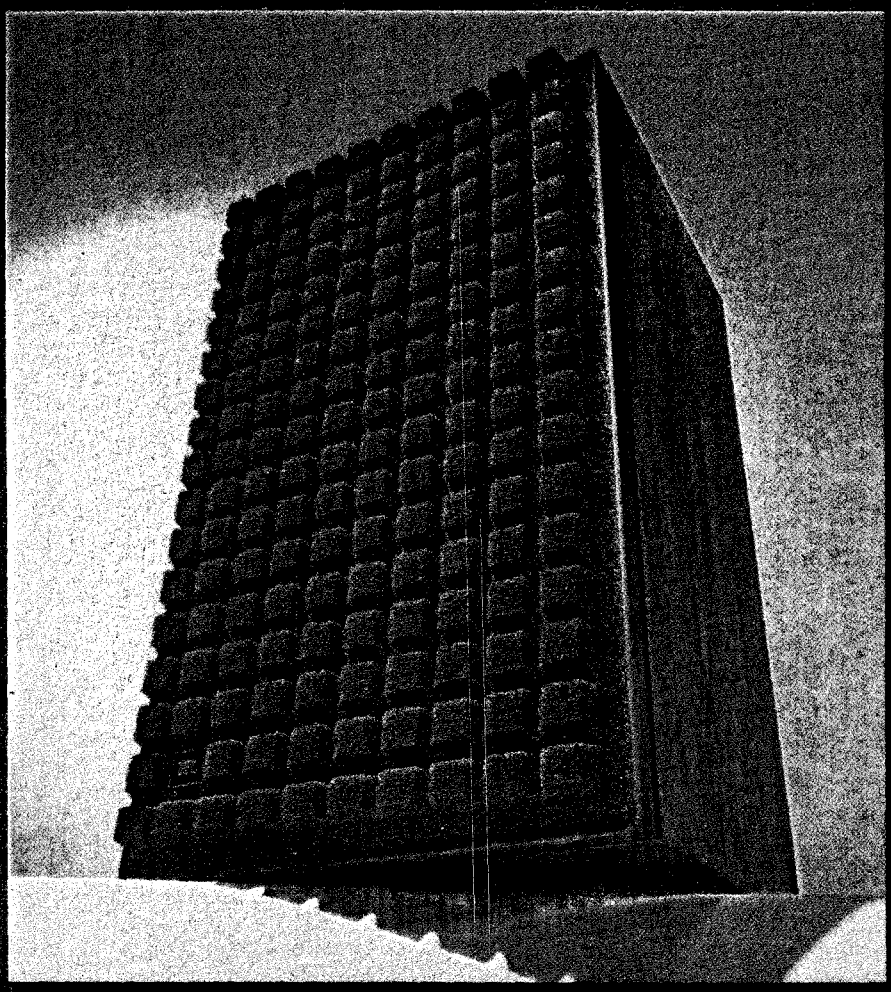
out



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news digest

Despite RCA's quoted ambition to become the number two computer manufacturer in the USA, the corporation's computer division never made it past number six. Their share was about 4%. By comparison IBM have 70%. Honeywell about 8%, Univac have 6% and Control Data and Burroughs share about 8% between them.

The closure of the computer division raises interesting legal speculation, for RCA recently guaranteed up to $45,000 damages to any purchasers if RCA failed to convert customer's equipment from IBM 360 variants within set times, costs and performances.

Estimates of the loss to RCA vary between $250 million and $500 million, and financial experts believe that at least another $2000 million would have had to be spent before the division became profitable.

MUMBO JUMBO

Passenger entertainment control units for the new QANTAS Boeing 747 jumbo jets are being supplied by Plessey Ducon.

These units, manufactured by Electronic Engineering Company of California, enable passengers to select any of seven audio channels or one movie sound channel by rotating a channel selector switch. A button and a switch provide hostess call and reading light control facilities.

The control units are fitted in an arm rest of each passenger seat and are connected to demultiplexers associated with each seat group. These demultiplexers receive a digitally coded multichannel signal from the zone multiplexer which combines the seven audio channels, the movie channel and the passenger address channel.

Selection of a channel by the passenger's control unit indicates a resistance level which represents a voltage level signal to the seat multiplexer which automatically selects and decodes the required channel from the multichannel signal.

In operation, each of the entertainment channels is sampled by the main multiplexer at a 25.6 kHz rate. At each sampling the analogue amplitude of the sampled audio signal is converted into a 12-bit digital word. Therefore, through one cycle of sampling (all channels) there is a series pulse train which contains the 12-bit words of all channels. This pulse train is a digital representation of the amplitude

news digest

advanced acousto-optic modulation and deflection technology.

The principle of Bragg reflection also lent itself to the visualizing of sound waves in bulk, Zenith researchers discovered. In essence, their research revealed that ultrasonic waves can be illuminated with laser light, and when so illuminated, can be seen without the aid of an instrument or converter.

This principle was applied to the development of an acoustic microscope that illuminates objects with waves of sound rather than light.

Most recent development from this research has been the Zenith acousto-optic character generator — an electronic device that translates input signals, such as those from a computer or a newswire, into readable numerals or letters of the alphabet. The character generator is silent, has no moving parts, and completely eliminates the need for a mechanical printer such as a typewriter in printout systems. It can print at speeds slow enough to be read directly, or as fast as several hundred thousand characters per second.

One simple version of the system, used in a demonstration at the 1971 IR-100 Exhibit at Chicago's Museum of Science and Industry, takes signals from the United Press International newswire and translates them into a visual display on a rotating phosphor-coated drum, so that visitors can read the news "hot off the wire".

Zenith was presented with the IR-100 award for the development of the M-40R laser modulator, an acousto-optic device that is an integral part of the character generating system.

Among practical applications, the most interesting might be the use of the character generator to take the high-speed output from a computer and print it on microfilm, thus eliminating the current bulky, inherently slow paper readout methods and current costly non-paper methods.

In addition to data processing and information readout displays, the system may find use in deep-space laser beam communications, short-link video-rate communications, telephonic print-out communications, optical ranging, video film, microfilm and microfiche printing, electronic typesetting, and vibration analysis.

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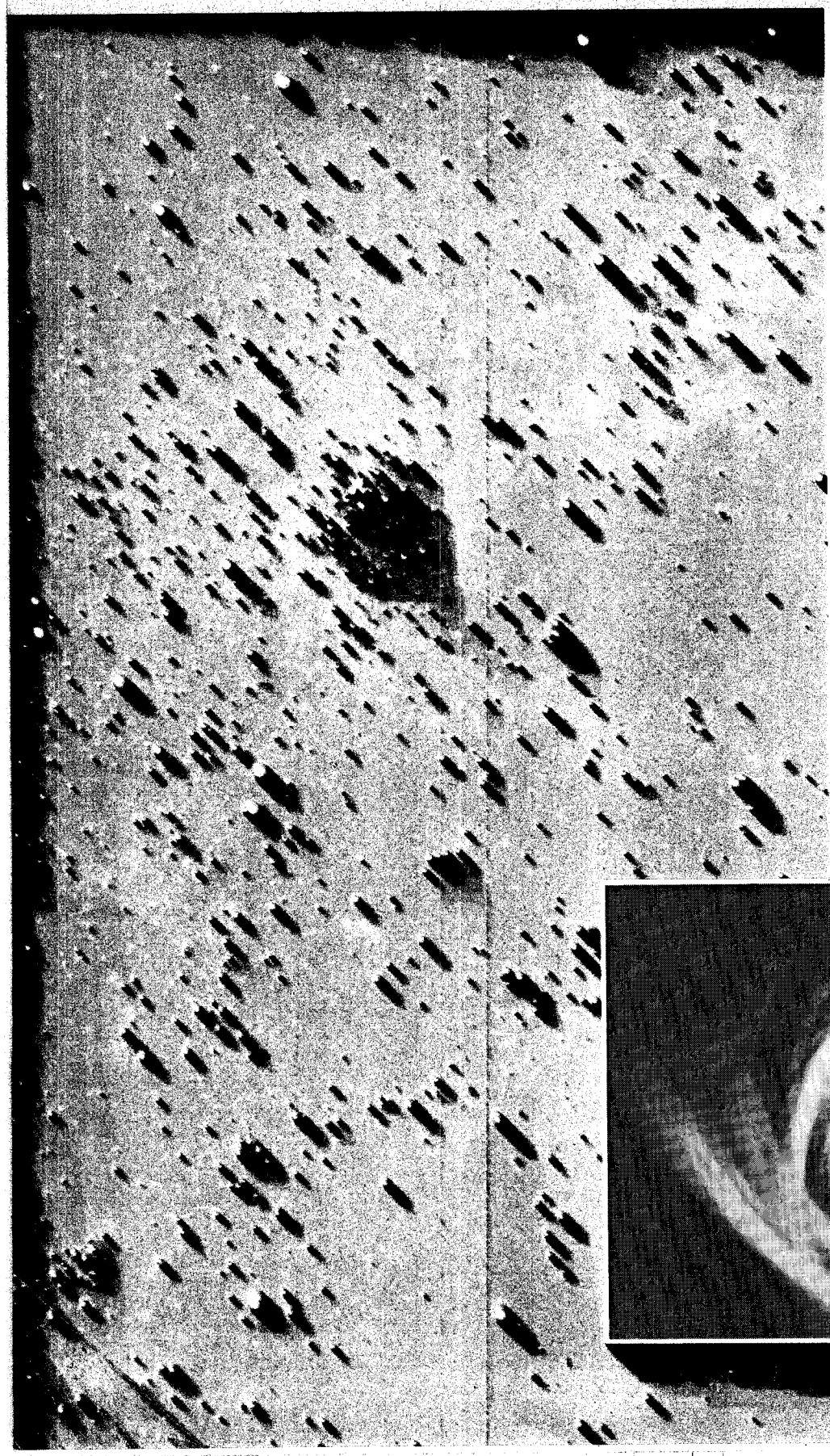
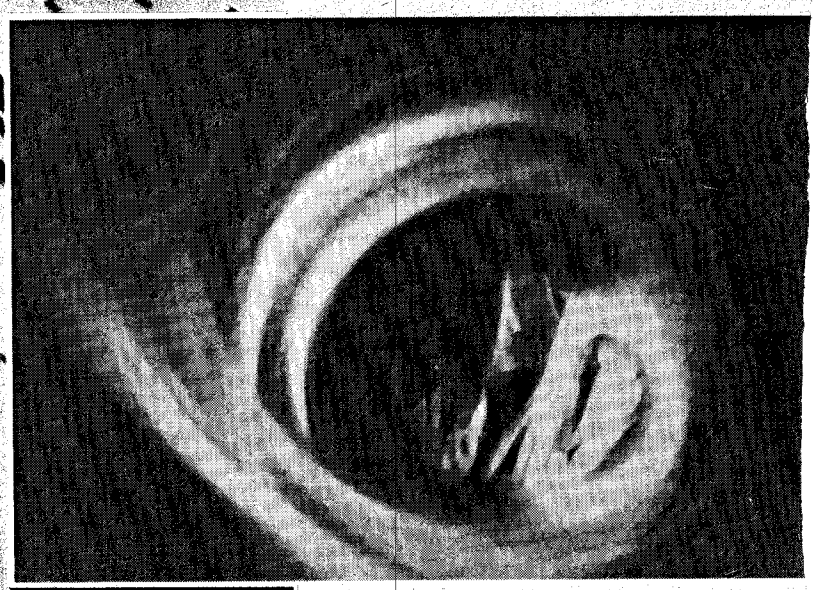
OF UTMOST

By Mort La Brecque, New York Academy of Sciences



DESPITE its complexities, the *General Theory of Relativity* is as simple in essence as all great creations of mankind: a mathematical poem about the nature of gravity and its profound influence upon the universe. Rather than the Newtonian force that attracts small objects to larger ones, Einstein said, gravity is a curvature in the space around objects similar to an indentation in flexible material; without their angular momentum, for example, the planets would literally roll into the Sun's deep gravitational pit.

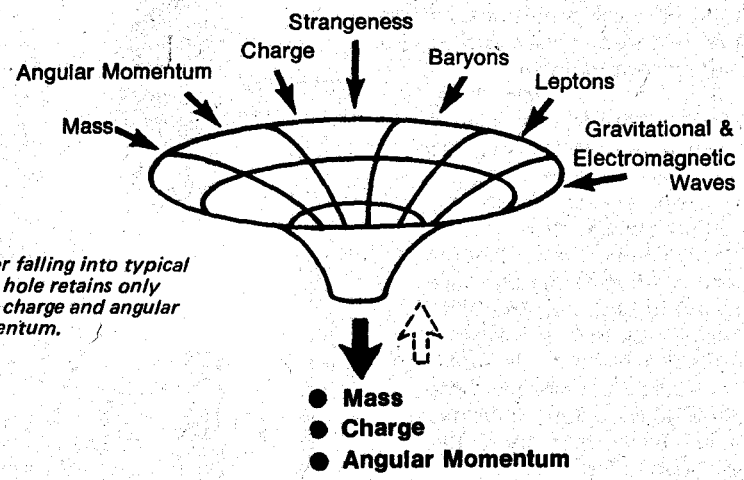
All forms of mass and energy are subjects of their own gravitational majesty. Four elementary forces account for known physical phenomena: the strong force and the weak force, both limited to atomic nuclei; electromagnetism and gravity, both of infinite range. In elementary particle interactions, electromagnetism is 10^{40} times more powerful than gravity. Because there are an equal number of positive and negative electric charges in nature, electromagnetism is largely neutralized beyond atomic dimensions; possessing a single charge, gravity's effects increase with mass. Its domain cosmological, gravity is the master field of existence.



GRAVITY

Black holes are stars, so dense that even light cannot escape the gravitational pull. A single cubic inch may weigh several billion tons. Here are the latest theories.

The most dramatic display of gravitional force in the universe is the death of stars twice as massive as the Sun which have become at least a million times more dense. Stars, extraordinarily hot hydrogen vapours held together by their own gravity, are self-sustaining fusion reactors that convert mass-hydrogen atoms – into energy: heat and gravitational pressure produce fusion, which produces heat and gravitational pressure. After billions of years, the hydrogen fuel is consumed and stars begin to cool and contract. According to Newton's inverse square law of gravitation, a one per cent decrease in all dimensions increases all gravitational forces by two per cent; ultimately, gravity overwhelms the stars.



Matter falling into typical black hole retains only mass, charge and angular momentum.

The resulting convulsions in stellar interiors, inaccessible to telescopic observation, have been computer-simulated at Lawrence Radiation Laborator by J. M. Leblanc and J. R. Wilson. If stars have twice the Sun's mass, their cores become denser than their outer portions, until they collapse, squeezed, in less than a tenth of a second, to a density comparable to that of an atomic nucleus. Simultaneously heated by the intense pressure to even higher temperatures – 10^{12}°K –collapsed cores then reverse implosion, acting as charges to set off supernova explosions in the stars' outer portions.

Such celestial fireworks, observed by Chinese astronomers in July, 1054, produced the Crab Nebula, a cloud of gas that still writhes and glows 6,000 light years from Earth and that may be a source of galactic cosmic rays. Quasars, quasi-stella objects that lie at enormous distances from the Earth, may be many supernovae exploding one after another to produce fairly regular light and radio waves, says Sterling Colgate, Socorro Institute of Mining and Technology, New Mexico.

The strong force, which binds the particles of atomic nuclei, halts gravitational collapse in supernovae stars, leaving objects that are several miles in diameter, weighing billions of tons per cubic inch and composed entirely of neutrons. Such properties as regular crystal lattices, superfluidity and superconductivity, ordinarily found only at very low temperatures, may characterize this superdense material, and normally short-lived particles may be stable in their cores. Spinning very rapidly at first, neutron stars emit energy, probably from their magnetic poles, and slow down; theoreticians have proposed such energy emissions as the source of the pulsar radio waves first discovered in 1967. Of the more than 60 known pulsars, NP-0532 in the Crab Nebula produces the most frequent signals – thirty per second – indicating that it is of comparatively recent origin and that it may be the remnant of gravitational collapse.

Small dying stars – less than 1.4 times as massive as the Sun – meet a different fate. Collapsing with neither a bang nor a whimper, they become white dwarfs, dense cold bodies whose mass is similar to Earth's. Pressure caused by electrons, spinning very near light's speed, successfully opposes gravity for small collapsing stars as the strong force does for medium-sized stars. Even in combination, however, these two most powerful physical forces cannot prevent the collapse of stars with more than double the Sun's mass. Because energy is equivalent to mass, dying stars that produce internal pressures to fight gravity increase their mass and gravitational attraction; the more massive the star, the greater its collapse. According to a prediction by J. Robert Oppenheimer and H. Snyder, made in 1939 and based on the principles of general relativity, very large cold stars collapse completely – beyond the neutron star stage to smaller and denser objects, whose stupendous gravitational curvatures are deathmasks that stretch deep in the structure of space.

Black holes, the systems produced by complete collapse of large stars and, perhaps, by matter accreting to white dwarf and neutron stars, have neither size nor shape in the conventional sense. Some are characterized only by mass, others by mass and charge or mass and angular momentum, and most by mass, charge and angular momentum – the basic constitutents of matter. According to theory, charged and uncharged objects revolving about completely collapsed stars reveal these three parameters, allowing one black hole to be distinguished from another. Although the diameters of all such systems are about 15 kilometers, the precise value depends upon mass, which may range from that of the Sun up to 10^{10} solar masses or more. However, no way is known to determine the original forms of matter and energy from which black holes are constructed. Irresistable whirlpools, they draw in additional particles passing their horizons. Matter, antimatter, neutrinos or gravitons, all are squashed in one direction and stretched in another by violent tidal forces until they fall apart, losing their identities forever as curvature of space.

Complete collapse is the source of bizarre relativistic phenomena that do not disobey but transcend familiar physical laws. Relativity defines time as an extension by three-dimensional space created by the active presence of matter in the universe; matter's

OF UTMOST GRAVITY

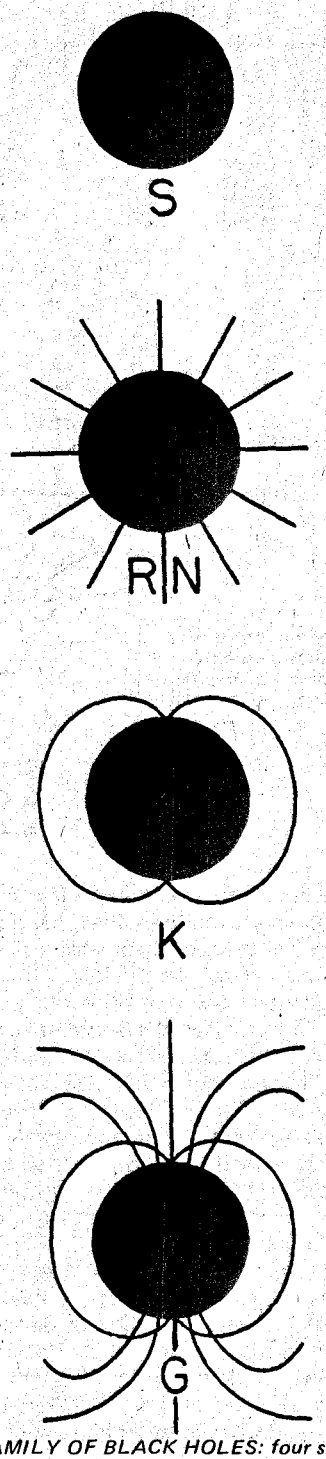
gravitational curvature warps space into spacetime, a geometrical manifold representing the history of physical events. Four-dimensional spacetime is so strongly distorted by a black hole's gravity that space and time exchange their characteristic properties; because the radius of their curvature is infinite, they become spacetime singularities. Under normal physical conditions, an object can remain in one place as time advances, but it must move forward in one direction in a black hole, occupying increasingly smaller areas of space. It can neither reverse its course nor regain its size, because space has unsurped time's progressive motion.

The spacetime warp also distorts time, in effect making it stand still for observers who witness events at a safe distance from a black hole. An object that falls into a black hole arrives at its centre in finite proper time – less than a second; if distant observers could see the object's travels, theory indicates that it would appear to stop at the black hole horizon, remaining poised there forever. "All signals and all information from the later phases of collapse never escape; they are caught up in the collapse of the geometry itself," write Drs. John Wheeler and Remo Ruffini of Princeton. *Physics Today,* Jan., 1971) Even with the most powerful telescope, observers could not actually see the object because light photons are also vulnerable to a black hole's suction; shifting infinitely to the red end of the spectrum as they fall in, they render the black hole black.

RELATIVISTIC THEORIES

Theoretical studies of gravitational collapse began soon after Einstein published his *General Theory of Relativity.* In 1916, Karl Schwarzschild developed the geometry of certain collapsed objects, a pioneer and classic work. According to the Schwarzschild radius equation, which relates mass to density, any gravitating mass compressed inside its Schwarzschild radius will curve space so much that light cannot escape: the universe fits this definition of a black hole, Dr. Ruffini told the writer.

However, Schwarzschild's geometrical formulations were much more restricted, limited to objects that are both spherically symmetric and non-rotating. Many stars show minor departures from symmetry and some are highly asymmetric. The question of whether such large departures might save a star from complete collapse has not yet been answered; however, using different methods, the Russian physicist Ya. B. Zel'dovich, and the



FAMILY OF BLACK HOLES: four states of completely collapsed stars, characterized by mass (Schwarzschild), mass and charge (Reisner/Nordstrom), mass and angular momentum (Kerr), mass, charge and momentum (Generalized). Black holes may alter from one state to another.

team of Steven Hawking, Roger Penrose and Robert Geroch have proved that black holes inevitably develop despite minor stellar asymmetries. Schwarzschild's geometry, also incomplete regarding the non-rotation of collapsed stars, was supplemented in 1963 by the rotational geometry of Roy Kerr, University of Texas. All stars have angular momentum; recently, James Bardeen, University of Seattle, proved that most have sufficient momentum to evolve into "living" black holes rotating at surface velocities equal to or near the speed of light.

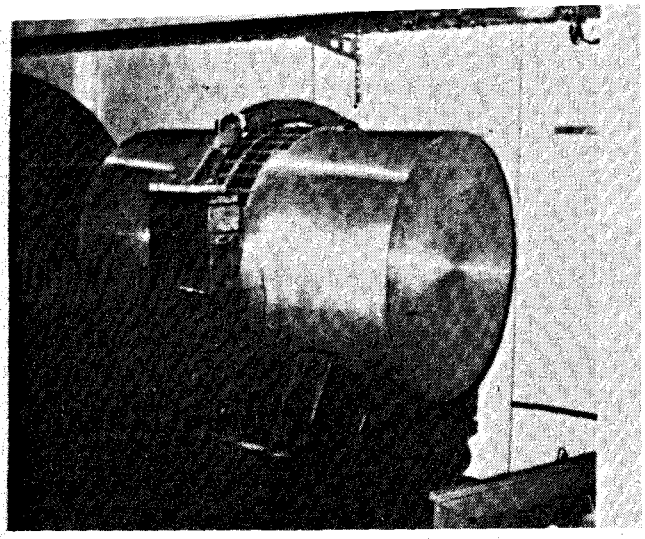
THE LARGEST POWER PLANTS

Rotating black holes are alive in that they can emit energy as well as absorb it and may provide mechanisms superior to fission and fusion for converting mass into energy. Dr. Bardeen has recently shown that, before they fall in, particles co-rotating with black holes will emit 42.3 per cent of their mass as gravitational energy.

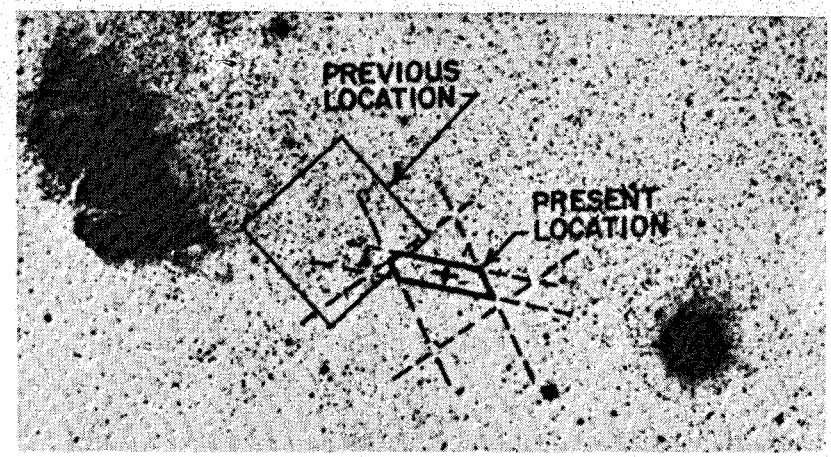
Drs. Ruffini and Demetrios Christodoulou, a 19-year-old theoretician who was recently awarded his Ph.D, propose in a paper submitted to *Physical Review Letters* that if rotating black holes are also charged, captured particles will emit all their energy, in a manner analogous to matter-antimatter annihilation. Charged rotating black holes are the largest storehouses of energy in the universe, they say, and up to 50 per cent of the rest-masses of these systems can be extracted.

An inventive proposal for easing hypothetical extraterrestrial power crises is proposed by Roger Penrose, mathematician at London's Birkbeck College, who says that black holes' phenomenal rotational energy could be used as a power source. Object masses could be totally converted to highest-grade energy in black hole ergospheres – regions between the surface of infinite red shift and the horizon, where particles can still escape black hole suction. Energy produced in ergospheres could then be retrieved. A more elaborate system of two stabilized structures, one rotating slightly with the black hole, would permit extraction of black hole rotational energy as well as energy contained in object masses: particles lowered into ergospheres would be split in half, one half escaping with more energy than the original particle.

Black holes are copious energy sources because they may contain most of the mass in the universe. According to general relativity, the closed and spherical universe will reach a maximum dimension and re-contract; sufficient matter must now exist to slow down and stop the present expansion by gravitational attraction. The density of matter predicted by theory is greater than the observed density in the dust and stars of galaxies by a factor of from 10 to 100. The missing matter may have been swallowed up by large numbers of black holes scattered throughout the universe, suggest Zel'dovich and I. D. Novikov and, more recently, A. G. W. Cameron of Yeshiva University's Belfer Graduate School of Science, New York. The high mass-to-light ratio of galactic clusters, deduced from their



Gravitational radiation emitted by destruction of enormous quantities of matter in the universe is detected by Joseph Weber's aluminium cylinder.



Is Cygnus X-1 a black hole? Negative astronomical map shows its 1967 location (square), and its present location (heavily outlined figure) inside area from which unusual X-ray emissions were detected by Uhuru satellite (four dashed intersecting lines).

motions and luminosities, has been attributed to the presence of unseen gas: such gas must be close to 10^6°K because it would emit radio waves at lower temperatures and X-rays at higher temperatures. And clusters of different sizes are unlikely to have gas at similar temperatures, Dr. Cameron told a recent meeting of the American Physical Society. The chemical history of the universe indicates that the earliest stars were very massive and would be expected to evolve into black holes, accounting for the observed mass-to-light ratio.

Because Einstein's ten non-linear partial differential equations for general relativity are time-symmetric, complete gravitational collapse demands a time-reversing, complementary event. Theoreticians are now trying to conceptualize white holes, stars that explode and emit matter and energy while black holes implode and absorb matter and energy. White holes are mandatory, according to the Einstein equations, but how they express themselves in the real physical world and what role they play in stellar energy phenomena is unknown. Determination of their boundary conditions — those physical conditions that they must fulfill at every point on their boundaries in space — may resolve these questions, says Dr. Raffini.

Although black hole theory is much more advanced than white hole theory, astronomical detection of black holes has proven extremely difficult. Since 1966, Joseph Weber of the University of Maryland, has experimented with antennas — instrumented bars of solid aluminium suspended by wires inside shielded chambers — to detect waves of gravitational radiation reaching the earth from events in space. ("Gravity Waves," *The Sciences,* Sept., 1968). His detection of many events indicates the large-scale destruction of matter in the universe. Any mass of asymmetrical shape whose configuration changes with time gives off gravitational radiation, but only gravitational collapse, involving large masses and very rapid change, is expected to provide an obvious source of radiation. Unfortunately, the newly developed gravitational radiation measurements are too crude for precision, but other techniques for discovering black holes have been put forward recently, leading to proposals of specific black hole sites.

The difficulties of finding black holes alone in space can be circumvented when matter falls into them, according to Professors Zel'dovich and Novikov; gas funnelled into the black hole heats by compression and radiates either in the visible part of the spectrum or in the X-ray and gamma-ray region, depending on the black hole's mass.

DIAGNOSING DISTANT X-RAYS

Uhuru, a NASA Small Astronomy satellite designed to detect stellar X-radiation, recently discovered three X-ray sources generating regular X-ray pulses of variable intensity: Cygnus X-1 in the Constellation Cygnus, Centaurus X-3 in the Constellation Centaurus and Lupus X-1 in the Constellation Lupus. Data for Lupus X-1 have not yet been analyzed, but Cygnus Z-1 pulses very rapidly — second in rate only to NP-0532 in the Crab Nebula, an X-ray and radio pulsar; Centaurus X-3 pulses slower than any known pulsar by a factor of two, but unexpectedly discharges as much energy as the Crab pulsar. Unlike conventional pulsars, Cygnus X-1 and Centaurus X-3 emit no radio waves and have no detectable gas clouds, properties presumed inherent in neutron star remnants of supernovae. These X-ray sources are rotating collapsed objects which may be peculiar neutron stars, a new class of objects, or black holes producing great quantities of radiation when matter funnels into them.

An alternative means of black hole detection arises when they are members of binary systems of co-rotating stars, close enough to their normal companions to draw in matter. Epsilon Aurigae, an eclipsing binary system, has a super-giant primary star 35 times as massive as the Sun, and a very mysterious secondary component nearby. Only the primary's light is ordinarily visible; the secondary's mass of 23 Suns should be 40 per cent as luminous as the primary. During eclipses lasting 700 days, "additional absorption lines associated with the secondary appear in the spectrum, indicating the presence of small amounts of dilute gas along the line of sight with an excitation temperature similar to that of the primary star," says Professor Cameron. (*Nature,* Jan. 15, 1971) He suggests that gas particles emitted from the primary are pulled into orbit around the secondary in the form of a large disc and then spiral downwards; because the secondary's present mass is too large for a white dwarf or a neutron star, it may originally have been more massive than the primary and collapsed into a black hole. Dr. Cameron recommends increased infrared observation of Epsilon Aurigae, improved orbit determinations and continued photometric coverage during eclipses to confirm his proposal.

Discovery and study of black holes has the greatest cosmological significance: complete gravitational collapse of stars may offer small scale models of complete collapse of the universe, according to relativistic theoreticians. Einstein published general relativity believing, as did most of his colleagues, in a closed universe of constant size. In 1922, however,

(Continued on page 118)

THE PRINTED CIRCUIT MOTOR

This article, written exclusively for Electronics Today by R.M. Evans C. Eng, M.I.E.E. of the National Research and Development Corporation, explains the principles and operations of the printed circuit motor. Electronics Today makes due acknowledgement to the staff and management of Printed Motors Ltd., without whose co-operation and considerable assistance this article would not have been possible, and to the National Research Development Corporation for permission to publish.

THE printed circuit motor was invented during the late 1950s. It is generally attributed to J. Henry-Baudot, employed at that time by the Societe d'Electronique et d'Automatisme in Paris. The printed circuit motor arrived on the industrial scene at a time when printed circuit techniques were being generally applied to a host of applications that had previously used solid conductors. Before the technique could be used for an electric motor, a suitable form of construction had to be found, and here the inventor dug deep into history to utilise the Faraday disc principle discovered in 1831 and which was the forerunner of all electric machines.

PRINCIPLE OF OPERATION

One big drawback of the original Faraday disc motor was that, because in essence the armature consisted of a single turn, it required the supply of very high currents at low voltages. This was unwieldly, consumed a lot of power and required the brushes to pass very heavy currents.

Although the principle of the Faraday disc has recently been resurrected for high current generators, traction motors and superconducting machines, it fell into disuse for a long period, during which the drum type machine as we know it today was developed. The excitation flux in a conventional dc machine is usually produced by energising coils located on the stator. The rotor has a multiturn winding arrangement with end connections brought out to a commutator and this allows considerable freedom of choice in deciding rated values of current and voltage. Because the excitation flux would otherwise have to cross the relatively large air gap presented by the bore of the machine it becomes necessary to locate the armature or rotor conductors in a magnetic core to minimise the reluctance of the flux path. This increases the bulk, cost and inertia of the armature and magnifies the commutation problems.

The essence of the printed motor is that it combines the advantages of both disc and drum type constructions without the disadvantages of either. By an ingenious design of armature which allows the printed circuit motor to be made in thin pancake form, the flux air gap is reduced to a minimum and no iron is required in its construction. And by having a multipole arrangement it becomes possible to design for practical levels of rated voltage, keeping current to manageable proportions.

A simplified diagram showing the basic principle at the printed motor is shown in Fig. 2. As can be seen by

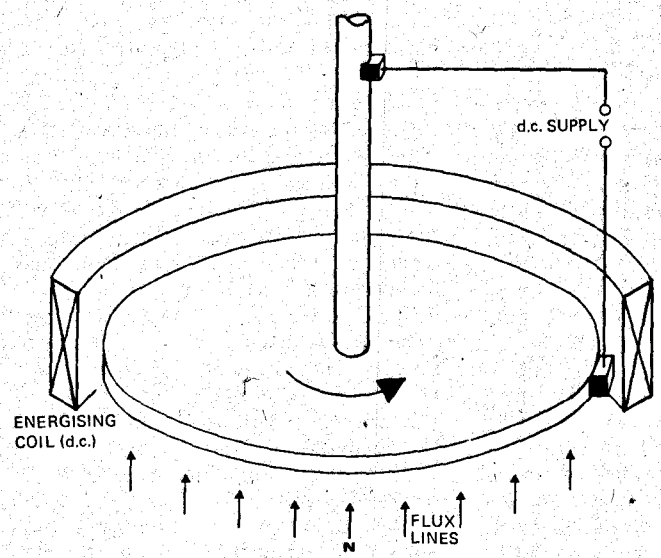


Fig. 1. Basic Faraday disc motor.

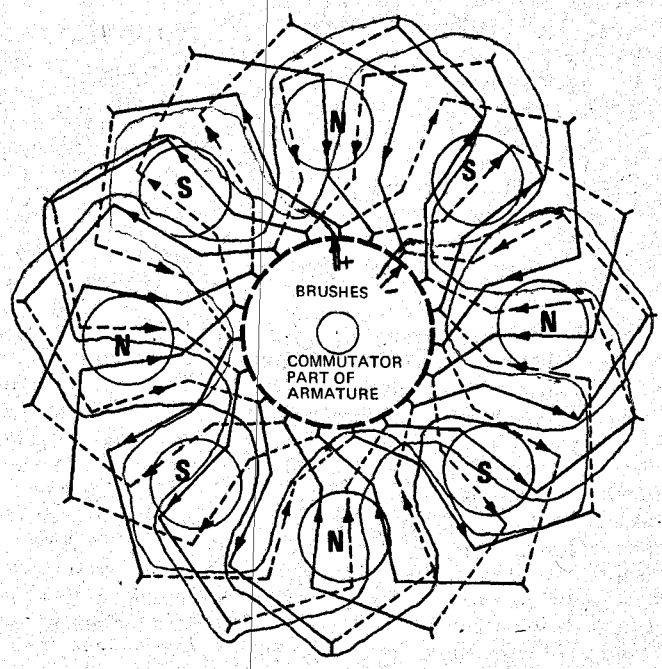


Fig. 2. This drawing shows the basic principle of the printed motor. The solid lines represent conductors on the front face of the armature; broken lines represent conductors on the rear face. The commutator is part of the armature.

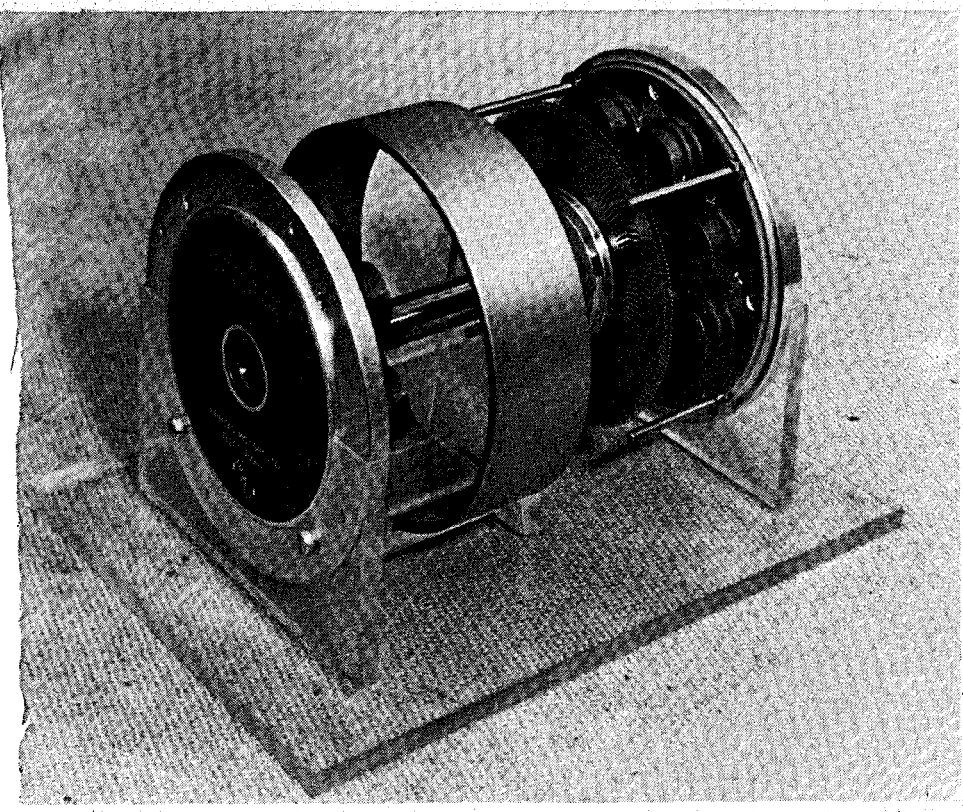


Fig. 3. Exploded view of a printed circuit motor. The windings wrapped around the pole pieces are used only for the initial magnetization. They are subsequently sealed off and left in position to avoid disturbing the magnetic circuit.

alternating the polarity of adjacent pairs of poles it becomes possible to connect the conductors under each pole in series, in a classical wave-wound arrangement in which the voltage rating V of the motor will approximate to:—

$$V \triangleq e \times \frac{n}{2}$$

Where e = induced voltage per conductor at rated speed

n = total number of conductors.

For simplicity only a small number of conductors per pole have been shown whereas in practice there will be a far greater number — the end connections between conductors are arranged geometrically to provide a running surface for the brushes which deliver the supply power to the motor thus dispensing with the need for a separate commutator.

CONSTRUCTION

The pole pieces which are made from Alcomax 3 are generally cylindrical in construction. They are located rigidly to their respective end plates as shown in Fig. 3 which gives an exploded view of one type of motor.

To achieve the best magnetic characteristics it is desirable to magnetise the motor after it is assembled into final form. The magnetisation is carried out by injecting the requisite dc current through the winding shown wrapped around the pole pieces. These windings are then sealed off and left in position as it would be impossible to remove them without disturbing the magnetic circuit.

When these motors first appeared on the industrial scene the armatures were formed using printed circuit techniques, i.e. copper foil on an insulation backing piece etched to give the requisite conductor layout. This was later superseded by a mechanical system of punching and the armature shown in Fig. 3 has had the notches between conductors produced by this process. Although no longer truly descriptive of the method of construction, the term 'printed circuit' motor has remained.

The armature starts off as two, four or six copper discs punched out in the manner described. With alternate discs reversed, they are then cemented together in pancake form with a circular wafer of insulation interposed between them.

CONNECTION

Electrical connection is made between the ends of the conductors on one face and the ends on the other so that a wave winding is formed. The 'chevron' part of each conductor is the "useful" portion which passes under the poles — all the 'forward' conductors, (shown with heavy lines in Fig. 2) are on one face whilst the "return" conductors (dotted) form the face on the reverse side.

The conductor contour of the armature is computer designed for optimum performance. The geometry ensures that the end connections align when placed back to back, and the curved portion forms a track on which the brushes run — the armature is thus provided with its own inbuilt commutator.

The remainder of the construction is fairly straight-forward, the armature is clamped to the main shaft which is located in bearings in the end plates, Brush housings are provided in one of the end plates though which special silver graphite brushes make contact with the armature.

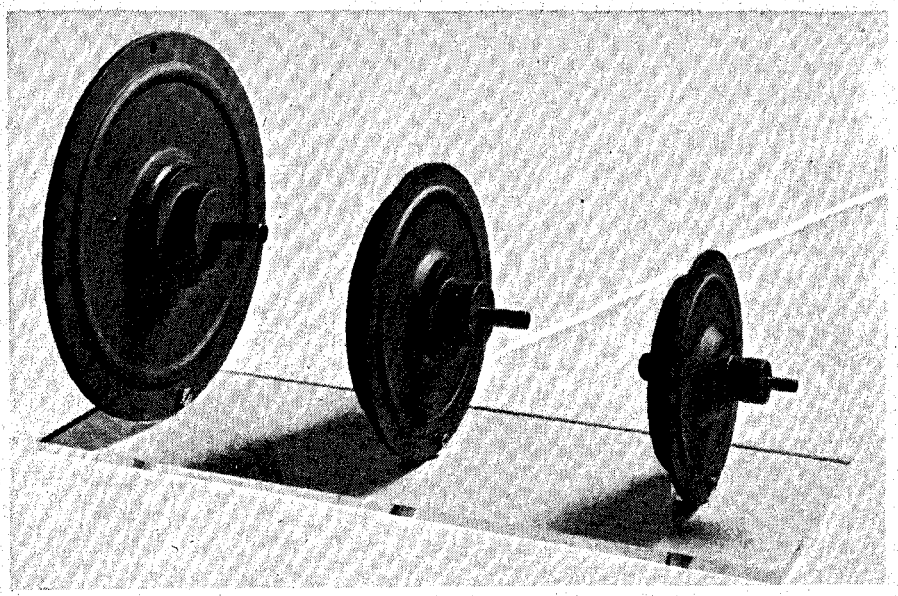


Fig. 4. Typical 'general purpose' printed circuit motors with ratings from 12 to 350 Watts at speeds of up to 4000 rpm. Rated voltage is from 12 to 47 volts.

THE PRINTED CIRCUIT MOTOR

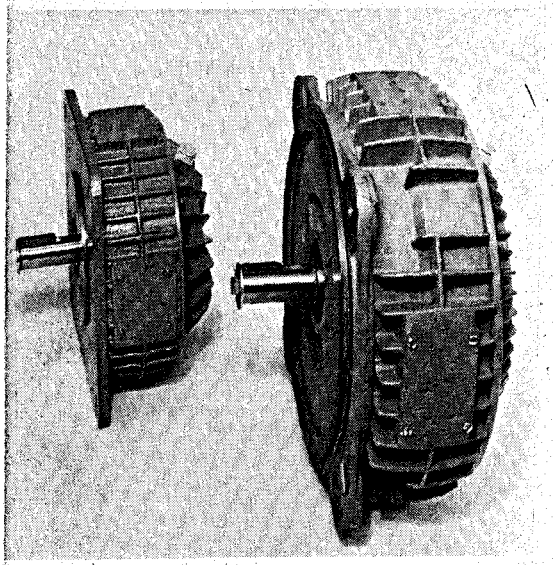


Fig. 5. These high power servo-motors are rated 1000 to 5000 Watts.

Because of its unique construction the printed motor has several advantages to offer over the more conventional machine.

The armature contains no iron in its magnetic circuit, therefore armature reactance is negligible. This is a particularly important feature especially in regard to commutation, as the high coil voltages induced in conventional machines (due to the rate of change of current during the commutation cycle) are not present. Commutation is thus virtually sparkless and the motor will accept very high current surges without damage. These characteristics are ideal for fast accelerating duties — in fact by suitable current injection a starting torque five times normal may be obtained.

Again, because of its negligible armature reactance, the motor has a virtually pure resistive input impedance. Changes in supply voltages almost instantaneously reflect a current change in the windings, and this, together with the low rotor inertia, make the printed motor eminently suitable for control applications.

A printed circuit motor runs smoothly at all speeds and being of a slotless construction and having a relatively large number of conductors (and thus commutator segments), cogging is eliminated. All armature conductors are exposed to the cooling medium enabling high current densities to be employed. Since the only insulating medium is that of a simple disc between armature faces, the cost of insulating for a higher working temperature category is not very great.

Table 1[1] shows a dimensional comparison between conventional and printed motors.

PERFORMANCE

Figs 4 and 5 show typical printed circuit motors; those in Fig. 4 are termed 'General Purpose' and are available with outputs from 12 to 350 watts at speeds up to 4000 rpm, rated voltage varies between 12 and 47 volts dc. The high power servo motors shown in Fig. 5 are available in powers from 1000 to 5000 watts at speeds of 3000 rpm and rated voltage varying between 90 and 150 volts dc.

The absence of magnetic material in the armature also means that the torque output is directly proportional to the armature current and is not limited by saturation. This allows a pulse torque of up to five times the normal full load figure to be developed, but the motor must be derated as shown in Fig. 6.

A further important feature of the printed circuit motor arising from the linear relationship between current and torque is the fact that there is no degradation at high currents as a result of magnetic saturation. And as previously stated currents up to five times the continuously rated level can be handled, the only practical limitations being the design of the associated drive circuit. The armature, which has a relatively small thermal capacity, heats up quickly whereas the rest of the motor has a much longer time constant. The peak temperature reached by the motor after a number of current pulses is therefore the sum of these two effects, one proportional to the duty cycle and the other to the pulse duration. This relationship is shown in Fig. 7.

Typical torque speed characteristics of the 3000 and 5000 watts printed motor are shown in Fig. 8.

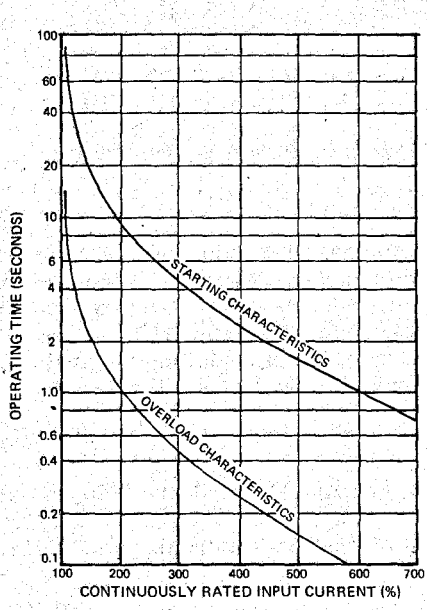


Fig. 6. Permissible motor overload current for short running times.

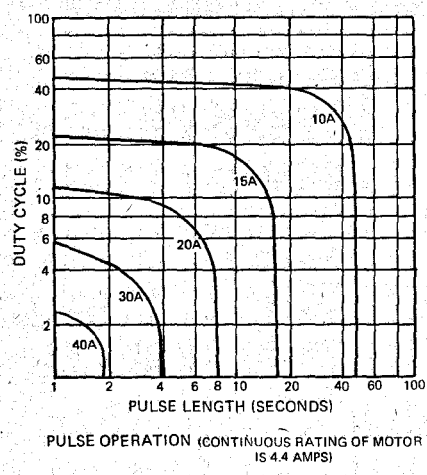


Fig. 7. This graph shows how a printed circuit motor, normally rated at 4.4 amps, can be used with pulsed operation.

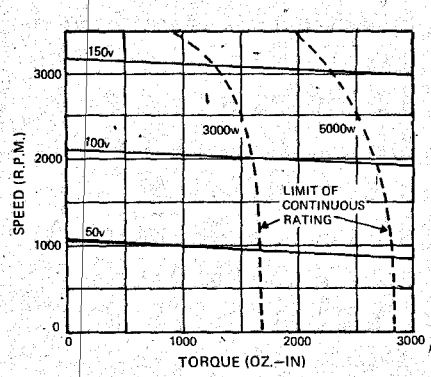


Fig. 8. Torque/speed characteristics of 3000 and 5000 Watt printed circuit motors.

APPLICATIONS

Printed circuit motors first made an impact on the industrial scene in computer peripheral applications, where their compactness, high current capacity and low inertia made them eminently suitable for tape drives. There has since been a steady inroad into the machine tool drive, graphic art, tape transport and traction fields and their introduction to the process industry as part of a packaged controller unit is imminent.

The high power/weight ratio of the printed motor combined with its compactness and high starting torque and overload capability make it eminently suitable for traction duties. Some thousands have been sold for electrically driven golf club carriers — Figs. 9 and 10 show lawnmower and tricycle applications. Fig. 10 brings

home the ease with which the motor may be adapted as the hub of a wheel taking up very little extra space in an application where space is at a premium.

Printed motors have been applied to the paper drive of U.V. recorders with some success. To record transient events which occur in mass spectrometry, it is necessary to use very high paper speeds, and to avoid wastage (the sensitised paper is costly) the recording speed must be reached in the shortest possible time. Utilising the rapid response of a printed motor to a pulsed supply, a roll of paper can be accelerated up to five metres per second in 0.3 seconds. The ease with which the speed of the motor can be controlled has also eliminated the expensive gearbox (with its attendant noise), making it possible to attain a continuously variable range of paper speeds of 5000:1.

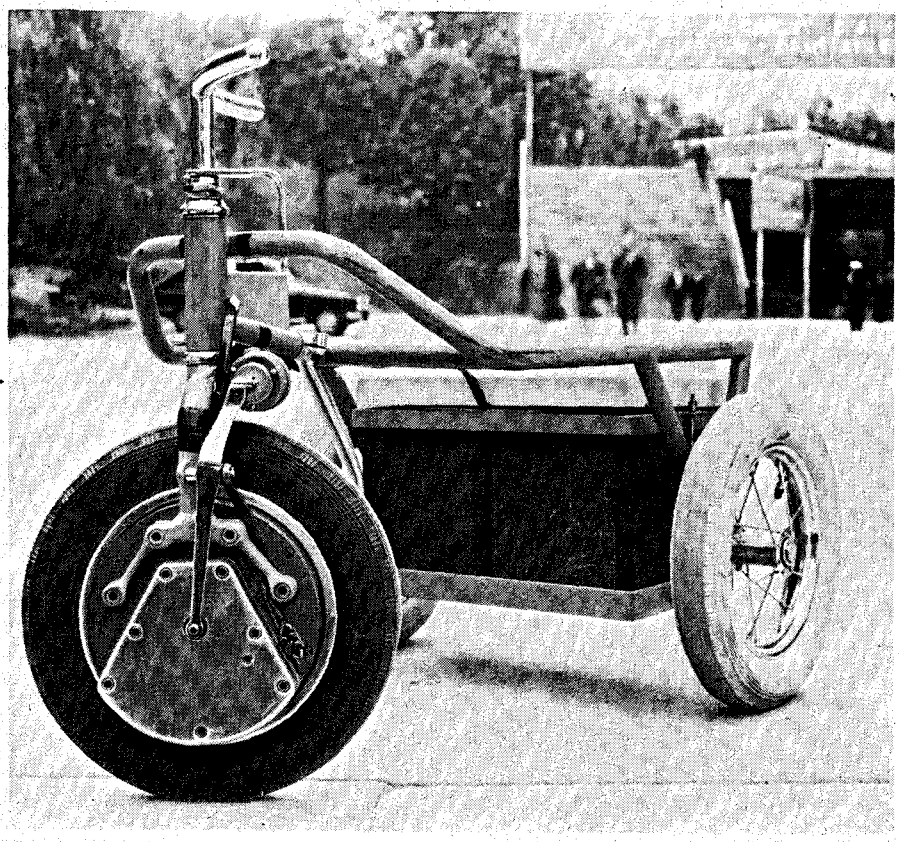
Another major demand for printed motors has been for servo applications, i.e. where precise control of the output shaft speed is required. This is generally obtained by using a feed-back loop so that any errors in the speed are automatically compensated for by adjusting the supply feeding the motor.

Magnetic and paper tape capstan drive servos are an ideal application where the tape speed is required to be held within closely defined limits so that analogue signals are faithfully recorded on and reproduced by the tape. A most accurate control method is the phase lock servo system marketed by Printed Motors Ltd., the block schematic of which is shown in Fig. 12.

In this system a high precision radially ruled optical disc is mounted directly on the motor shaft. The frequency of signal produced from the pick-off unit is compared with the reference frequency which represents the desired speed of the machine. If too slow, the dc amplifier increases the voltage supply to the motor, and reduces it if too fast, until the desired speed setting is reached. By this method motor speeds may be controlled to within an accuracy of 0.1%.

Fig. 9. This electrically powered lawnmower uses a printed circuit motor drive.

Fig. 10. The printed circuit motor of this electrically powered tricycle forms the hub of the front wheel.



An instrument tape transport system using printed circuit motors would have typical performance figures as follows:—

Start Time	4 sec at 120 i.p.s.
Stop Time	2 sec at 120 i.p.s.
Tape Accuracy	0.1% of nominal speed
Cumulative Flutter (peak to peak)	.25% at 120 i.p.s. (Bandwidth .1Hz to 10 kHz.
	1.7% at $\frac{15}{16}$ I.P.S. (bandwidth 1Hz to 200 Hz)

Although the servo capstan provides the tape drive, the tape still has to be wound and unwound onto the spools and to avoid stretching or breaking it is essential that the spool speeds be compatible with that of the capstan. This is accomplished by monitoring the tension in the tape and feeding back a proportional signal to the spool drive to ensure constant tension is maintained. Due to the relatively large inertia of its load, and the rapid excursions in acceleration torque that are required, the printed motor is ideally suited to handle the spool drive duty.

In data logging systems where the input is in digital form, the capstan drive speed requirements, (although in some respects similar to those for instrument tape transports), are not so onerous, tolerances between ± 4% being generally acceptable. Where the input is delivered in an intermittent

Table 1 shows a dimensional comparison between conventional and printed motors.

Continuous rated output at 3000 rpm (watts)	Length of motor (excluding length of shaft extn.) (inches)		Motor diameter (inches)		Weight (lb.)	
	Printed motor	Conventl. motor	Printed motor	Conventl. motor	Printed motor	Conventl. motor
230	2½	10	7	6½	16	34
1000	4¼	12	8¾	7½	30	68
1600	4¼*	15	8¾*	10	30*	150
3000	5½	18	12¼	13	66	240
5000	5½*	23	12¼*	13	66*	290

* Force cooled

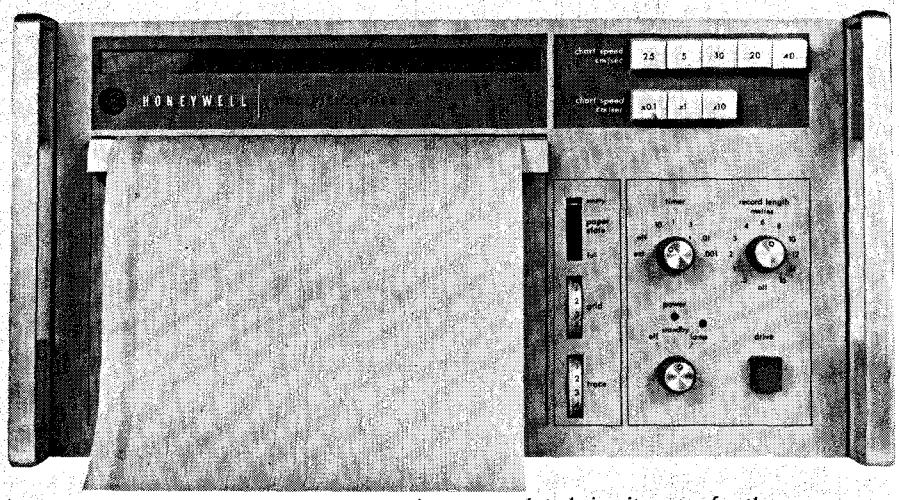


Fig. 11. This Honeywell ultra-violet recorder uses a printed circuit motor for the paper drive mechanism.

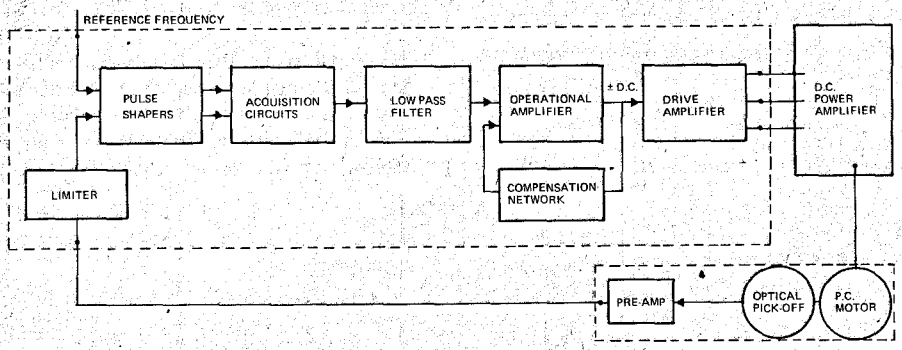


Fig. 12. This phase-locked loop servo system provides precise control of motor speed.

fashion it is desirable to have the tape driven discontinuously to save tape and storage space. An incremental mode of operation is therefore adopted, so that just before the digital information is required to be recorded, a command signal sets off the capstan drive. Obviously the speed of run up of the capstan motor is of a prime importance as this will determine the repetition rate at which information may be recorded. Typically the capstan is required to advance the tape in small discrete steps of about 0.001" so that packing densities of 1,000 bits per second may be achieved. An illustration of an incremental tape transport using printed motors is shown in Fig. 13.

In an entirely different field is the use of printed motors for operating large control valves where torques in excess of 10 lb.ft. are required. Fast operating time is required and by using a reduction gear in conjunction with a screw and nut arrangement piston speed travels in the region of 1" per second have been achieved. This is much faster than has been obtained using a conventional motor. A typical example is shown in Fig. 14. The printed motor in this illustration has a continuous rating of 25 oz. inches. The motor may be supplied directly from the process controller pulsed output, and an added advantage is that its high torque characteristics is invaluable in overcoming the valve stiction.

The virtually sparkless commutation action of the printed motor has been used to advantage in electron beam welding, where a drive was required for a work table which had to be fitted within a vacuum chamber under conditions of 10^{-4} mm Hg. Because of its inaccessibility it was necessary for the drive motor to be maintenance free for considerable periods. By fitting special brushes maintenance free life of up to 1,000 hours was obtained.

CONCLUSIONS

Although first invented during the '50s the printed motor has only gained acceptance as a reliable piece of electrical equipment over the past few years. But now the motor is making inroads into applications which have long been the preserve of conventional motors and there seems no reason why the high growth rate which has been achieved over the past few years should not be maintained, if not accelerated, in the future. ●

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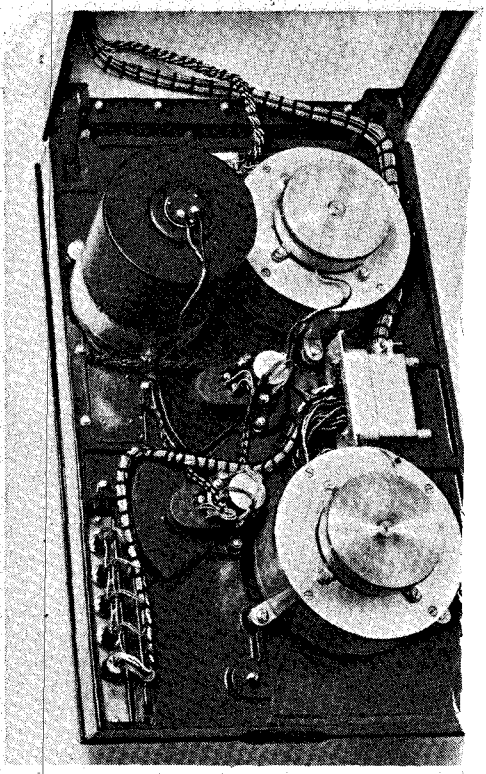


Fig. 13. The printed circuit motors used in the tape transport system of this data logging recorder advance the tape in 0.001" increments.

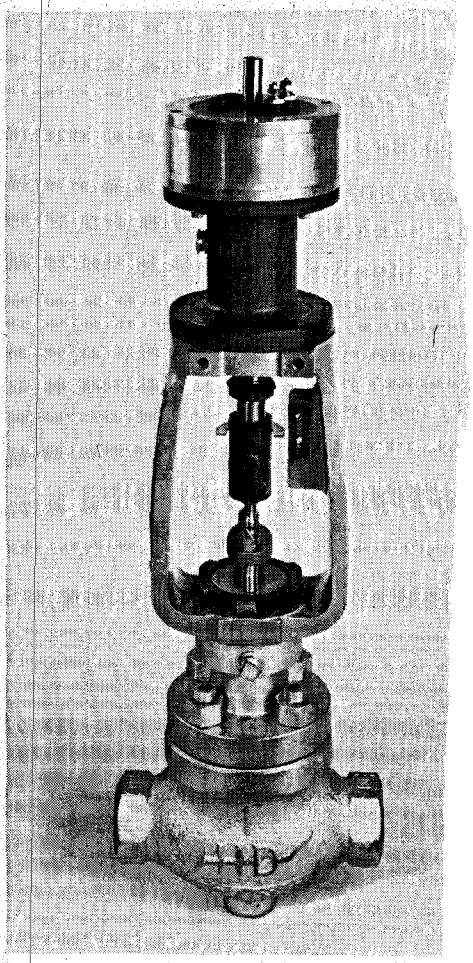
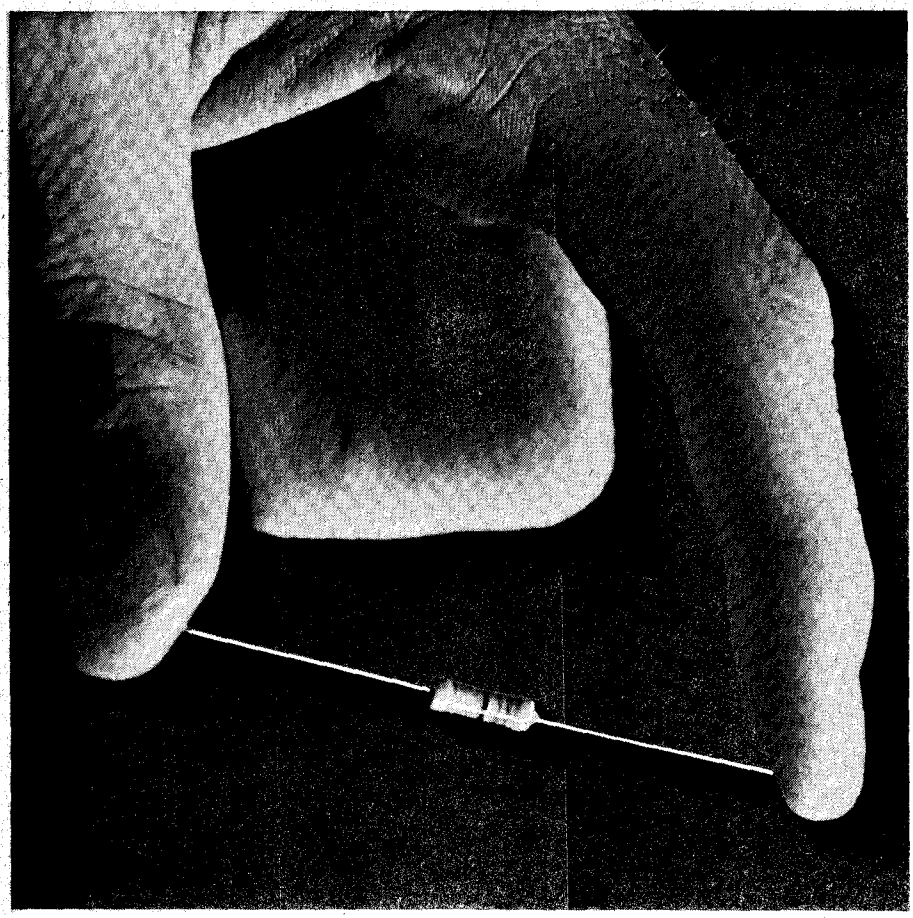


Fig. 14. This large control valve is powered by a printed circuit motor capable of sustaining 25 oz. in. torque.

The Philips resistor.



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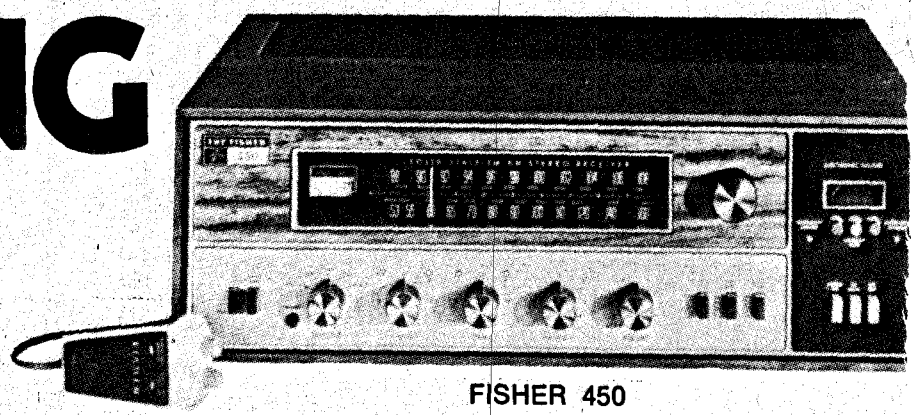
TUNING WITH NO MOVING PARTS



FISHER 450

By Leonard Feldman

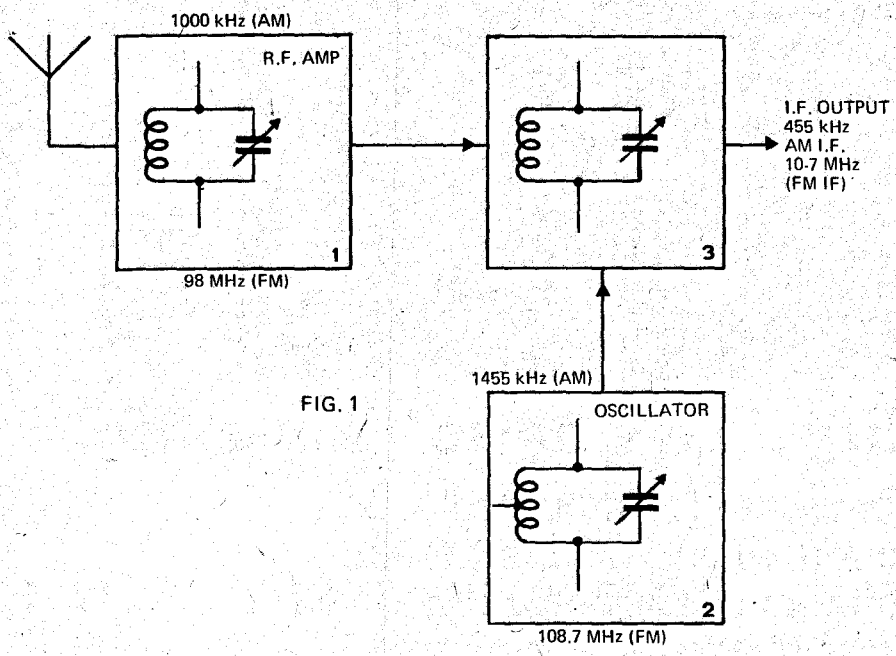


FIG. 1

DURING the past few years, tuners designed for high fidelity component use have reached levels of perfection undreamed of barely a decade ago.

Sensitivity figures have approached theoretical noise limits and are not likely to get significantly better because such limits, dictated by physical constants, do exist. Selectivity recently has undergone significant improvements thanks to crystal and ceramic filters which yield band-pass (or i.f. "response") curves which were once described as "text-book ideals." Proper use of field effect transistors in "front-ends" of tuners has enabled designers to reduce spurious responses and cross-modulation products that once plagued solid-state tuner designs, to levels which are as low or even lower than even the best cascode-triode designs of yesteryear.

It is therefore not surprising to find that engineering efforts are now being devoted to areas of performance not directly related to "specifications," but of great importance and convenience to the ultimate consumer. One of the most interesting innovations in this area is the transition to "electronic" tuning of both AM and FM frequencies in recent tuner and receiver designs.

By way of a quick review of the principles involved in "tuning in" a station using "superheterodyne" circuitry, let's refer to the block diagram of Fig. 1. The elements or blocks apply whether we're talking about AM or FM — only the frequencies are different — and an example of a station frequency received in each medium is illustrated numerically in the diagram.

The first block, labeled 'RF' is an amplifier, which both amplifies and selects the desired signal from amongst the myriad of radio waves present in the vicinity of the receiving antenna. The "selection" part of the process is accomplished by the use of one or more (sometimes as many as five or even six) "tuned circuits", sometimes called resonant circuits which, regardless of their "schematic diagram" complexity, can always be resolved into a combination of L (inductance), C (capacitance) and (R) resistance as shown in Fig. 2.

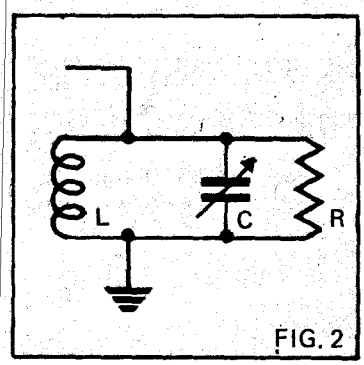


FIG. 2

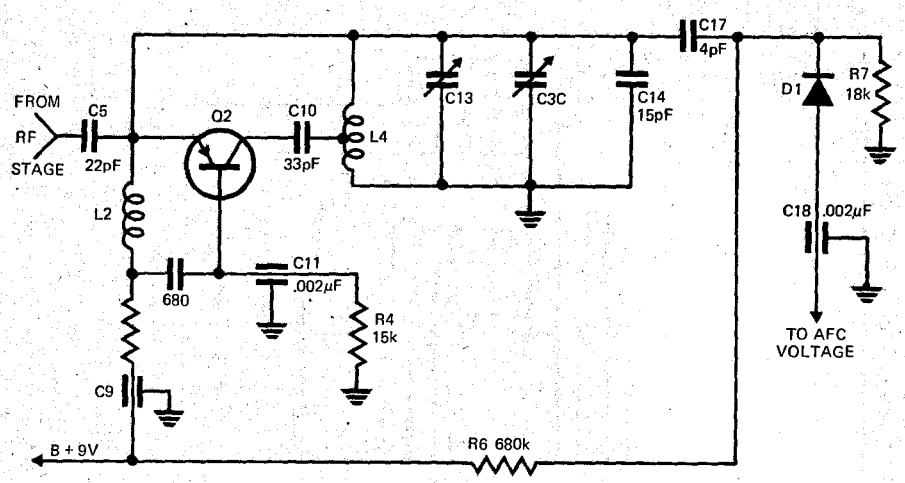


FIG. 3

Varactor diodes are replacing tuning capacitors in modern radio receivers.

Once the sections of the tuned circuit have been resolved down to these simple elements, the formula for the incoming frequency at which this circuit will resonate (or tend to be "selective") is $F = \frac{1}{2\pi}\sqrt{LC}$, in which L stands for inductance (measured in Henrys) and C stands for capacitance (measured in Farads). The value of R simply determines *how* selective the circuit will be, and therefore does not appear in the formula for frequency.

The second block of Fig. 1 also contains a tuned circuit, but it is tuned to a frequency *above* the desired station frequency. Its function is not to "select" but to oscillate, or produce a signal of its own, always removed in frequency from the desired incoming signal by the same amount (10.7 MHz in the case of FM tuners, 455kHz in the case of AM tuners). In block 3 of Fig. 1, the amplified "selected" incoming signal is "mixed" or "heterodyned" with the locally produced oscillating signal to produce a "difference" signal known as the i.f. frequency. (A "sum" signal is also produced in the process, but it is rejected by more tuned circuits in the i.f. stages which choose the desired "difference" frequency only.)

From the formula shown earlier, you can rightly deduce that to change the frequency of any of the tuned circuits present in a tuner "front end," you need only change either the inductance or the capacitance, and since both of these terms are in the denominator of the formula, an increase in either one of their values will cause a decrease in resonant frequency and vice versa. While some tuners utilized a variable inductance to change frequency of the various tuned circuits (this practice was quite popular in many automobile radios and even in some FM tuners years ago), by far the greater number have used *variable capacitors* to accomplish the "tuning" or change-of-frequency function.

DIODES AS CAPACITORS

The elimination of the variable capacitor as the main means for tuning to desired radio frequencies was made possible by the development of a very special kind of diode, usually called a "varactor" diode. Actually, these diodes, which behave like capacitors of a specific value when some "reverse bias" voltage is applied, have been used in consumer circuitry for many years.

Fig. 3 represents a simple FM converter stage, in which one transistor serves the dual purpose of local oscillator and mixer. The local oscillator resonant circuit constants consist of L-4 and C-3C in parallel with C-13 (a trimmer capacitor used to "fine tune" the main variable capacitor C-3C) and C-14 (a fixed capacitor required to establish the minimum and maximum values of total capacitance as C-3C is rotated from its closed to its open position). Notice however that there is another network, consisting of C-17 in series with diode D-1 in parallel with all of the foregoing components. One end of this diode has positive or "reverse bias" voltage applied to it because of the voltage divider action of R-6 and R-7. Since the diode is biased in the reverse or nonconducting mode and no dc current is flowing, this reverse voltage is easily calculated as 180 ÷ 680 x 9 V., or approximately 2.4 volts dc. At this reverse voltage, the diode has a certain amount of junction capacitance. Let us presume that it is 4 pF. The effective additional capacitance in the resonant circuit arising from the series combination of C-17 and D-1 is therefore two more pF.

Note, however, that the lower end of the diode is connected to "AFC Voltage" — a voltage which is *zero* when stations are perfectly tuned in, but which goes slightly *positive* if the tuner is tuned a bit too *high* in frequency. With a slight positive voltage at the lower end of the diode (let us say 1 volt), the *net* potential across the diode will now be only 1.4 volts. The effective junction capacitance will be *greater* — perhaps rising to 6 pF. Now the extra capacitance contribution of C-17 and D-1 in series amounts to 2.4pF (4.6 ÷ 10). The *total* capacitance in the overall resonant circuit is therefore greater, which means that the local oscillator will tend to oscillate at a somewhat lower frequency, tending to compensate for our having tuned the tuner off frequency on the "high side" in the first place. This is, of course, exactly what AFC is supposed to do. Had we been detuned below the correct frequency, the AFC voltage would have been slightly negative at the lower end of D-1, resulting in a greater reverse bias across the diode, a lower junction capacitance, a lower overall resonant circuit capacitance and a resultant higher local oscillator frequency required to "pull" the desired station back towards proper tuning.

The case illustrated is typical of AFC circuits that have been used for many

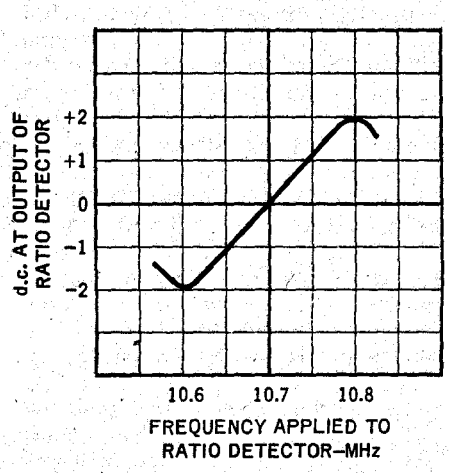


Fig. 4. Varying d.c. voltage at the output of the FM detector is used to automatically correct for improper tuning of stations.

TUNING WITH NO MOVING PARTS

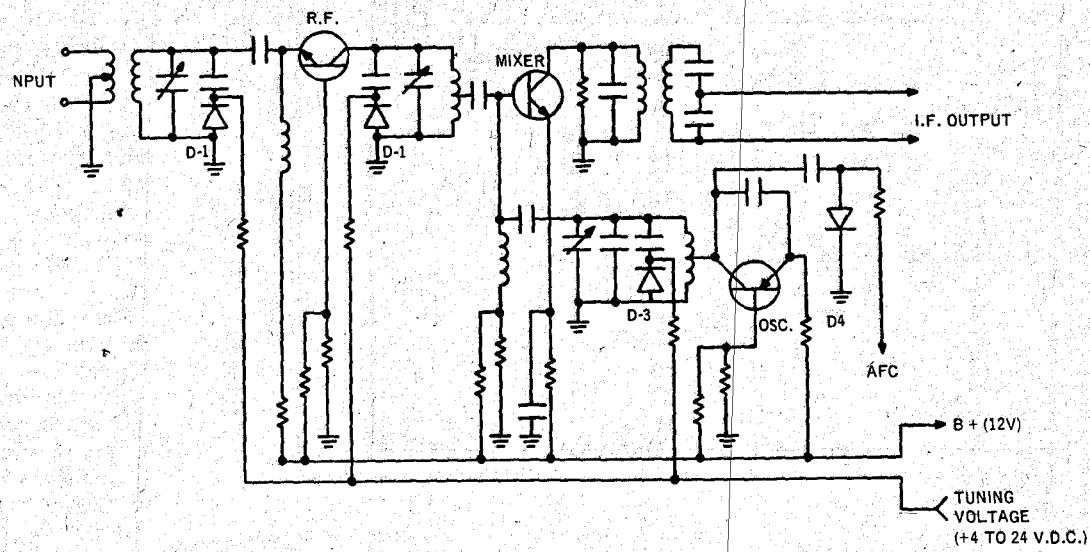


Fig. 5. Basic FM front-end by Görler, using three varactor diodes instead of the usual variable capacitor.

years. The varying voltage supplied across the diode to help "pull" the frequency of the local oscillator back where it belongs is derived from the dc output of the ratio-detector or discriminator circuit of the FM i.f. section, which has exactly the right kind of "plus and minus" excursion about a zero-center point to work quite nicely in this arrangement, as shown in Fig. 4. Remember, that 10.7 MHz is the desired center i.f. frequency. Incorrect tuning of the dial (and hence the local oscillator) leads to frequencies either above or below that number, as shown on the diagram of Fig. 4, and such departures from center frequency cause either positive or negative voltages at the detector output which are then used as AFC voltages in the manner just described. In a very minimal way then, tuners have been "tuned" by a varying dc voltage for a long time. It would seem a very simple transition to go from this "minimal" amount of tuning to full tuning of the entire set, just by varying the voltage applied to a diode. In order to understand why the transition was not so simple, let's consider the size of the change of capacitance required for covering the FM band (88 to 108 MHz) and then, the more difficult AM band (535 kHz to 1605 kHz). In the former case, the ratio of highest to lowest frequency (allowing for no overlap) is 1.35. Referring back to the formula for resonance, however, we see that this involves a change of capacitance of $(1.35)^2$, since the "C" term in the formula is inside the radical, or "square root" sign. Thus, the required change of capacitance to tune the FM band must be a ratio of at least 1.82 to 1. Since we usually want some overlap at the ends of the band, a ratio of 2:1 in capacitance would be more realistic. Now, consider the situation with the AM band. Here we are dealing with the ratio of 1605/535, or 3:1. Again, squaring this ratio leads to a capacitance change ratio of 9:1.

WIDE RANGE DIODES

As finally developed for wide range tuning applications, varactor diodes are p-n junction diodes, generally constructed of silicon, although gallium arsenide may be used for higher frequency response. Additional impurities may be introduced to increase capacitance variation as a function of reverse voltage applied. Figures of merit (Q), which determine the selectivity of the ultimate tuned circuit, can run higher than 100 — often as high as 200 or more.

Two examples of available varactor diodes for use in FM applications are the Siemens BB-104 and the Motorola IN5142A. The former has a typical capacitance (with 30 volts of reverse dc applied) of 14 pF and a capacitance ratio (if one varies the reverse voltage from 3 volts to 30 volts) of 2.65 — more than enough to cover the FM band. The unit is, by the way, a double diode, having a common cathode and as such can be used in two tuning stages or in a push-pull application when extreme linearity and symmetry is desired. The Motorola unit has a capacitance (with 4 volts of dc applied) of about 15 pF. Its ratio of capacitances (from 4 to 60 volts of reverse bias) is about 3.0 — again, more than sufficient for the FM band.

In 1966 Matsushita Company of Japan introduced an automatic tuning AM radio which used no moving parts for tuning. They developed a form of varactor diode which they called the "Capistor". The device is produced by an alloy-diffusion process and is of a hyperabrupt silicon junction. The

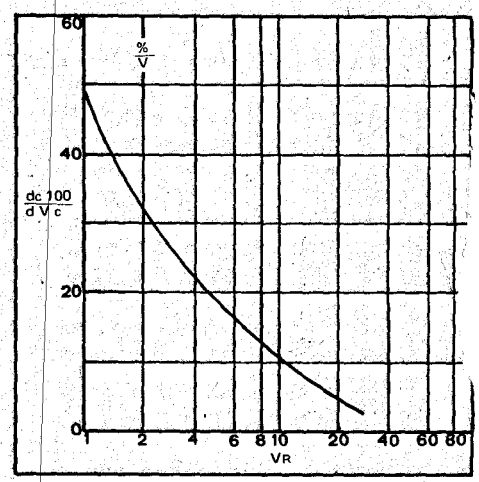


Fig. 6. Change in capacitance with applied voltage of a typical varactor diode.

ratios of capacitance obtained with a change of voltage from -1 V to -10 V is no less than 16! With maximum capacitance at about 250 pF, the device is quite suitable for covering the entire AM band, and that is how this radio was able to be tuned with "no moving parts." For whatever reason, not too many AM radio manufacturers have followed Matsushita's lead in this area, but an ever-increasing number of FM tuner and receiver manufacturers in this country and abroad have realized the niceties of "tuning with a dc voltage" and a number of designs have come forth — each taking better advantage of the inherent possibilities than the one before it.

As an example, consider the schematic of Fig. 5. It is a complete FM "front-end" developed by the Görler company of West Germany. Three tuned stages are used, each

equipped with a varactor diode in place of the familiar variable capacitor symbol. (The "variable capacitor" is a trimmer capacitor, set once during alignment, to help the varactor diodes "track" over the entire FM band. It is not moved during the actual station-to-station tuning process). Diode D-4, is the old familiar "AFC" diode, still being used in its minimal capacitance-changing mode along with its more sophisticated "first cousins," D-1 through D-3. Tuning voltage required ranges from 4 to 24 volts, with the 4-volt bias corresponding to 87.5 MHz and the 24-volt point providing coverage up to 108.5 MHz. (See Fig. 6). Obviously, a simple potentiometer or variable resistance hooked up as in Fig. 7 is all that is needed to tune this front-end. Equally obvious is the fact that if a simple power supply was used to provide this variable voltage, any slight variation in ac line voltage would cause a substantial shift in frequency – more than the compensating AFC circuits could cope with.

Again, diodes come to the rescue – this time zener diodes which exhibit the remarkable characteristic of "breaking down" at specific reverse voltages and changing their internal impedance with current flow in such a manner that the voltage appearing across the diode is very nearly constant over a wide range of current flow. A typical power supply for use with the varactor front-end of Fig. 5 is shown in Fig. 8. With an available accurate source of variable voltage, accurate, stable tuning using just this variable voltage is assured.

TUNING INNOVATIONS

Given the "new freedom" of no mechanical linkages and no moving parts, engineers came up with a variety of sophisticated tuning aids. The first one to suggest itself was the "push button" radio, in which several favourite stations may be "pre-set" by turning individual potentiometers, connected to the source of voltage and the "tuning voltage" point of the front-end by means of individual switches in the form of push buttons. (Fig. 9).

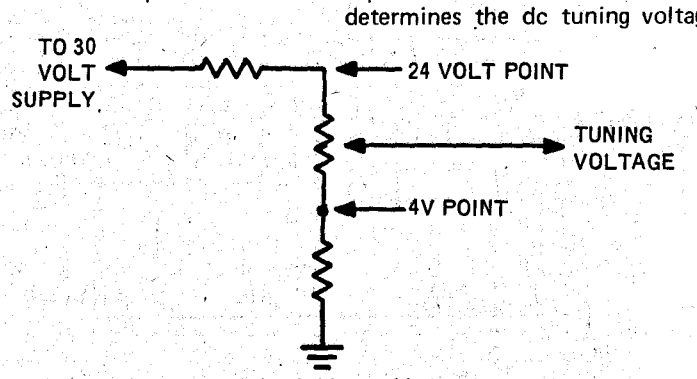


Fig. 7. A potentiometer acting as a voltage divider could easily serve as the "tuning control" for the circuit of Fig. 5.

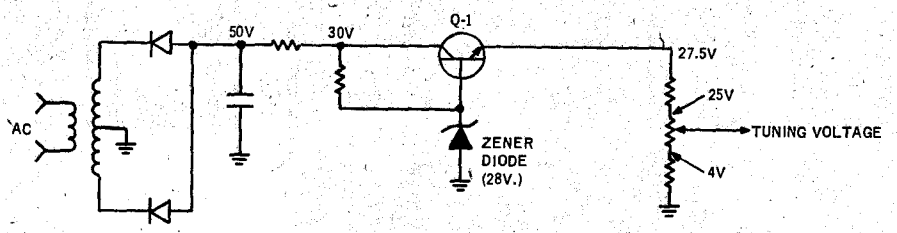


Fig. 8. A Zener-diode regulated power supply provides tuning voltage. Transistor Q-1 improves temperature stability of the system.

AUTOMATIC TUNING AND SIGNAL SEEKING

To Fisher Radio Corp. must go the credit for carrying the varactor-tuning concept to its present level of sophistication. Not content with just a few preselectable stations, Fisher engineers devised two more forms of tuning.

Called 'Autoscan', one form of the circuit "scans" the dial from low end (88 MHz) to high end (108 MHz) in a slow sweep, automatically stopping along the way when stations are properly tuned in. When 108.0 MHz is reached, the tuning voltage instantly lowers to the 88 MHz setting the process starts again, always in the up-scale direction.

In the other version of Autoscan, buttons are available enabling the user to tune down-scale or up-scale, depending upon which button is depressed. The former circuit is used in Fisher's 450-T while the latter appears in Fisher's 500-TX and their new four-channel Model 701. A complete schematic of the somewhat simpler circuit is reproduced (with their kind permission) in Fig. 10, and the explanation of the workings of the circuit, as contained in their service manual, is so clear an exposition that we have taken the liberty of quoting it, almost verbatim.

HOW 450-T AUTOSCAN WORKS

Transistor Q-902 provides the constant-current source to charge capacitor C-906 which actually determines the dc tuning voltage for the varactor front-ends. As voltage on C-906 rises, the front-end tunes higher in frequency, towards 108 MHz. Q-903 is a unijunction transistor. When the voltage across C-906 reaches approximately 25 V dc which corresponds to the emitter peak-point of Q-903, C-906 is discharged through Q-903 to approximately 3 volts dc. As soon as C-906 is thus discharged, Q-903 resumes its normal, essentially open-circuit condition and the charge cycle begins to repeat.

Field-Effect Transistor Q-901 is a variable shunt across the constant-current charging source. Its gate is dc coupled to the output of the ratio-detector. When the output voltage of the ratio detector sweeps through zero (which corresponds to exact centre of station tuning), Q-901 loads the charging source so as to maintain a constant tuning voltage across C-906. The hold control adjustment, R-909, is used to set the load current equal to the charge current (constant tuning voltage) when the gate voltage is zero. The source of Q-901 is dc coupled to the audio muting circuit. When the receiver is tuned to center-station, the muting output voltage is approximately zero. As the receiver is tuned off-station, however, the muting voltage applied to the source of Q-901 through R-910 rises to + 15 V dc, allowing the tuning voltage to rise once more. When the receiver scans upwards in frequency to the next desired station, muting and detector voltages both swing through zero once more, and Q-901 loads the charging source Q-902 to establish and hold the new correct tuning voltage.

The emitter of Q-906 is dc coupled to the i.f. amplifier. With the receiver tuned to a station, Q-906 is reverse biased and operation of the i.f. amplifier is unaffected. When either the continuous advance or the one-station advance button is pressed, the grounding of C-904 temporarily drops the base voltage, forward biasing Q-906 and shorting out the i.f. amplifier. The drop in output of the i.f. amplifier releases the hold on the tuning voltage across C-906 and the receiver begins to scan. As the voltage

(Continued on page 85)

THE PHILIPS GA202 TURNTABLE

This latest Philips unit has servo-controlled drive motor

The GA202 electronic turntable is one of the newest and most unusual record players that the giant Philips organisation has yet released. And whilst the turntable appears to be similar to many other domestic units there are engineering differences that make this unit quite different from the rest.

One doesn't for instance, normally expect to find a 5 Watt germanium power transistor, let alone a photo-cell underneath the turntable!

The major difference between the GA202 and most other units is that the turntable is *electronically* driven. Philips have used a commutator motor, energized by an oscillator and power amplifier (hence the 5 Watt transistor) the half-wave unrectified output of which is variable to provide for speed changes.

An ac tacho-generator, driven directly from the commutator motor spindle provides an electrical speed reference that is used as a control signal in a feedback loop.

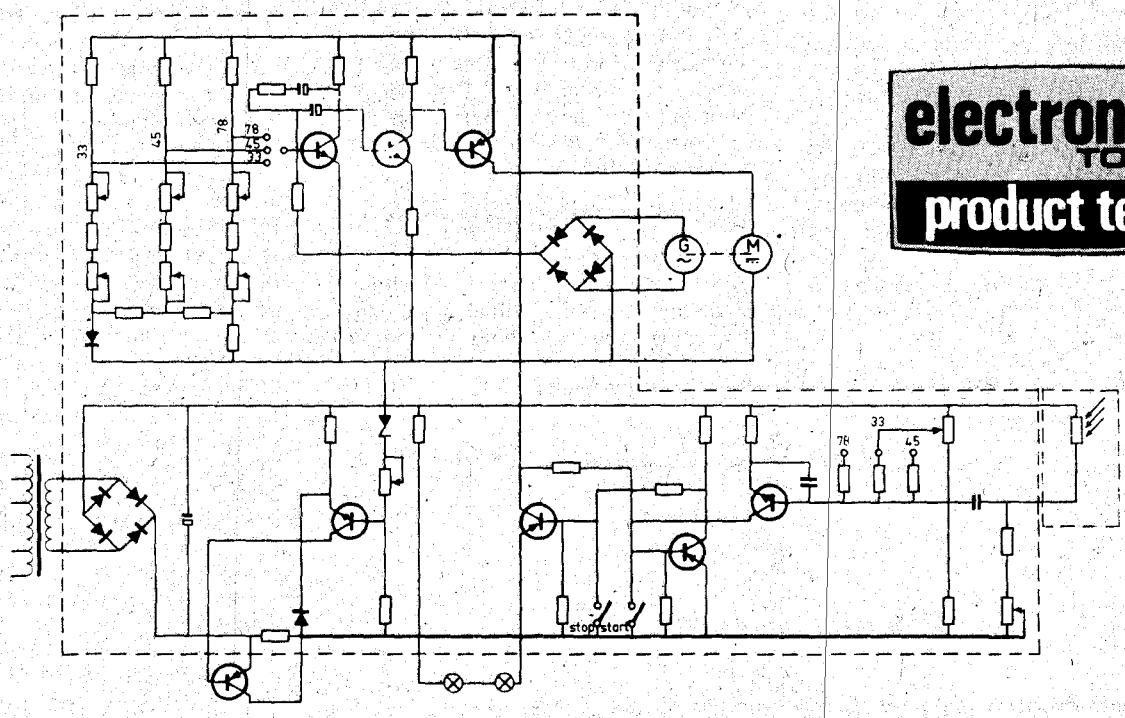
The motor is enclosed in a plastic box lined with foam rubber. This reduces the transfer of vibrations from the motor to the turntable and pick-up. This is necessary because the pulsed power supply to the drive motor will generate vibration components at higher and more annoying frequencies than the 50 Hz and 100 Hz components produced by a conventional induction motor.

The GA202 motor and control system has been well designed to provide accurate speed control of the turntable. But there is more to producing a good turntable than speed control alone, and the next link in the drive proved to be below the standard of the remainder of the system.

The actual drive from the motor to the turntable is via two belts, one from the motor to an idler shaft; the second from this idler shaft to a fibre impregnated drive wheel on which the pressed turntable is seated. But using two belts decreases the available torque, and simultaneously increases the wow and flutter.

The intermediate pulley on the idler shaft incorporates a clutch which allows torque to be transmitted in one direction only. Thus with the motor switched off, the turntable continues to free-wheel.

Balancing of the pick-up arm is achieved by screwing a chrome plated counterweight in or out. The action is smooth in operation and is effective. Most arms using this method of



Circuit diagram.

balancing, move the counterweight a calibrated distance away from the zero balance position to obtain the desired tracking weight. This is not the case with the GA202 unit. A small weight is fitted to the tubular pick-up arm and is moved from the gimbal joint towards the head shell to obtain the desired tracking force. The arm is marked at intervals corresponding to one gram, two grams, three grams and four grams tracking weight.

The head shell is a Philips designed plug-in unit that will accept a standard cartridge with ½" mounting centres. The unit we tested was supplied with a Philips GP400 cartridge.

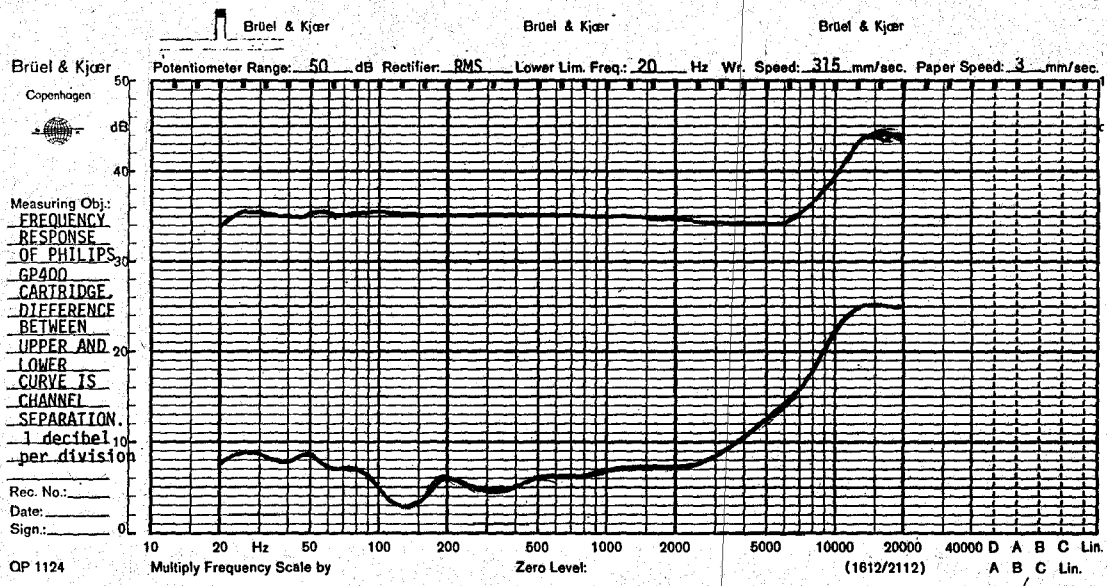
The turntable base, which contains the control switches and speed adjusting potentiometers, has a brushed aluminium top and front panel, and timber side panels. The controls are simple, and adequate for a manually operated turntable. The power on/off switch is located at the front left hand corner and has a "push off" operation. A rather elaborate bezel about ¾" long by ¼" wide with internal diffuser, is fitted adjacent to this switch and indicates when the power is on. Located on the right hand front corner is the lever for speed selection; stop and start buttons and a rocker type action cueing switch. On the right hand side of the deck behind the cueing switch there are three screw slotted potentiometers for speed adjustments and an antiskate adjusting lever with different setting to suit either elliptical and spherical stylii.

SPEED SETTING

The speed select lever has three positions – 78, 45 and 33 1/3 rpm. A stroboscopic disc is supplied with each unit, and once the desired nominal speed has been selected it is possible accurately to set the speed by adjusting the appropriate potentiometer until the respective band on the disc appears stationary under a 50 Hz light (i.e. a standard incandescent or fluorescent light). This adjustment must be made with a record on the turntable and the arm tracking the record, otherwise speed errors as great as 5% are readily possible.

The stop and start pushbuttons are of the momentary contact type. They are completely noiseless in operation, and because of this and the freewheeling action of the turntable, one never knows for sure whether the motor has actually stopped or not. Because of this feature, one has to wait a while for the turntable and motor to react to a speed change. In

THE PHILIPS GA202 TURNTABLE



fact, noticable wow and flutter occurred in some instances when the stylus was lowered on to the record.

Another example of the unconventional techniques is the method used to switch off the motor at the end of a record. A very light vane is attached to the pick-up arm and this cuts off a light beam between a light source and a photocell when the pick-up comes to the end of the record. This produces a pulse which turns off the power supply to the motor.

The cueing switch has two positions, either fully up or down, and requires a reasonable familiarization period before one can accurately cue at any point on the record. In the lowering mode the cueing arm was under-damped and fell faster than we would like when using a tracking force of two grams. The antiskating adjustment, when set for a two gram spherical setting effectively compensated for a two gram tracking weight.

The dust cover, which is moulded from tinted clear plastic, was fitted with a spring loaded arm that, when the cover was raised, dropped down and held the cover at an approximate angle of 45°, allowing adequate access to the turntable for changing records. This minimizes the chance of accidentally dropping the lid, and consequent damage to record and stylus.

One property of the dust cover that we did not like was its electrostatic characteristics which result in large quantities of airborne dust being attracted to it. Whilst this may appear a minor point it would be annoying to a fastidious housewife.

The cartridge fitted had a relatively flat frequency response to 6 kHz with a rise above 6 kHz to 15 kHz. In the average domestic installation for which this unit is designed, this rise would partly compensate for the higher frequency drop off, characteristic of some medium-priced speaker systems. The channel separation was good and adequate throughout the frequency range. The output sensitivity of the cartridge was slightly higher than claimed.

MEASURED PERFORMANCE

The measured performance of the turntable also differed slightly from the manufacturer's specification. We found the speed adjustment range to be even greater than that claimed and more than adequate for speed correction.

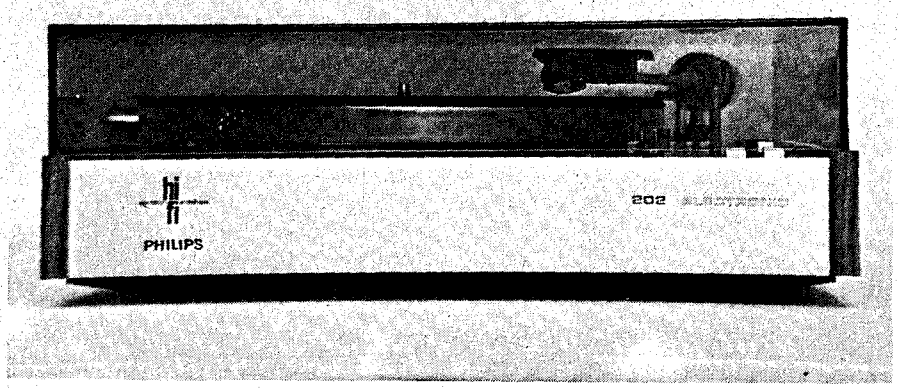
MEASURED PERFORMANCE OF PHILIPS GA202 TURNTABLE SERIAL NO. 224602 WITH PHILIPS CARTRIDGE TYPE GP400.

FREQUENCY RESPONSE:
20Hz to 10kHz $^{+2}_{-3}$ dB
20Hz to 7kHz ± 1 dB
CHANNEL SEPARATION:
TYPICALLY 28dB at 1kHz
OUTPUT SENSITIVITY WITH 1kHz 5cm/second signal – 8mV
WOW AND FLUTTER at 33 1/3 rpm – 0.6%
UNWEIGHTED HUM & RUMBLE – 30 dB

The wow and flutter was high for a belt driven turntable. As it was considerably worse than Philips specifications we asked the company to supply a second unit so that we could establish whether or not this performance was typical. The second unit tested had a wow and flutter performance practically identical to the first unit. No doubt this is due to the use of two belts in the drive system. The arm friction was very low, allowing tracking force as low as ½ gram to be used satisfactorily with a suitable cartridge.

For a person who rates speed accuracy and/or a servo-controlled drive as the prime consideration when selecting a turntable this unit is the cheapest in its class that we have yet seen.

However, at the proposed selling price of $174.00 (complete with cartridge), we believe that the average audiophile has a choice of many other turntables having a better balanced performance in all respects for the same price. ●



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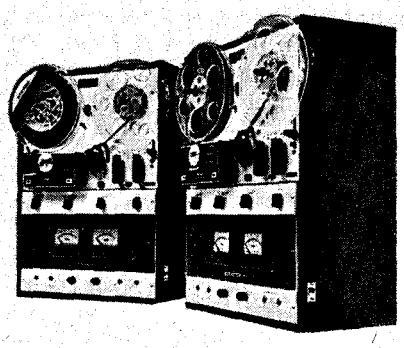

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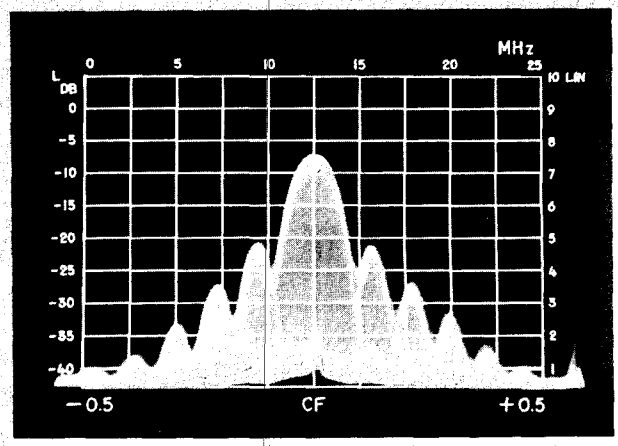
The electro-magnetic spectrum is becoming increasingly polluted by electrical and electronic devices — this article explains how to reduce rfi, especially that generated by phase control circuits.



RADIO FREQUENCY INTERFERENCE

Biologist, Barry Commoner, says that "we are destroying this planet as a suitable place for human habitation".

This may be an extreme view, but what with pesticides and herbicides filtering into our food, glass and plastic containers littering our beaches and countryside, and inconceivable quantities of industrial detritus poisoning our rivers, we have more than sufficient cause for alarm.

But there is another, less obvious, form of pollution that is causing increasing concern — and that is pollution of the electro-magnetic spectrum by electrical and electronic devices that generate radio frequency interference.

In Australia this is now such a serious problem that the Australian Navy finds it necessary to take its ships 100 miles out to sea (from Sydney) to obtain a noise-free environment for testing some of its sophisticated electronic equipment.

It is so bad that essential radio services in New Zealand suffered severe interference from an installation of rf industrial equipment in Sydney having a power output of 15kW.

Yet at the present time (in Australia), industrial radio frequency generating equipment is not licenced or controlled in any way.

No records are kept of the location or power outputs of such equipment, and when interference problems occur, each case is dealt with individually.

Incredibly, the PMG can then only ask the equipment user to reduce the interference. The user, can, if unco-operative, completely ignore such requests, without fear of legal action.

Radio frequency generating equipment most commonly causing interference includes induction heaters, dielectric heaters and plastic welders. These devices usually operate at 27.12 MHz or 54.24 MHz and may have power outputs up to 50 kW. The interference that they produce is due to large and rapid frequency changes of the Class C oscillators commonly used. Harmonics are radiated that are both amplitude and frequency modulated.

PHASE CONTROL SYSTEMS

Another, and very prevalent, form of radio frequency interference is that caused by SCRs and Triacs used in phase control systems.

Phase control (fully described in 'A Practical Guide to Triacs', Electronics Today, July 1971) is commonly used for heating regulation, light dimming, dc motor speed control etc. It is the type of radio frequency interference generated by these devices that we are primarily concerned with in this article.

The use of phase control equipment is increasing, and nowadays three phase heater loads of 60 kW or more, and dc drives of up to 1000 hp, are not uncommon.

Light dimming installations of over 100 kVA are being installed in theatres, hotels and functions rooms, and in addition, the use of small dimmers in private homes has dramatically increased since these units have become available at less than $10 each.

It is understood that legislation is being considered to limit the use of phase control for heating regulation — an application for which zero voltage switching is eminently suitable — but for light dimming, zero voltage switching cannot be used.

Nevertheless, that radio frequency interference from phase control and other systems is being taken very seriously indeed, is shown by the draft documents released for public review by the Australian Standards Association in February of this year.

These documents — Numbers 1693-1696 propose standards for measurement and limits of rfi. Document 1696 in particular, proposes electromagnetic interference limits and measurements for semiconductor control devices.

The limits laid down in these specifications could well be the basis of legislation, and authorities such as the PMG, ABC, DCA and electricity supply authorities may be given powers of enforcement (as have similar bodies in the US and New Zealand).

The limits of interference as laid down in SAA 1696 are detailed in Tables 1 and 2.

Two limits are specified. One limit concerns the radio frequency voltage fed back into the mains supply, and the second, and less onerous limit, concerns the radio frequency voltage across the load terminals. (The second limit is necessary because in many cases the load will be remote from the control unit, and severe interference may be caused by direct radiation from the load supply leads).

A surprisingly large amount of rfi is generated by unsuppressed phase control devices. A small (500 VA) light dimmer which is not suppressed at all may produce levels of injected interference in the radio broadcast band in excess of 100 dB (referred to the internationally accepted reference level of 1 uV). In this case 50 dB of suppression would be required to make the dimmer conform to the SAA specification.

Few — if any — domestic dimmers sold today would meet the proposed SAA specifications.

Interference levels due to phase control of semiconductors falls off very rapidly with frequency and is of no consequence in the TV or FM bands, in fact very little rfi is generated above 3 MHz. Nevertheless dimmers and other phase control devices can cause severe interference with radios and audio amplifier equipment.

This was demonstrated (somewhat ironically) to a very large audience in Sydney recently — when during a public concert in support of an anti-pollution cause — a performer was all but drowned out by rfi on the public address system.

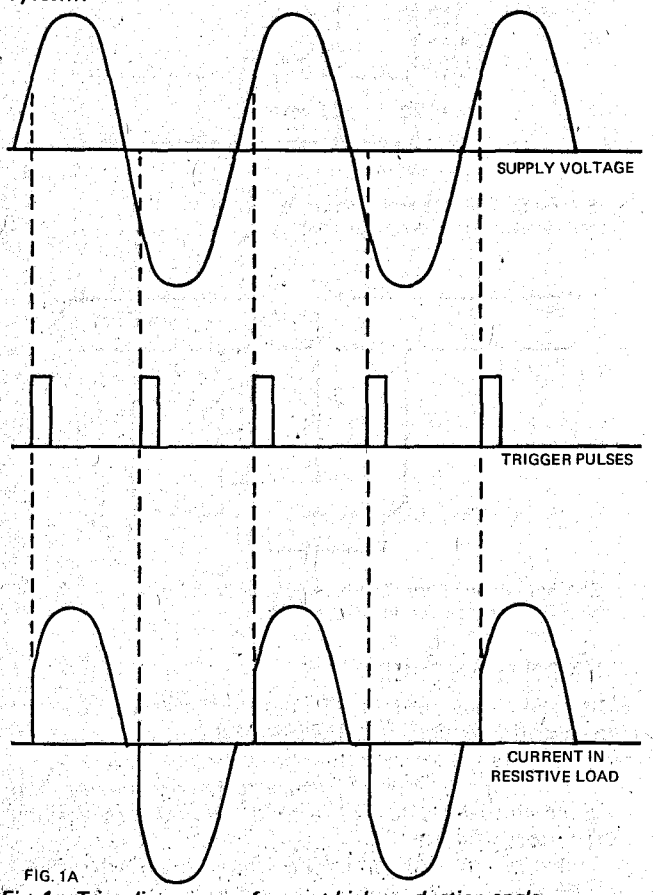


FIG. 1A

Fig. 1a. Triac dimmer waveforms at high conduction angle (high light level).

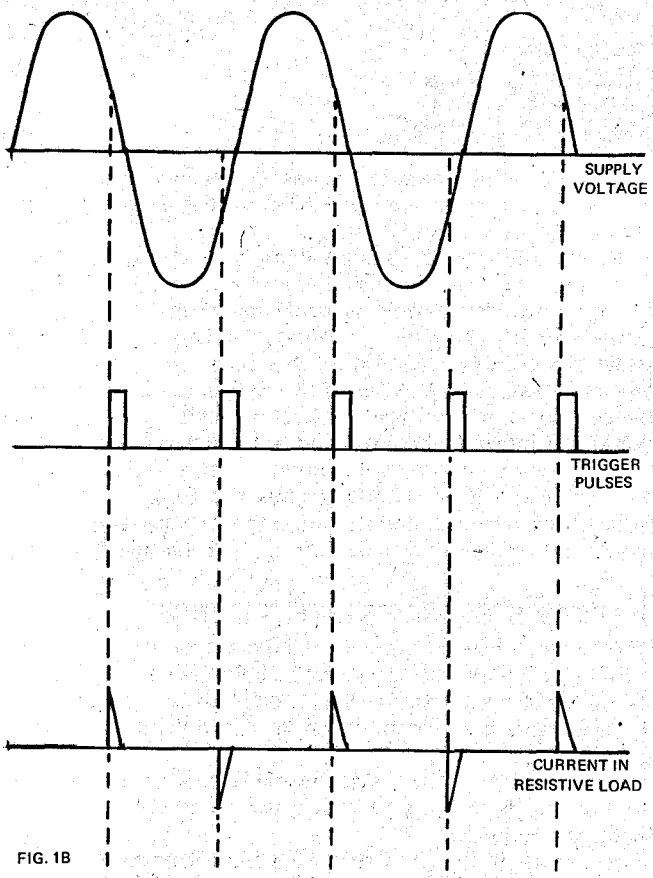


FIG. 1B

Fig. 1b. Triac dimmer waveforms at low conduction angle (low light level).

The phase control method of power regulation is shown in Figs. 1a and 1b. As can be seen, a firing pulse triggers the SCR or Triac into conduction at a time in the voltage half cycle which may be externally varied, thus controlling the average amount of power delivered to the load.

With a purely resistive load, such as an incandescent lamp, the non-sinusoidal voltage applied to the load causes a non-sinusoidal current to flow in the mains supply leads and in the leads to the load. The non-sinusoidal current produces voltage drops across the impedance of the supply mains and therefore causes interference voltages to appear at the mains input of other equipment connected to the same supply. The magnetic field associated with these currents may also induce fields in adjacent conductors; this effect is known as conducted interference. An rf field is also generated and this propagates through space in the normal manner inducing noise voltages in radio antennas etc. The maximum rfi is generated when the initial voltage applied to the load is at its highest point, i.e. at the 90° conduction point.

HOW RFI IS PROPAGATED

Thus the energy associated with these radio frequency currents and voltages may be propagated to a radio receiver in four ways:

1. By direct radiation from the dimmer and its associated wiring.
2. By conduction, from the dimmer along the mains wiring and into the mains supply to the receiver.

Purpose of control	Frequency Range MHz	Limit	
		dB (μV)	μV equivalent
Speed control of portable tools	0.15 to 0.2	70	3000
	0.2 to 0.49	66	2000
	0.49 to 30	54	500
General purpose control of domestic appliances and lighting	0.15 to 0.49	66	2000
	0.49 to 30	54	500

Table 1 — Limits for RFI injected into the mains.

Purpose of control	Frequency Range MHz	Limit	
		dB (μV)	μV equivalent
All types of control	0.150MHz	72	4000
	0.150MHz to 0.49MHz	falling linearly from 72 to 54	falling linearly from 4000 to 500μV
	0.49MHz to 30MHz	54	500

Table 2 — Limits for RFI appearing at the load terminals.

RADIO FREQUENCY INTERFERENCE

3. By conduction along the mains wiring connected to the receiver and subsequent radiation to the aerial system of the receiver.
4. By radiation to, conduction along, and re-radiation from conductors, not directly connected to the dimmer but closely coupled to it or its associated wiring.

Interference in radio receivers is most commonly associated with propagation by the third method and may best be alleviated by reducing the conducted interference. Hence the limits as per SAA Document 1696 specify conducted interference only, and not radiated interference. But it should be kept in mind that a reduction of conducted interference usually gives rise to an increase in radiated interference, and therefore the level of suppression should not exceed that necessary to meet the specification.

METHODS OF REDUCING INTERFERENCE

Radio frequency interference is inherent in phase control of SCRs or Triacs and can never be completely eliminated. In industrial installations where expense is not such a critical factor, steps can be taken to reduce the interference to negligible levels, but in domestic applications an economic compromise has to be made and an acceptable level of rfi in relation to cost must be accepted if light dimming is required.

The circuit of Fig. 2 is that of a typical domestic light dimmer. The inductance L1 is a small iron-cored choke (usually of about 100 uH) which limits the rate of rise of load current and hence reduces conducted rfi. Capacitor C1 provides a low impedance path around the dimmer circuits for the rfi components. This capacitor is usually from 0.033 uF to 0.1 uF.

Some better quality dimmers are also enclosed in an aluminium case, which apart from acting as a heat sink for the SCRs or Triac, provides electrostatic shielding thus limiting rfi radiated directly from the dimmer itself.

Whilst this degree of suppression may be adequate for most applications, still further suppression will almost certainly be required to enable equipment to comply with the proposed SAA specifications, particularly at the low frequency end of the radio broadcast band.

To achieve the required levels, an additional capacitor would need to be mounted — probably externally — in parallel with C1. The leads of this capacitor must be kept as short as possible, as the self inductance of a capacitor is mainly proportional to lead length. Long leads lower the self resonant frequency and thus reduce the effectiveness of the capacitor at high frequencies. (See Fig. 3).

Additional filtering by chokes or integral filter units will further improve the level of suppression, but these would not normally be required in most domestic applications.

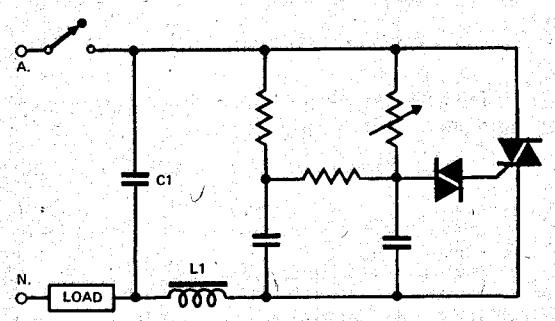


Fig. 2. Typical light dimmer circuits, fitted with rfi suppression components (L1 and C1).

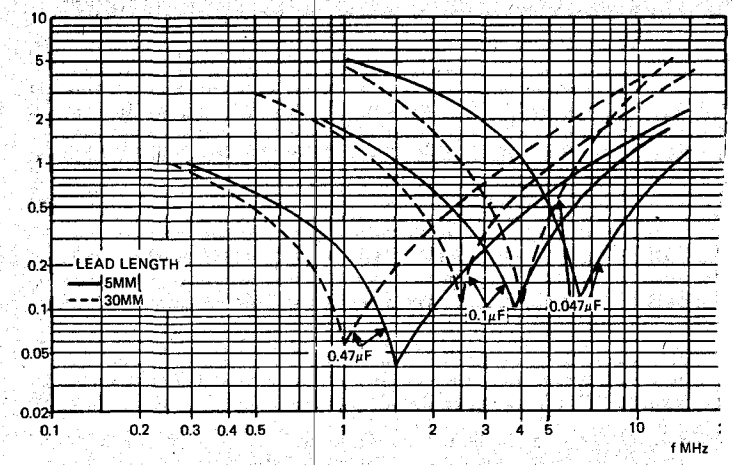


Fig. 3. The self inductance of a capacitor is mainly dependent on lead length. For best suppression at high frequencies, the length of the leads should be kept to a minimum.

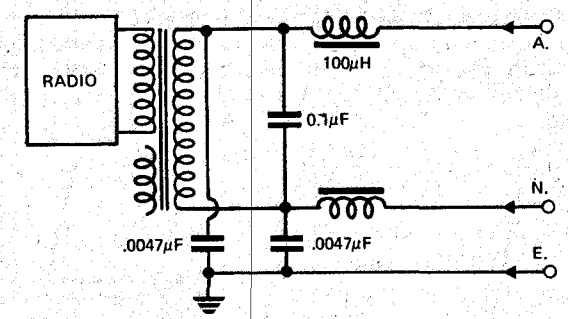


Fig. 4. How to filter the mains input to a radio receiver or other sensitive electronic equipment.

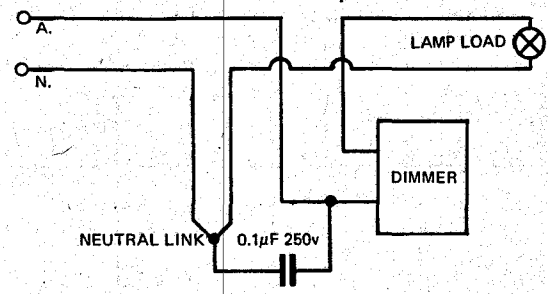


Fig. 5. A bypass capacitor fitted between active and neutral provides a low impedance path for the rfi.

ADDITIONAL METHODS

Other steps may be taken to reduce the effect of rfi on radio and other equipment. These include:

1. Use an external aerial with a shielded lead-in cable.
2. Filter the mains input to any affected equipment. The equipment should be well earthed and 250 V ac working capacitors fitted to —
   (a) active to earth, and neutral to earth — each 0.0047 uF.
   (b) active to neutral — 0.1 uF.
   (Note that SAA safety regulations prohibit the use of larger capacitors than those quoted above.)
   Small filter chokes — each of approximately 100 uH may be installed in the active and neutral lines.
3. Wherever possible both active and neutral leads to the dimmed circuit should be run in close proximity. If possible the neutral should also be brought down to a linking terminal on the dimmer (Fig. 5). This latter procedure will reduce radiation from the main leads, as the opposing currents in active and neutral tend to

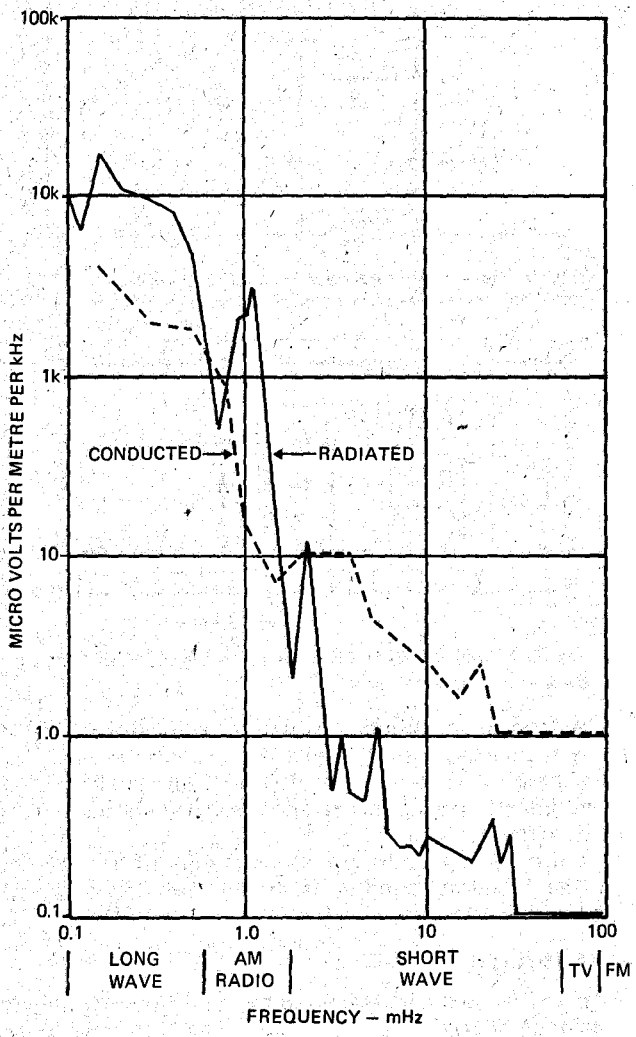


Fig. 6a. Noise generation from a typical unshielded fluorescent light fitting.

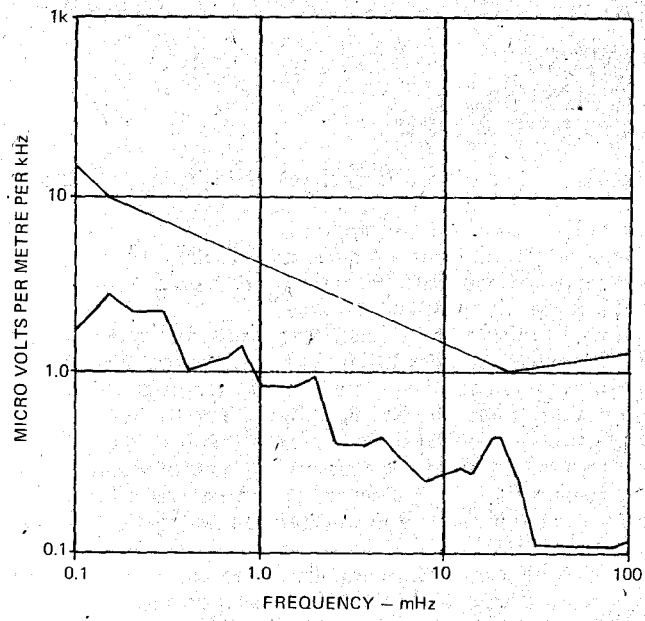


Fig. 6b. Radiated noise generated by a typical fluorescent light fitting fitted with rfi shielding. (The unbroken line indicates the radiation levels laid down by MIL 16910A)

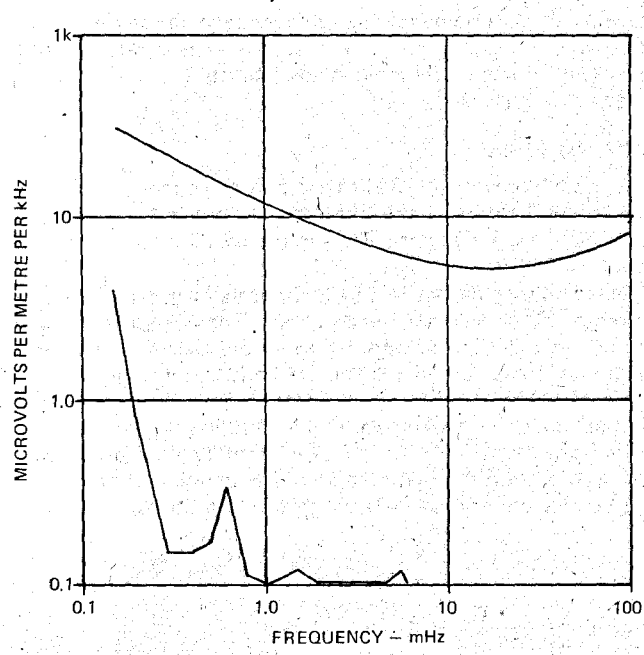


Fig. 6c. Conducted noise generated by light fitting shown in Fig. 6b.

cancel out. If this is done a bypass capacitor may be fitted between active and neutral. This capacitor will provide a low impedance path for the rf back to neutral. Leads should be kept as short as possible and the maximum value of the capacitor should not exceed 0.1 uF.

4. The installation of the dimmer in a metal wall box will reduce direct radiation from the dimmer itself. The wall box will provide screening even if it cannot be earthed.
5. Installation of all dimmer supply and load wiring in screwed, earthed metal conduit will eliminate radiated rfi from these cables. This would of course only be economically feasible in new installations.
6. Wiring associated with sensitive electronic equipment, such as sound systems, TV or radio antennae, pH meters, digital computers, etc. must be kept well clear of dimmer wiring. Where such wiring must cross dimmer wiring it should do so at right angles to eliminate inductive pickup.

As many as possible of these precautions should be taken during the initial installation as it is costly, and sometimes difficult, to make the necessary modifications after installation has been completed.

INCANDESCENT LAMPS

With an incandescent load, the load current will be in phase with, and proportional to, the non-sinusoidal output voltage from the dimmer. This is because an incandescent lamp is an almost purely resistive load, and thus the rapid rise of current in the dimmer waveform will produce considerable rfi. The small chokes commonly incorporated within domestic dimmers limit the rise time to some extent, but in the case of industrial dimmers of higher power outputs, further suppression is required.

High quality industrial dimmers incorporate iron-cored chokes of several millihenries. These chokes, which are wired in series with the output lines, ensure that the current rise time at the 90° conduction point is not less than 200 microseconds. In extreme cases, such as TV studios where trailing leads may come close to microphone cables, additional chokes may be necessary to lengthen the rise time to one millisecond.

Further precautions are necessary on high power dimmers and other phase control systems to reduce the rfi injected back into the mains. This is usually achieved by a line filter (which will be described later in this article).

FLUORESCENT LAMPS

Fluorescent lamps invariably have a large inductance (in

the form of a ballast choke) wired in series. The lamp current is therefore largely sinusoidal and because of this, additional chokes are not required.

Nevertheless, precautions must still be taken to prevent rfi being injected back into the mains, and the capacitor shown as C1 in Fig. 2 will still be required.

Apart from this, like all discharge lamps, fluorescent tubes are themselves sources of rfi. The majority of these lamps generate only a relatively low level of rfi, and this is readily suppressed (Figs. 6a, 6b, 6c). But a small percentage of lamps produce strong interference – this is believed to be due to a condition of the emissive cathodes of the lamps. It is very erratic in its incidence, but in general a lamp will show a marked increase in interference during the last few hours of its life.

A 0.02 uF capacitor is usually fitted within the starter switch to reduce rfi, but this may need supplementing by additional capacitors (as shown in Fig. 7.) if a higher degree of suppression is required.

For really critical applications, such as satellite tracking stations, it may be necessary to cover each fluorescent with a diffuser having a built in rf screen. The screen should consist of a grid of metallic strips (about ½" mesh) printed on the rear surface.

LINE FILTERS

As stated previously, industrial phase control equipment may need rf filters at the line input to prevent injection of rfi back into the mains. The circuit of a suitable filter is shown in Fig. 8.

The inductors shown in Fig. 8 suppress assymetrical noise currents flowing down each lead. These inductors are wound – in magnetic opposition – on opposite legs of a square ferrite core and are thus effectively in parallel with noise currents (which are symetric) but in series with assymetric currents. And so, if the coupling is near unity at the supply frequency, the effective inductance is near zero, but as the coupling is looser at rf frequencies, these latter frequencies experience a large effective inductance. Thus,

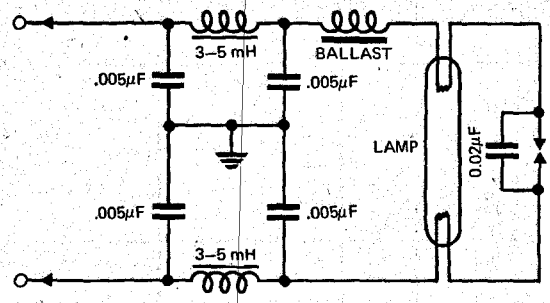


Fig. 7. Where a very high degree of suppression is required, extra chokes and capacitors may be installed.

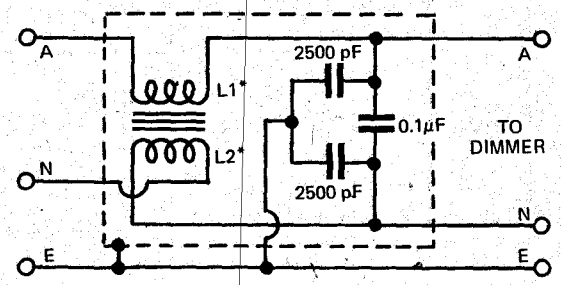


Fig. 8. A line filter of this type will prevent injection of rfi back into the mains.

this method of construction causes low voltage drops at the supply frequency, but high rejection of rf voltages.

The three capacitors in the filter are usually constructed in one integral pack. This reduces lead length and hence, self inductance.

This filter will provide approximately 50 dB of rejection over the broadcast band – it should meet the proposed SAA requirements.

MEASURING RFI

Interference levels are measured by Field Intensity Meters – such as that shown in Fig. 9. The instruments are essentially superheterodyne radio receivers with accurately controlled bandwidth. They incorporate a detector metering system calibrated in terms of the rms value of a sinewave. They are in effect, tunable voltmeters. ●

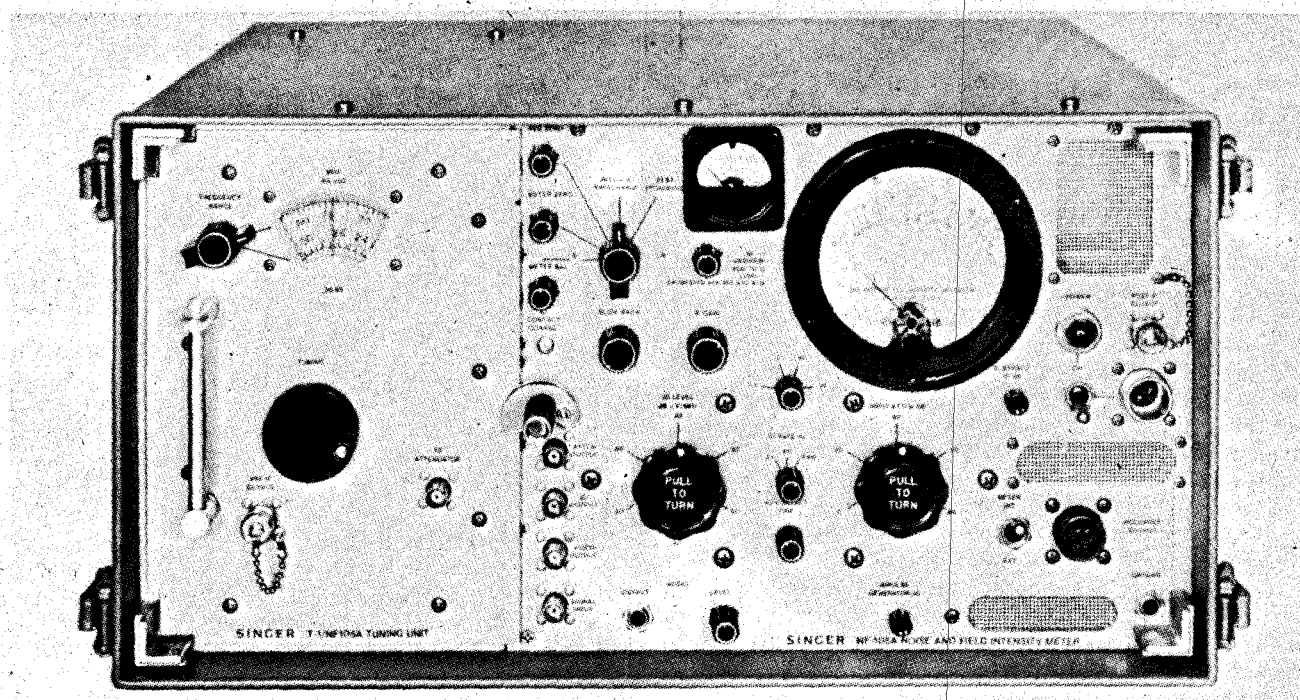
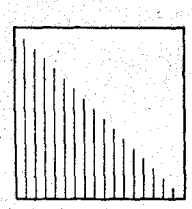


Fig. 9. Rfi may be measured by instruments similar to this Singer Model NF 105A Noise and Field Intensity Meter.

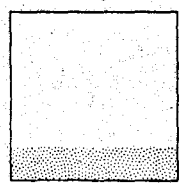
REDUCE TAPE NOISE UP TO 10 dB

INSTALL KELLAR KDB1 DOLBY SYSTEM ®

HOW IT WORKS

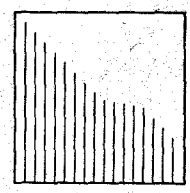


1. Music. Music is made of sounds of different loudness separated by intervals of silence. Loud and soft sounds are here shown as long and short lines. The music represented by this diagram starts loud and gradually becomes very quiet.

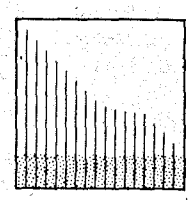


2. Noise. Any recording tape, even the best kind, makes a constant hissing noise when played. At the very slow speeds and narrow track widths used in tape cassettes, tape noise is much more noticeable than it is in professional tape recordings, although even there it is a problem.

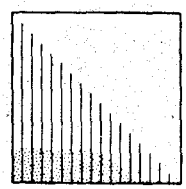
3. Music and Noise. When a tape recording is played, the noise of the tape conceals the quietest musical sounds and fills the silence when no sound should be heard at all. Only when the music is loud is the noise not usually heard; however, tape noise is so different from musical sounds that it sometimes can be heard even then.



1. What the Dolby System does first. Before the recording is made, the Dolby System "listens" to the music to find the places where a listener might later be able to hear the noise of the tape. This happens mainly during the quietest parts of the music. When it finds such a place, the system automatically increases the volume so that the music is recorded louder than it would be normally.



2. The Recording. In a Dolby System recording, the parts of the music which have been made louder stand out clearly from the noise. As a result, Dolby System recordings sound brilliant and unusually clear even when played back without the special Dolby System circuit.



3. What the Dolby System does during playback. When the tapes are played on a high-fidelity tape recorder equipped with the Dolby System circuit, the loudness is automatically reduced in all of the places at which it was increased before recording. This restores the music to its original loudness again. At the same time, the noise which has been mixed with the music is reduced in loudness by the same amount — usually enough to make it inaudible.

DOLBY is a trademark of Dolby Laboratories Inc.

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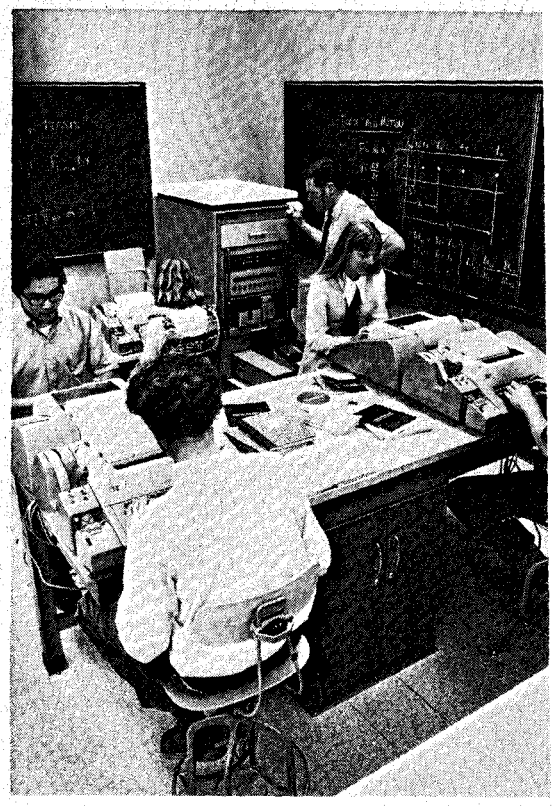
Electronics in Education



A single Hewlett-Packard computer now can be easily and economically converted into a "mini-timesharing system" for simultaneous operation by up to eight users.

Multi-terminal capability can be obtained merely by buying $10 worth of software and adding more terminals.

Schools, colleges and universities are expected to be the primary beneficiaries of two new software packages which make the conversion possible. The systems are broadly useful, but should be particularly helpful to educational institutions, where computer equipment is often limited and must be used by large numbers of students.

The software was contributed to the Hewlett-Packard programme library by Pacific Union College at Angwin, California, and Montana State University at Bozeman, Montana. Both systems allow users to programme the computer in BASIC, an easily learned, conversational, English-like language.

Depending upon which software package is used, the number of terminals desired and the core memory capacity of the computer, a small-scale time-sharing system would cost only 10% to 15% of the price of full-scale time-shared computer systems.

Both software packages are compatible with Hewlett-Packard's Educational BASIC System, which provides programme entry by means of marked cards. The new software thus allows several users to interact with the computer in a time-sharing mode, or with marked cards for high-volume input.

The Pacific Union College system, contributed to the HP software library by Dowell Martz and William Tyler, can accommodate up to eight terminals. It operates with computer memories from 8,192 to 32,768 words. Since the PUC system occupies about 6,000 words of core, an 8K system would be necessary for four users and a 12K computer would be required for eight terminals.

The Montana State University package, contributed by K. B. Baker and J. S. Shema, accommodates up to four terminals.

It is somewhat more powerful, since the 8,000-word system performs matrix operations and does system accounting to keep track of the time each user spends running programmes. Minimum hardware requirements include an HP computer with 16,384 words of memory, a time-base generator, paper tape reader and teleprinter for the system operator.

As new additions to the HP contributed software library, the multi-terminal BASIC programmes are fully documented and are assembled or compiled by HP analysts. Updating and error correction are the responsibilities of the contributors. ●

TEACHER ON TAPE

American education experts are now favouring open-plan systems. Schools are designed as one vast area with movable partitions to expand or contract each teaching section. The institutional colours have been replaced by bright, vivid patterns and extensive areas of glass. The traditional array of desks and chairs have completely disappeared and in their place there are attractive modern chairs and tables. One teacher described the new-style schools as "rather like having a group of students in your living room".

"It's a rebirth of teaching", says Ken Garrett, principal of another modern school in San Bernardino, the North Park Elementary School. "We do have some problems with children who come from homes with TV in every room. They don't want to put too much into learning. With the new building, we are trying to get the children to be more responsive to learning patterns".

Indeed, the new system involves more than just a new building. Even the teaching methods are revolutionary. The pupils receive much of their knowledge from TV screens and tape recorders.

The children can easily be divided into small groups according to their intellectual ability and the speed at which they can absorb facts. This means that bright pupils never get bored, and slower ones are never left hopelessly behind. Sometimes, of course, traditional methods prove best with those who need a little personal coaxing from the teacher. Blind children can also be taught at the school instead of going to special institutions.

Perhaps this is a logical teaching method for the TV generation! ●

THE PHASE LOCKED LOOP

Dr. Tucker's 'Synchrodyne' comes of age

SYNCHRONOUS detection had something in common with Leonardo da Vinci's auto-gyro – both were brilliant ideas, and ahead of the level of technology required for their execution.

But unlike the 450 years required for da Vinci's auto-gyro, synchronous detection has taken only a relatively short time to become a practical concept. Recent development of phase locked loop ICs has made it all possible.

It all began in the 1930s as a quest for better audio frequency response than the (then) newfangled superheterodyne could provide. (For whilst the early crystal sets had their failings, distorted reproduction was not one of them).

Then in March 1947, Dr. Tucker, a research scientist with the British Post Office, published an article in 'Electronic Engineering' describing his 'Synchrodyne' receiver. (Fig. 1).

The basic 'Synchrodyne' principle was very simple – for AM reception a highly stable local oscillator produced a signal identical in frequency, and locked in a specific phase relationship with the incoming signal.

The incoming signal, and the locally produced signal, were then mixed together. The output from the mixer then consisted only of the modulation frequency that was superimposed on the original carrier, plus a number of unwanted components that were removed by a low-pass filter following the mixer.

The result? Recovery of the modulation frequency directly, and free of the distortion introduced by conventional superhet circuitry. There were no IF transformers to impose frequency limitations, and no detector to introduce distortion. The original modulation was recovered and separated from the carrier frequency in a form that was practically as pure as the modulating signal.

The locking of the local oscillator to the incoming carrier was, of course, the vital part of the system. In the

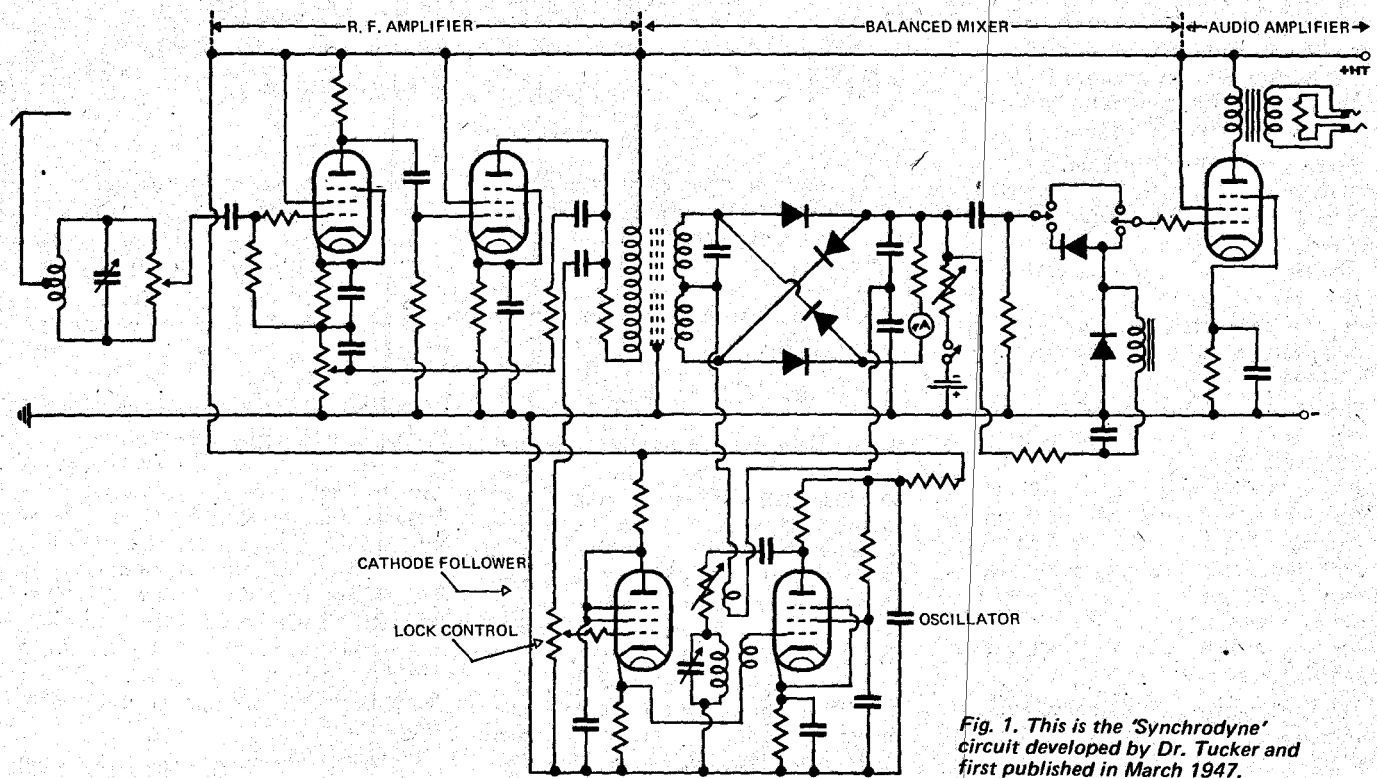


Fig. 1. This is the 'Synchrodyne' circuit developed by Dr. Tucker and first published in March 1947.

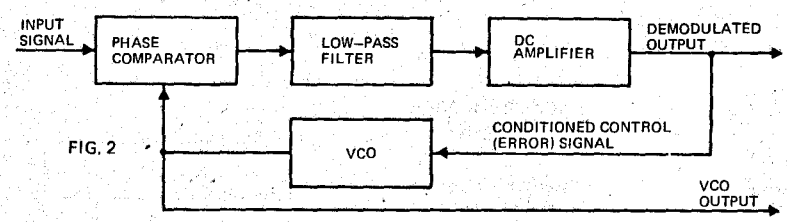


FIG. 2

A sinusoidal input signal is compared by the phase comparator with the VCO output to produce an error voltage representing the phase difference between these two signals. The phase comparator output is filtered, amplified, and applied as a control voltage to the VCO. The control (error) voltage is used to move the VCO frequency in the direction that reduces the phase difference between the input signal and the VCO output. Thus, a corrective feedback loop is formed. When the free-running frequency of the VCO is sufficiently close to the frequency of the incoming signal, the VCO synchronizes or "locks" with the input and tracks it over frequency deviations. When the PLL is "locked", it operates as a signal-tracking filter. For an FM input signal, the low-frequency VCO control voltage (dc amplifier output) is the demodulated output. Similarly, if the output is taken from the VCO, the PLL operates as a frequency-selective signal conditioner. This occurs since the VCO output duplicates the frequency of the input signal at a higher power level and at a greatly improved signal-to-noise ratio. In addition, the PLL can also function as a tuned frequency divider or multiplier by locking on multiples or submultiples of the input frequency.

original 'Synchrodyne' this locking was controlled by an adjustable injection of incoming signal to the local oscillator. Unfortunately, this 'brute force' method was a cause of instability, for with too little signal the lock was unstable, whilst with too much signal the local oscillator would lock on to the side bands rather than the carrier.

The real problem was that there was no feedback loop to control the local oscillator — rather the principle was one of 'feed-forward'.

Various modifications were proposed at the time to provide automatic gain control for the local oscillator, but their cost and complexity were too high, and so whilst the basic 'Synchrodyne' principle was simple enough, the methods of achieving it were not, and the 'Synchrodyne' went out of favour.

But now the development of the phase locked loop has brought it back again.

When used as an AM detector, the phase locked loop operates in a very similar manner to the 'Synchrodyne' except for one very important difference. And that is that the device generates a feedback signal which is used to control the frequency of the local oscillator.

If at any time the frequency of the locally produced signal attempts to drift away from the frequency of the incoming signal, the resultant difference frequency is fed back to the local oscillator in the form of a control voltage. This control voltage then acts at all times to maintain the local oscillator and the incoming signal, in synchronization.

The basic block schematic diagram of one type of phase locked loop is shown in Fig. 2. This is the Signetic Corporation's type NE 561B. This standard sized, 16 lead, dual-in-line IC contains a phase detector, a low pass filter, a dc amplifier and a voltage controlled oscillator. Given an output stage and a few capacitors and resistors, this IC contains all the requirements to build a complete AM or FM radio.

Figure 3 shows the Signetic NE 561B phase locked loop connected as a synchronous AM receiver. In this mode of operation, the PLL locks on the carrier, and produces, at the voltage controlled oscillator output, a reference signal at the same frequency as the input carrier, but without amplitude modulation. This reference is mixed with the modulated AM input. The output of the mixer is filtered to remove any remaining high frequency components, leaving the demodulated audio information. The external phase-shift network (normally two resistors and two capacitors) imparts a 90° phase shift to the input signal of the PLL section so that the voltage controlled oscillator output will be in phase (or 180° out of phase) with the incoming carrier.

This circuit may be tuned by either of two methods. The first, more 'conventional' way is to use a variable capacitor for C1. For broadcast band operation C1 should be variable from a minimum of 220 pF (1600 kHz) to a maximum of 650 pF (550 kHz).

Another, and perhaps more elegant way of tuning the receiver is to use a fixed capacitor for C1 (the value of which corresponds to the geometric mean of the required frequency range — probably about 450pF) and then to inject current, via a potentiometer, into pin 6 of the IC. (Fig. 4). Varying

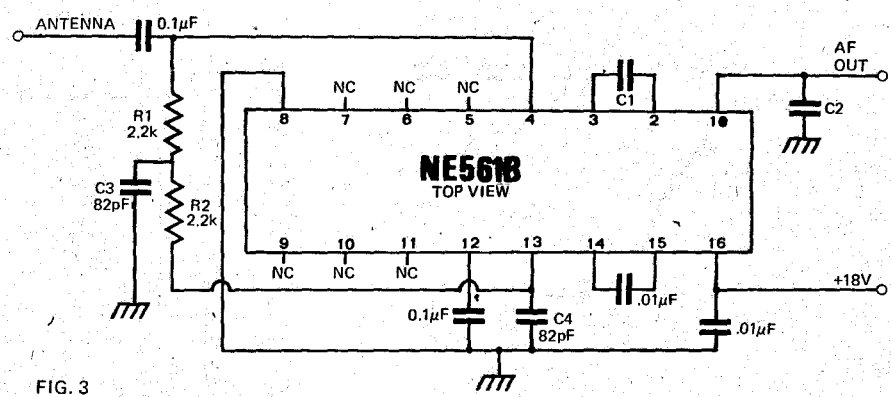


FIG. 3

THE PHASE LOCKED LOOP

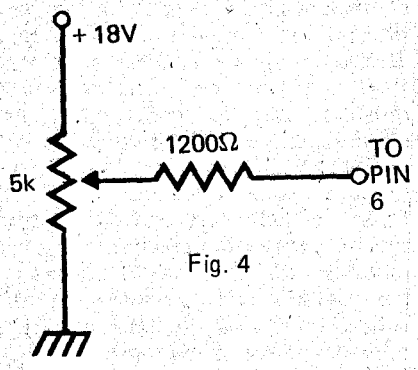


Fig. 4

the potentiometer will tune the receiver across the broadcast band over a range of approximately 3 : 1.

For satisfactory results, this receiver must have good input signal strength. It requires good antenna and earth systems. The signal strength, measured between pin 9 and earth must be at least 100 uV.

Full constructional details of a AM phase locked loop broadcast receiver and audio output stage, will be published in ELECTRONICS TODAY in the very near future.

FM DETECTION

The phase locked loop is one of the simplest ways yet known, to make an FM receiver. When the phase locked loop is locked on to an incoming FM signal, the average dc level of the phase detector output is directly proportional to the frequency of the input signal. As the input frequency changes with modulation, this dc output changes and thus causes the voltage controlled oscillator to change frequency and thus remain locked onto the input signal. The dc output voltage changes are directly proportional to the modulating frequency, and hence the audio signal.

But there is one snag — the current generation of phase locked loop ICs run out of enthusiasm at 30 MHz.

The circuit of a simple FM detector is shown in Fig. 5.

The centre frequency of the voltage controlled oscillator is set by C1 — and the graph shown in Fig. 6 shows the correct value of C1 for frequencies between 100 Hz and 30 MHz. Fine adjustment of this frequency is achieved by injecting current into pin 6. Fig. 7 shows the percentage of frequency change for various values of current injection.

Input signal level should be at least 120 uV.

Despite its upper frequency limitations, the phase locked loop may be used at VHF frequencies by using a crystal controlled converter between the antenna and the rest of the circuit.

FREQUENCY MULTIPLICATION

A phase locked loop may be used as an excellent multiplier or divider.

For use as a multiplier, the centre frequency of the voltage controlled oscillator is set to the required harmonic of the input signal. With a sinewave input the technique can be used to multiply by two, three, four or five times the input frequency. The output in all cases will be a square wave.

If a square wave input is used, any output up to 15 MHz can be produced from any multiple between twice and ten times the input frequency.

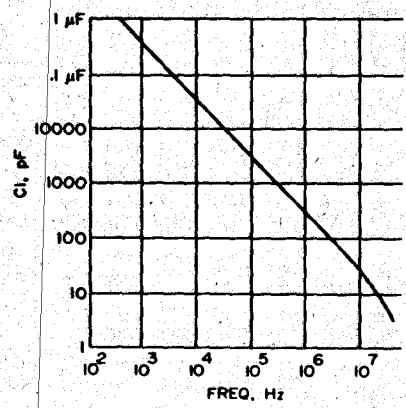


Fig. 6

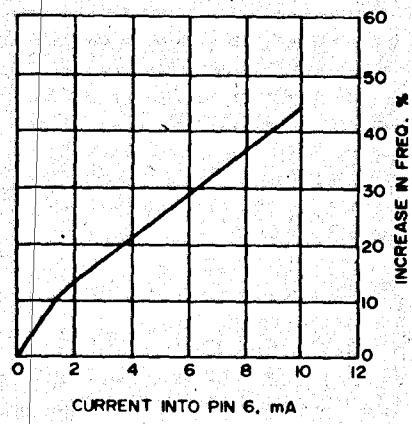


Fig. 7

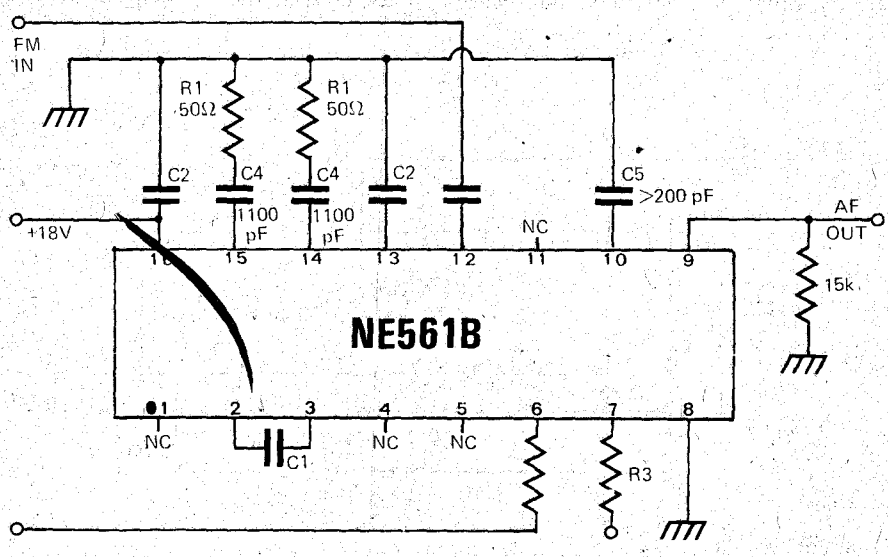


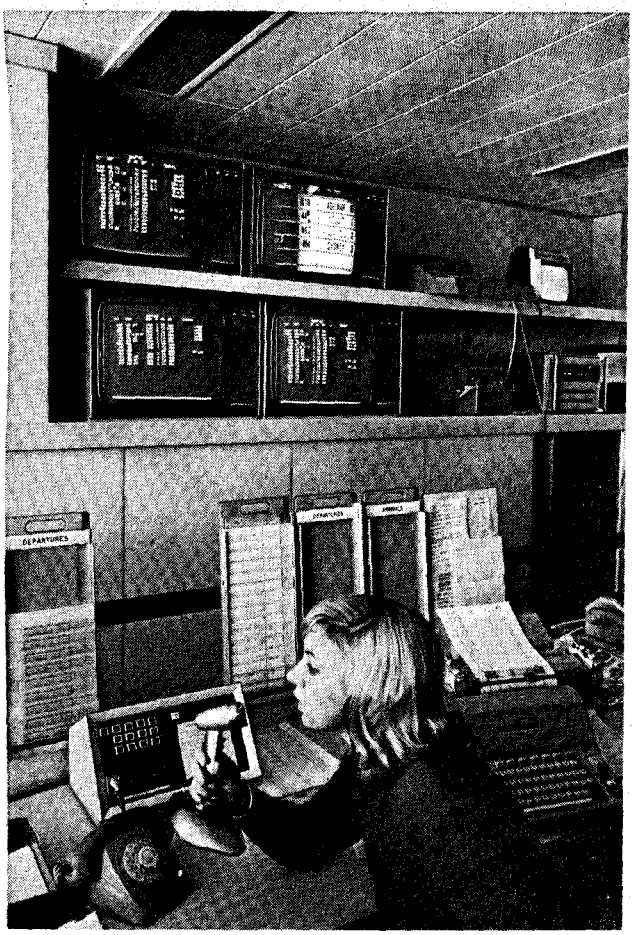
Fig. 5 This circuit shows how the NE 561B phase locked loop is used as an FM detector.

FREQUENCY DIVISION

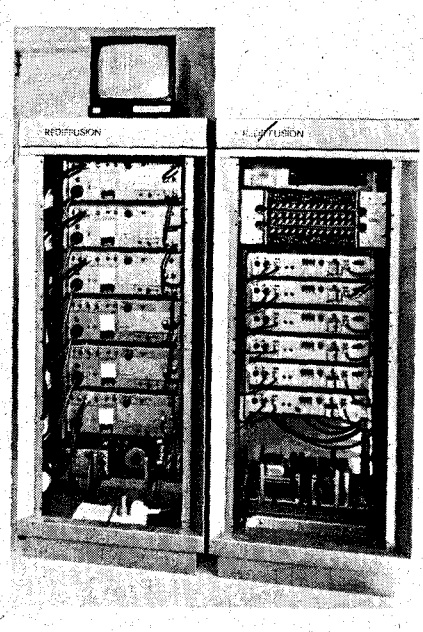
The phase locked loop can also be used as a divider — but only for *odd* submultiples, i.e., 3, 5, 7 or 9. If you need to divide by 2, 4, 6 or 8 then the technique is not for you.

For most of us, what the phase locked loop has to offer is purer, less distorted reception of radio broadcasts, but it has many other applications in fields such as radio astronomy, space communications, telemetry, long range radar detection, frequency synthesizers and amateur radio operation. ●

AIRPORT CCTV



Barbara Morgan of TAA operates the new computer controlled communications and control system.



This twin-rack assembly includes the system modulators and amplifiers.

AUSTRALIA's first AWA-Rediffusion closed-circuit television system is in operation at the Trans-Australia Airlines terminal at Melbourne's Tullamarine airport.

Essential data covering aircraft arrivals and departures, gate position, flight details and control are fed into a digital computer.

This information is then channelled, via a video converter, to 50 display units each of which is capable of being used at any of 70 outlets located in the terminal and in adjacent T.A.A. buildings.

The heart of the system is a twin-rack assembly which includes modulators and amplifiers (capable of carrying colour television quality signals) to feed the high-frequency wired network.

More than two miles of cable feed the 70 outlets at each of which a choice of six television information channels may be selected.

The network is equipped with thirty-three 24-inch and seventeen 11-inch monitors. These are located in the main airport terminal, baggage areas, crew, maintenance and catering sections, passenger lounges, bar and buffet, "kiddies' corner" and, nearly half a mile away, in the cargo centre.

The hub of T.A.A. aircraft control is the Port Co-ordination centre. From here, an operator feeds information to the system and, working in conjunction with Ramp Control, ensures the smooth turn-round of aircraft, allocation of seating, passenger and baggage movement.

The 11-inch display monitors are used for the disposal of aircraft arrival and departure control details for T.A.A. staff use while most of the 24-inch monitors are used in public display areas.

The television network is backed-up and complemented by a sophisticated loud-speaking communication system, a public address system and a pneumatic tube installation.

Before choosing AWA-Rediffusion, a T.A.A. study team visited airports in Europe and America where they obtained operational information of the system at London airport.

GRAHAM G. HALL

1910-1971

The death occurred suddenly in London, on September 11th, of Graham George Hall, at the age of 60 years. At the time of his death Mr. Hall was on a business trip for his company Plessey Ducon Pty. Ltd. Mr. Hall suffered a moderately severe heart attack at his hotel on September 9 and died at University College Hospital two days later.

Graham Hall was educated at Royal Melbourne Technical College, where he gained the Radio Engineering Diploma. He subsequently joined AWA as a development engineer in 1936. Mr. Hall joined Tecnico in 1940 as components engineer. He was responsible for the development and production of a wide range of components, including capacitors, resistors, and switches. During World War II he was chief project engineer of the Company's aircraft magneto division.

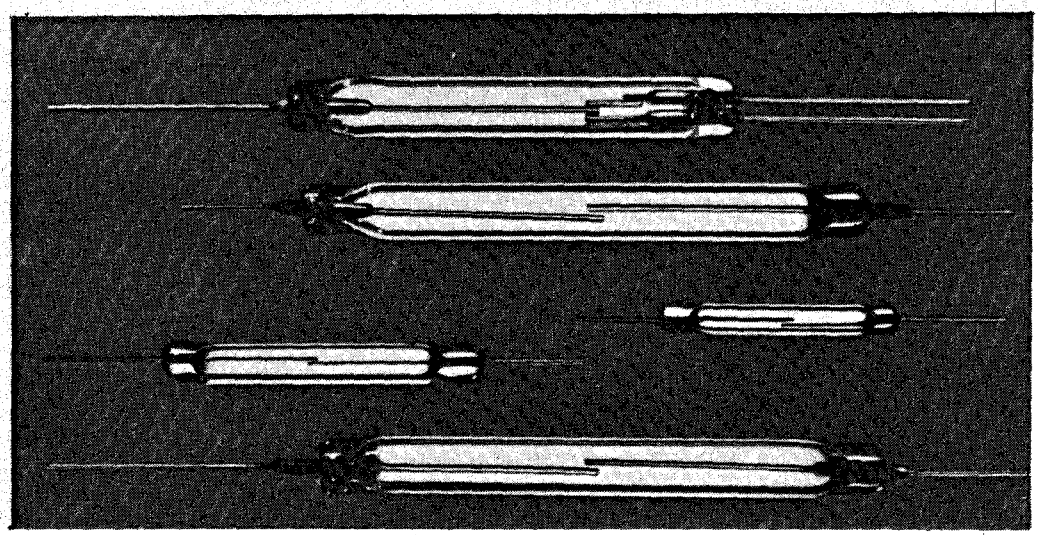
In 1954 he joined Ducon Condenser Ltd. as commercial applications engineer. In recent times he has been the manager of the Professional Components Division of Plessey Ducon.

Mr. Hall was a former president of the Institute of Radio and Electronics Engineers, had been a member of the Institution's Council since 1939 and chairman of its Publications Board since 1953.

Graham Hall enjoyed a wide circle of friends within the electronics industry. He was a humanist with an innate sense of serving his fellows.

He is survived by his widow and a married daughter to whom ELECTRONICS TODAY extends sincere condolences.

PRACTICAL GUIDE TO REED SWITCHES



Final article in this three-part series describes reed switch applications.

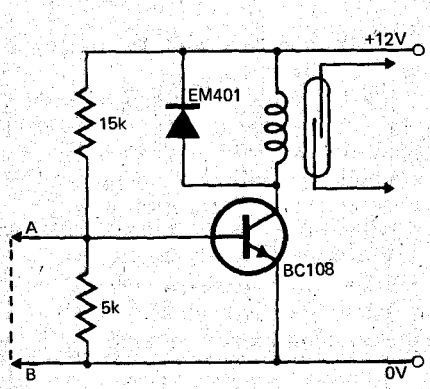


FIG. 23

Reed switches can be combined with solid-state electronic components to provide extremely reliable and maintenance free circuitry.

The low operating current of the actuating coil is well within the collector current rating of practically any transistor (and most linear integrated circuits). Many simple practical circuits can be constructed using a single transistor and a reed switch.

The circuit shown in Fig. 23 is commonly used to open or close a relay when an external circuit is made or broken. It is commonly used in simple burglar alarm installations.

In operation, the transistor is cut off by a short circuit across points 'A' and 'B' (shown as dotted lines). Because the transistor is cut off, the reed relay operating coil in the transistor's collector circuit is not energized, and the relay contacts are open.

If the short circuit is removed from points 'A' and 'B', the transistor is biased on via the 15k resistor, the relay coil is energized and the reed switch is closed. Current consumption of this circuit — whilst the relay is de-energized — is less than one milliamp.

The circuit shown in Fig. 24 has a similar function to that of Fig. 23, except that the relay will close when a short is placed across points 'A' and 'B'.

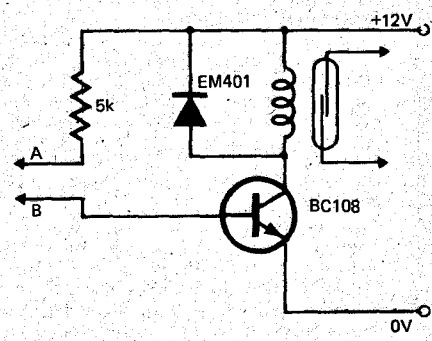


FIG. 24

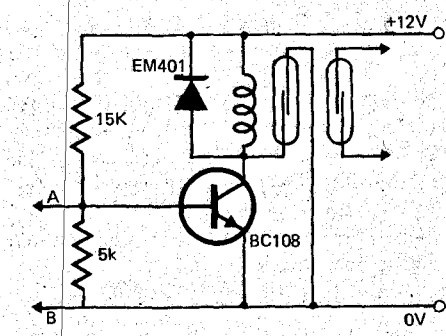


FIG. 25

It is often necessary to arrange for the relay to remain closed even though the actuating signal is only momentary. This can be done by using an actuating coil containing two reed switches, and using one of the reed switches to short out the transistor the moment the coil is actuated — Fig. 25 refers.

A very sensitive circuit that can be used as a moisture sensing switch is shown in Fig. 26. This circuit has a gain of well over 2500.

The relay will close whenever the resistance between points 'A' and 'B' falls below a few hundred thousand ohms. The 100k potentiometer is not

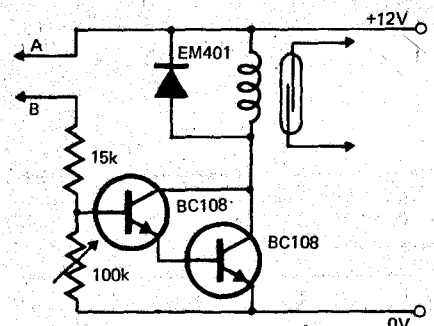


FIG. 26

an essential part of the circuit, but may be included as a 'sensitivity' control. The current consumption of this circuit, when the relay is de-energized, is less than one micro-amp.

Any of these circuits (Figs. 23, 24, 25, 26) may be combined with the Triac actuating circuit shown in Fig. 27 and used to switch very high current loads.

For example the moisture sensing circuit shown in Fig. 26 can be combined with the Triac switching circuit to energize a large motor driven pump. If necessary, three reed switches may be combined in one energizing coil to switch three Triacs in a three phase circuit. Using this principle loads of several hundred Amps may be switched without using a single contactor.

An unusual application for a pair of reed switches is shown in Fig. 28.

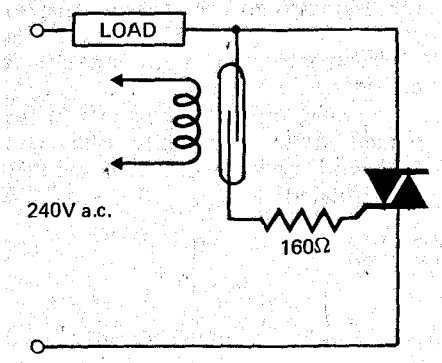


FIG. 27

This circuit can be used to switch a common antenna to either a transmitter or receiver. As the capacity between the contacts on the open reed is less than 0.2 pF, the system may be used at very high frequency.

Time delays of up to 10 seconds can be obtained using the simple circuit shown in Fig. 29. The delay is adjusted by the 50k potentiometer. It is not practicable to obtain longer delays than 10 seconds by increasing the size of the capacitor.

RESONANT REEDS

Resonant reed switches are basically similar in construction to normal reed switches, except that one reed is designed to resonate mechanically when its operating coil is energized at a specific frequency. At all other frequencies the reed will not move to any extent.

As the reed only makes contact for a portion of each cycle, it is usually necessary to arrange for latching action, or for some form of storage or pulse lengthening circuit.

Resonant reed switches are used for a variety of applications where response is required only to one specific frequency — these include communications, selective signalling, data transmission, telemetry, frequency monitoring etc.

Reed switches may also be used in very sophisticated logic circuits, usually in applications where their immunity to noise causes them to be chosen in preference to the generally cheaper solid-state components.

Fig. 30 shows a four-stage shift register which uses reeds as magnetically latched devices in simple magnetic circuits. The information in each stage is stored as closed or open switches, and the condition of each stage is transferred to the next as the shift control is operated. Only a single contact set is used for control purposes in each stage, as the state of a stage is stored as a capacitor charge during the shifting interval. However each stage as auxiliary switching contacts for output purposes.

The basic principle of operation can be considered as a series of latching

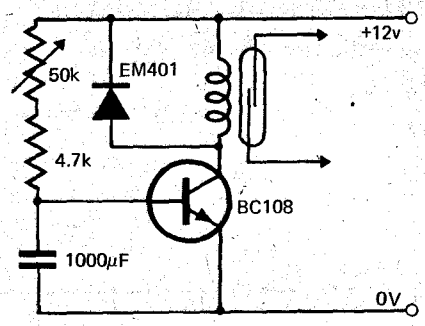


FIG. 29

relays. Momentarily closing the 'set' contact energizes coil S1 and closes reed switches STG1. The associated bias magnet latches these switches closed, thus allowing the 'set' contact to be re-opened. The logic state of the first stage may now be shifted to the second stage by operating the shift contacts in this sequence:

a. Closing contact A, thus charging capacitor C2.
b. Closing B for a few milliseconds and thus unlatching STG1 switches.
c. Opening contacts A and B.
d. Immediately and momentarily closing contact C. Capacitor C2 now discharges through coil 2S via contact C. Switches STG2 now close and are latched by the associated bias magnet. The switches associated with the second stage are now closed and those of the first stage are open.

Sequential operation of the shift circuits in this manner moves the closed or open logic state of the reed switches from each stage to the next stage in sequence.

Two additional sets of contacts are provided in each stage, one set may be used to provide visual indication of the logic state of the stage, the second set may be used to trigger particular operations whenever required.

Reed switches may also be used in many types of coding and decoding systems. A simple decimal to binary encoder is shown in Fig. 31 In this circuit, the input is from a decimal keyboard energizing reed relay coils, while the output is in four-bit binary. Single, double, and triple switch relays are required for this application.

MERCURY WETTED CONTACT RELAYS

The mercury wetted contact relay overcomes the problem of contact bounce that is inherent in the dry reed switch.

The construction of the mercury wetted switch is shown in Fig. 32. It consists of a glass encapsulated reed which has one end immersed in a pool of mercury. The other end of the reed is capable of moving between two sets of stationary contacts. The mercury

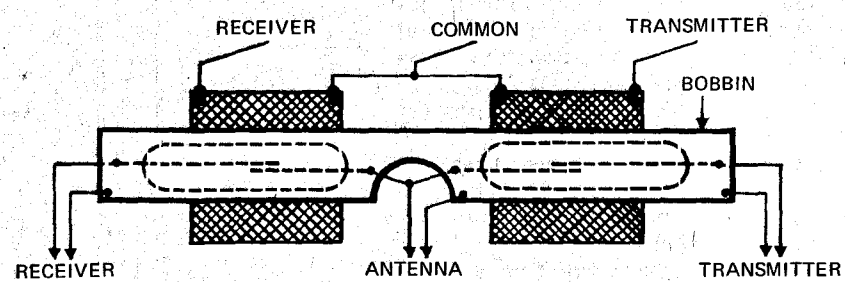


FIG. 28

Fig. 28. Here reed relays are used to switch a common antenna to either a receiver or transmitter. As the capacitance between the reeds is less then 0.2pF, the arrangement may be used at very high frequency.

PRACTICAL GUIDE TO REED SWITCHES

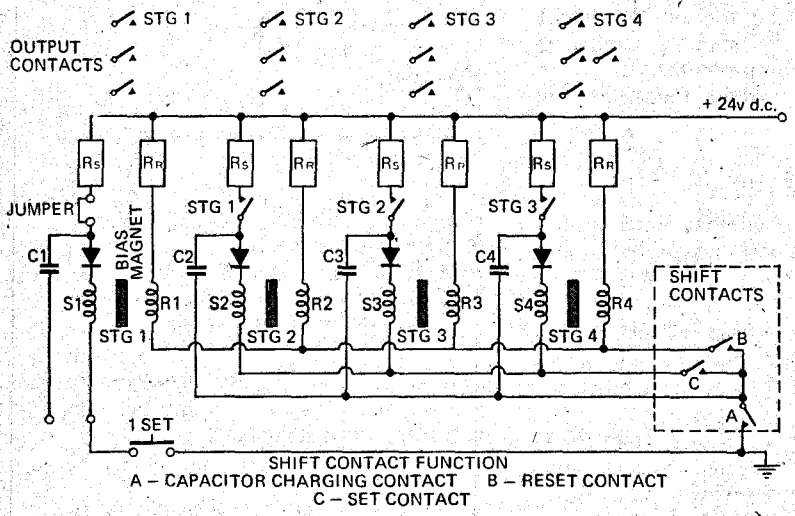


Fig. 30. This four-stage shift register uses reed relays.

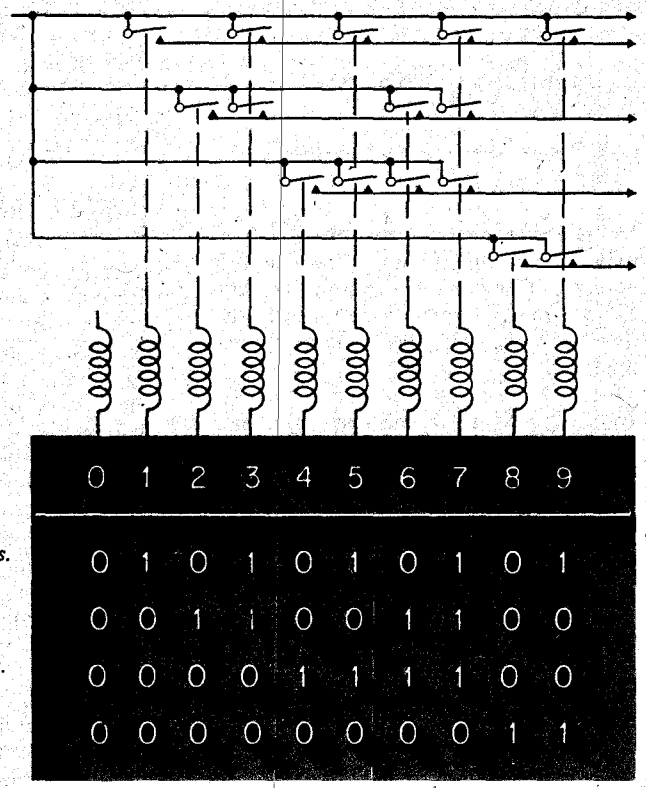


Fig. 31. Reed switch decimal binary encoder.

flows up the reed by capillary action and wets the surface of the fixed and moving contacts. Thus a mercury to mercury contact is maintained whilst the contacts are closed.

The resistance of mercury is very low and contact to contact resistances of mercury wetted switches rarely exceed 50 milliohms. This is somewhat less than if the contacts were permanently soldered together!

The mercury wetted switch may be opened and closed in a similar fashion to its dry reed counterpart. Operating times are typically 10 milliseconds at normal coil current, falling to three milliseconds at twice the normal ampere-turn rating. The release time is typically four milliseconds under any conditions.

Apart from their high current carrying capacity, mercury wetted reeds have extremely long life since contact erosion is eliminated.

The disadvantages of mercury wetted reeds are poor resistance to shock and vibration, and the need to mount the reed vertically.

FUTURE DEVELOPMENTS

A lot of development work is currently being undertaken — particularly toward the use of cladded reed material.

Nickel-iron reeds combine optimum magnetic characteristics with the high internal damping that is required to minimize contact bounce; but the material is by no means an ideal conductor, and because of this, high resistivity losses within the switch are appreciable at high current loadings.

Cladding with gold or copper substantially reduces many of the undesirable characteristics of the nickel-iron reeds. This cladding reduces the effect of skin resistance — which can be appreciable at high frequencies — and if the cladding is continued right to the ends of the external lead-outs — it virtually eliminates the thermal emfs generated when a copper wire is soldered to a nickel-iron reed in a conventional reed switch.

Another problem currently being investigated is that of reed switch contacts failing to separate, especially after they have been held closed for long periods at high temperatures. This is caused by molecular migration and the resultant metallic bond cannot be broken by the low separating force available. This problem has not yet been completely overcome but current development is toward heat treatment to produce a diffusion of gold into the nickel-iron base, and multi-layer diffusion techniques.

Prices of reed switches are still decreasing, and as they become cheaper, new markets are opening up.

The motor industry in particular is using reed switches in fuel injection and ignition systems. The security industry appreciate the reliable maintenance-free service that can be obtained. Machinery manufacturers are beginning to use reed switches in applications in which adverse environments preclude open switch contacts.

For what other type of switch can remain static for twenty years and then work perfectly the first time that it is actuated? ●

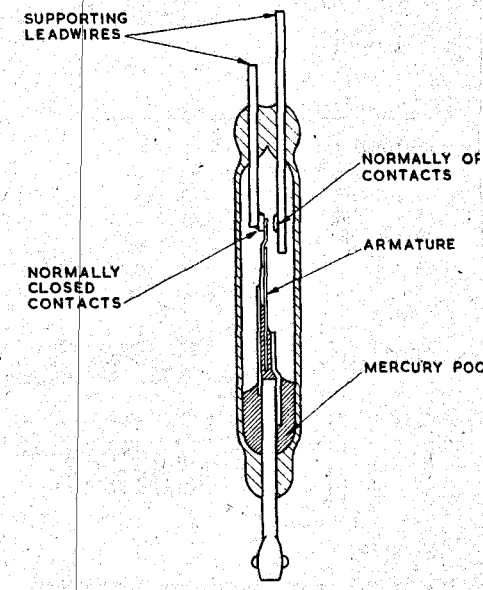


Fig. 32. Construction of a mercury wetted reed switch.

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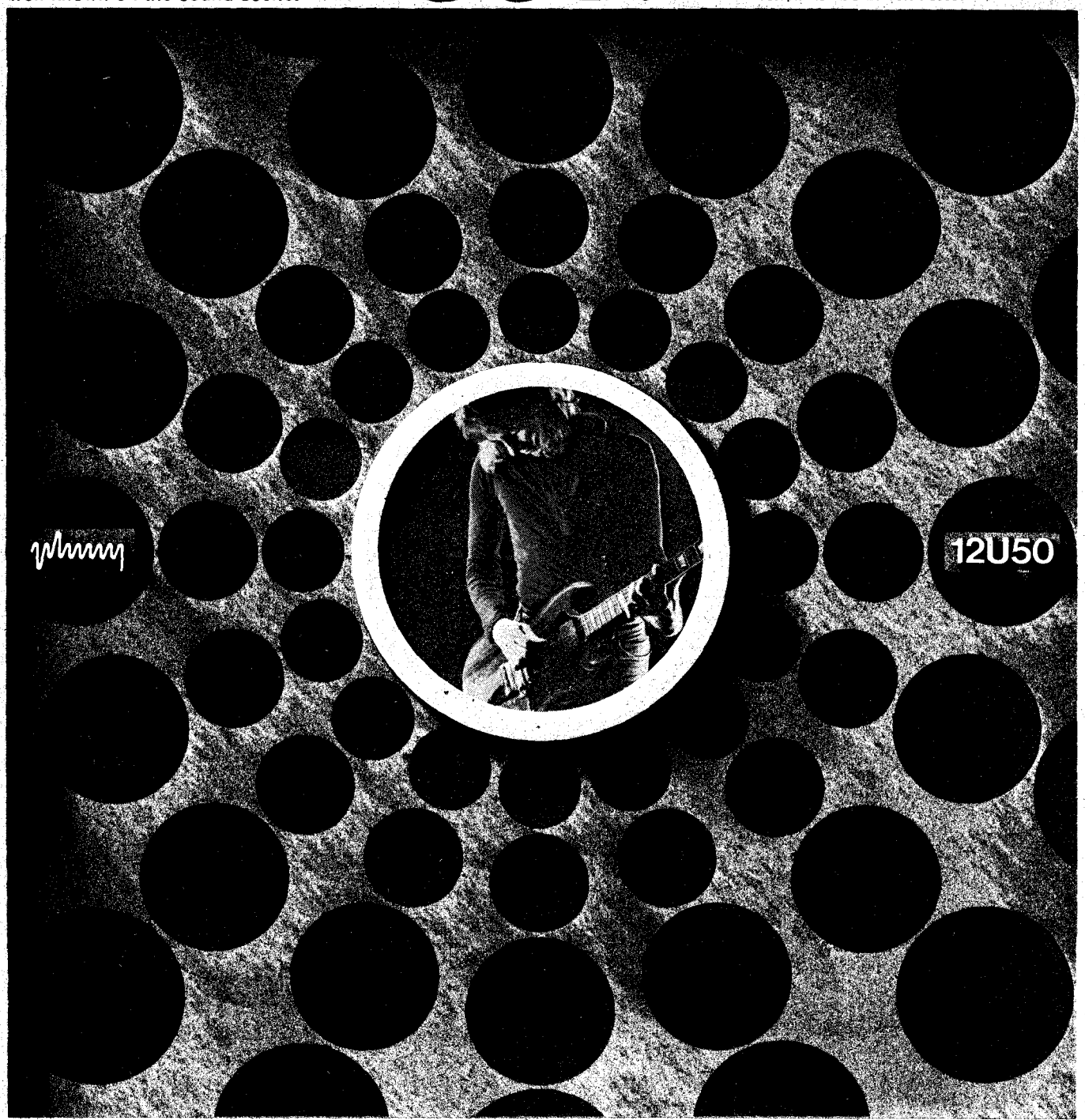

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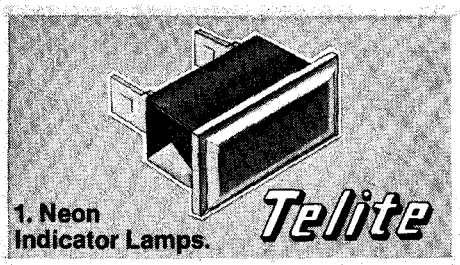
components with a purpose *



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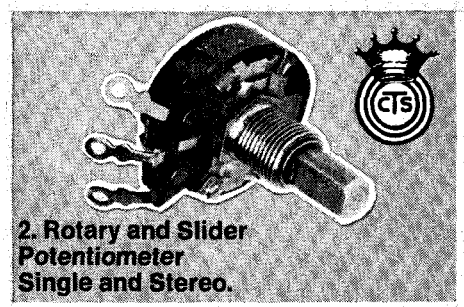

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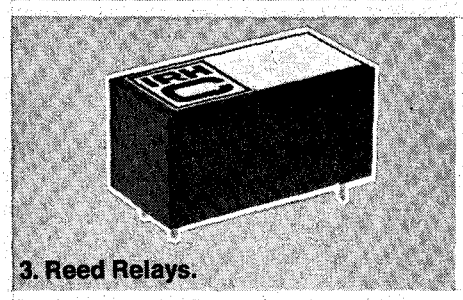

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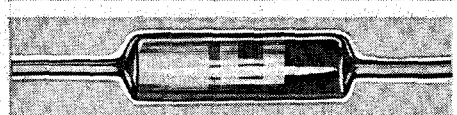

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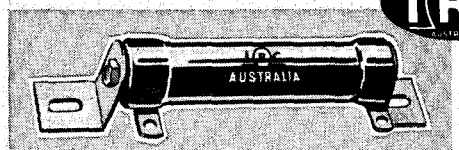

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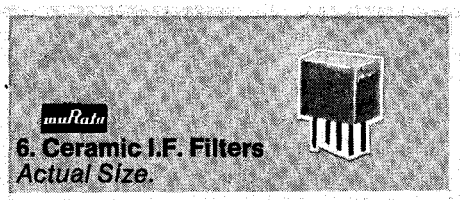

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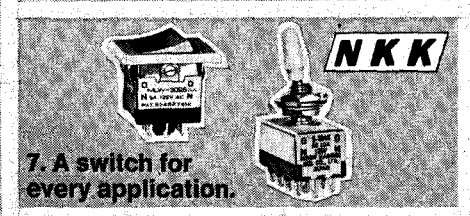

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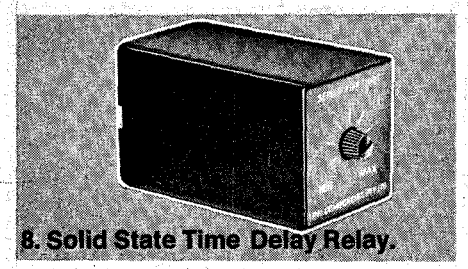

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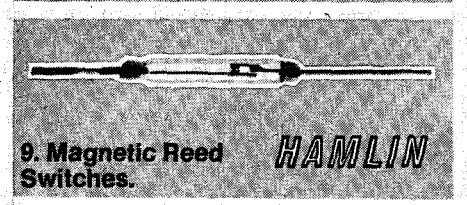

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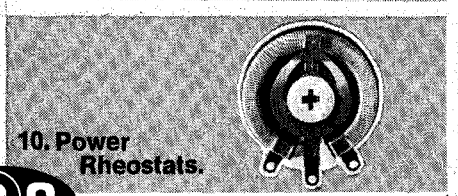

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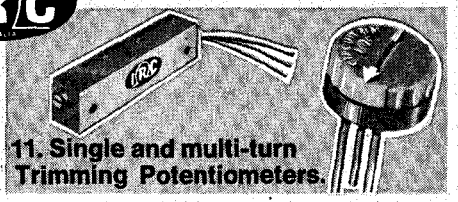

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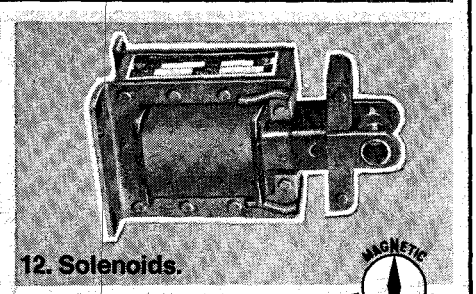

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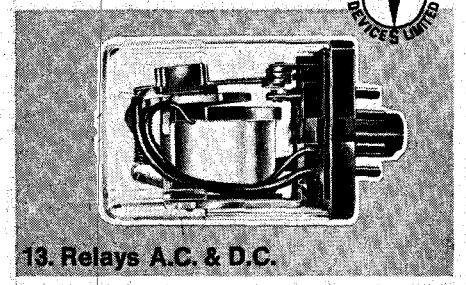

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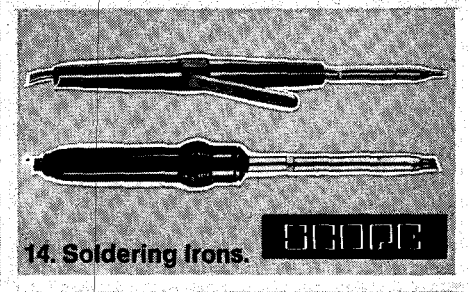

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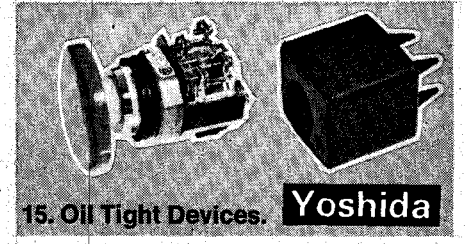

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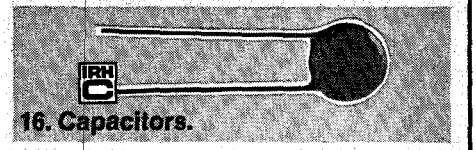

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Neutron Radiography

By HAROLD BERGER/Senior Physicist, Argonne National Laboratory, U.S.A.

A new testing technique using a source of radioactive neutrons permits inside views of object that would be impossible with x-rays

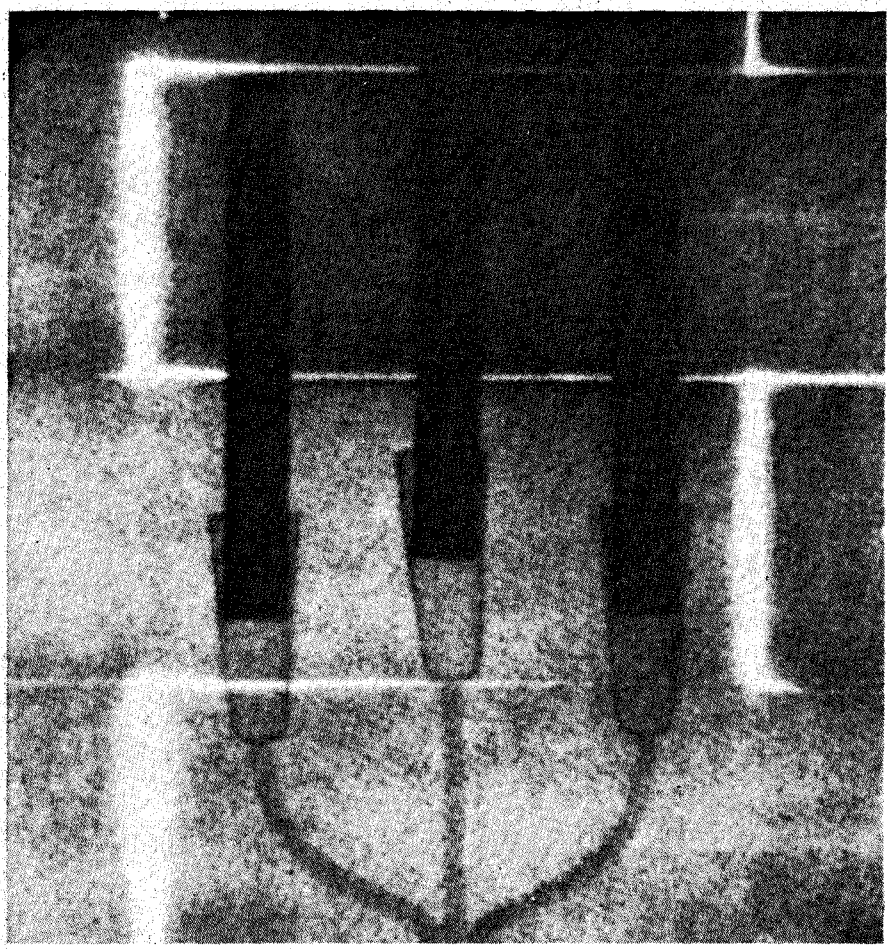

Fig. 1. This thermal neutron radiograph showing wax candles in steel holders was taken through a four-inch-thick lead-brick wall!

THE world of electronics is becoming more and more aware of the value of nondestructive testing.

X-ray, infrared, and ultrasonic techniques have become useful diagnostic tools that complement the normally used electrical tests.

Neutron radiography supplies an additional capability to this arsenal of test methods; it should prove to be useful in a variety of inspection applications. In addition, the impact of neutron radiography on electronics is significant because of the use of electron image devices, accelerator neutron sources, and various electronic techniques. There should be an increasing awareness of neutron radiography within the field of electronics. — Ed.

TO an x-radiographer, the prospects of obtaining a good radiographic image of a column of water in a lead pipe, an insulator within a metal connector, or a rubber "O" ring in a metal valve are very poor.

This is because the high x-ray energy needed to penetrate the metal goes right through the water, insulator, or rubber with minimum attenuation. But the recent emergence of neutron radiography changes that situation.

Thermal neutrons are strongly attenuated by several materials containing hydrogen, lithium, and boron; hence such materials are almost opaque to such neutrons. On the other hand, such materials as lead, bismuth, and uranium are practically transparent to thermal neutrons. Therefore, it becomes a simple matter to get a picture of common hydrogen-containing materials, such as plastic, wax, rubber, wood, paper, water, or other liquids, even when contained in a metal assembly.

As an example, Fig. 1 shows a thermal-neutron radiograph of wax candles in steel holders, taken through a four-inch-thick lead-brick wall. A good contrast shadow is obtained simply because wax has a high attenuation for thermal neutrons whereas the lead is essentially transparent. Of course, for an x-radiograph of the same object, the attenuation pattern would be reversed. The x-radiograph would show, primarily, the lead with little, if any, observable shadow of the wax.

An interesting comparison of neutron and x-radiographs of a battery is shown in Fig. 2, and several differences are apparent. A high contrast is obtained on the neutron image of the plastic battery cap and electrolyte (upper photo). The x-ray image, on the other hand, presents high contrast of the upper metal contact but the metal case tends to reduce the contrast of the internal battery details.

These examples of neutron and x-radiographs illustrate some of the possibilities for the application of

Neutron Radiography

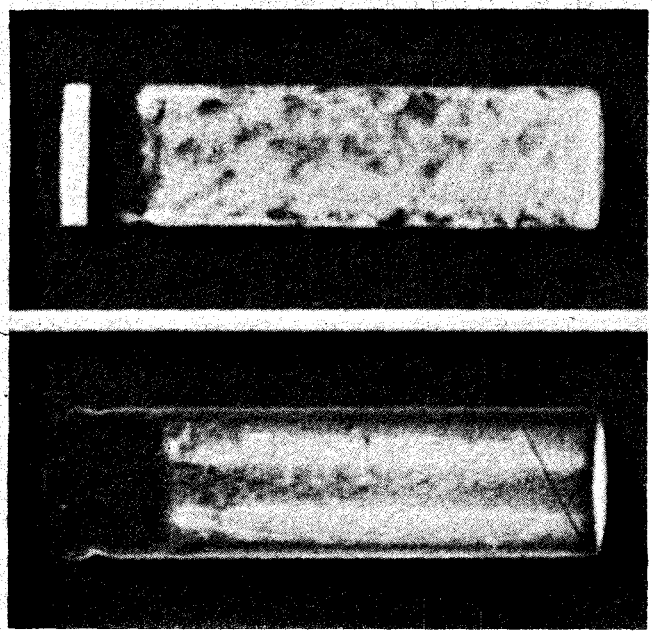

Fig. 2. Radiographs of battery using thermal neutrons at top, x-rays at bottom. Note high contrast of plastic battery cap at the top of the cell and the electrolyte mix within the cell in the top photo. The x-ray photo shows the metal casing.

neutron radiography. Let's consider the technique and its applications in the electronics field.

RADIATION SOURCES AND DETECTORS

The methods used to perform neutron radiography are fairly simple. The object is placed in a thermal-neutron beam in front of an image detector. The neutron beam may be obtained from a nuclear reactor, a radioactive neutron source, or an accelerator.

The highest quality neutron radiographs have been produced by a reactor source because more neutrons are available in the thermal-energy range. More neutrons mean that collimation of the neutron beam can be tighter; therefore, the beam will be more nearly parallel and the resultant images of thick objects will be sharper. Better collimation in thermal-neutron radiography is comparable to reduced focal spot size in x-radiography.

The collimation, that is the bringing out of a beam of neutrons from a large source, is necessary for thermal-neutron radiography because there are no useful point sources of thermal or low-energy neutrons. Fortunately, the fast neutrons emitted from sources can be slowed to lower energies simply by surrounding the source with a moderator containing light material, such as water, paraffin, beryllium, or carbon.

A diagram of a simple arrangement for an accelerator source is shown in Fig. 3. In the illustration, the ion beam could be a deuteron beam, striking a tritiated target to produce neutrons by a relatively prolific and inexpensive reaction. Alternately, the centre of the moderator could contain a radioactive neutron source, or even the core of a nuclear reactor. The principle remains the same.

Detectors for thermal-neutron radiography are usually commercially available x-ray films exposed in conjunction with an intensifying screen. The common screens are neutron scintillators, or metal foils of gadolinium. The scintillators are made of a boron or lithium compound mixed with a phosphor powder, such as ZnS. Several scintillators for neutron radiography are also commercially available.

Prompt *alpha* emission is produced in the lithium or boron by thermal-neutron capture; the *alpha* particle stimulates the phosphor and the resultant light exposes the film. This technique can produce very fast results. Total thermal-neutron exposures as small as a few hundred thousand neutrons/cm^2 produce useful images.

Somewhat better quality radiographs are normally produced by the slower techniques with gadolinium foils. Exposures may be about a hundred times higher for the metal intensifier method, but results are normally improved in terms of less graininess and improved image sharpness. The battery neutron radiograph that is shown in Fig. 2, for example, is a good-quality radiograph obtained with a gadolinium foil.

Among other detectors for neutron radiography is a dynamic approach in which the neutron image is converted to light and then detected by a

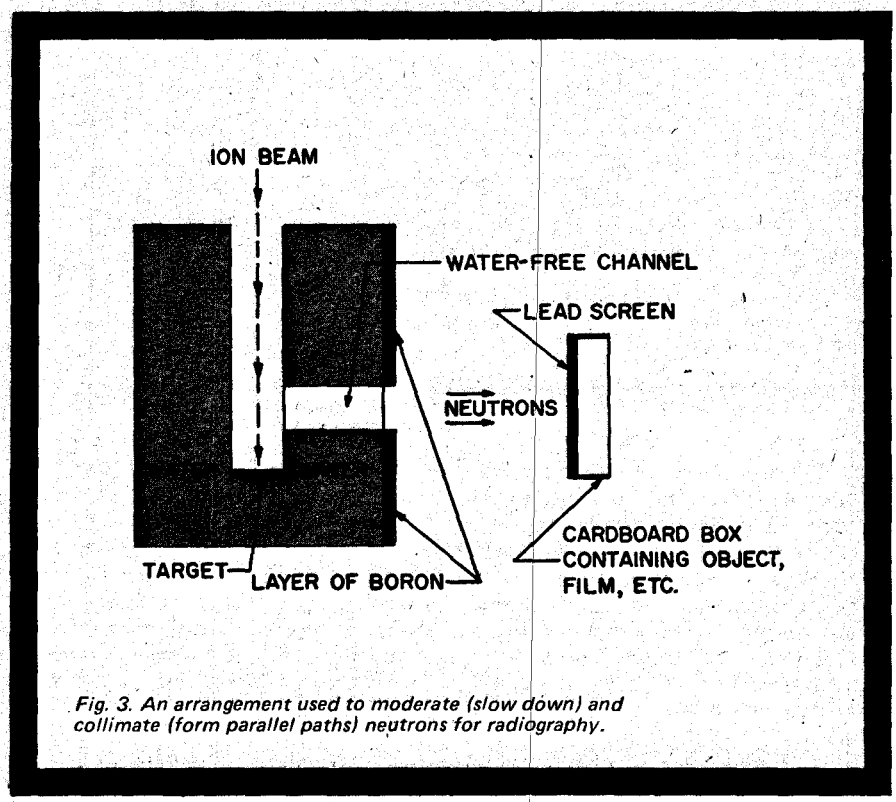

Fig. 3. An arrangement used to moderate (slow down) and collimate (form parallel paths) neutrons for radiography.

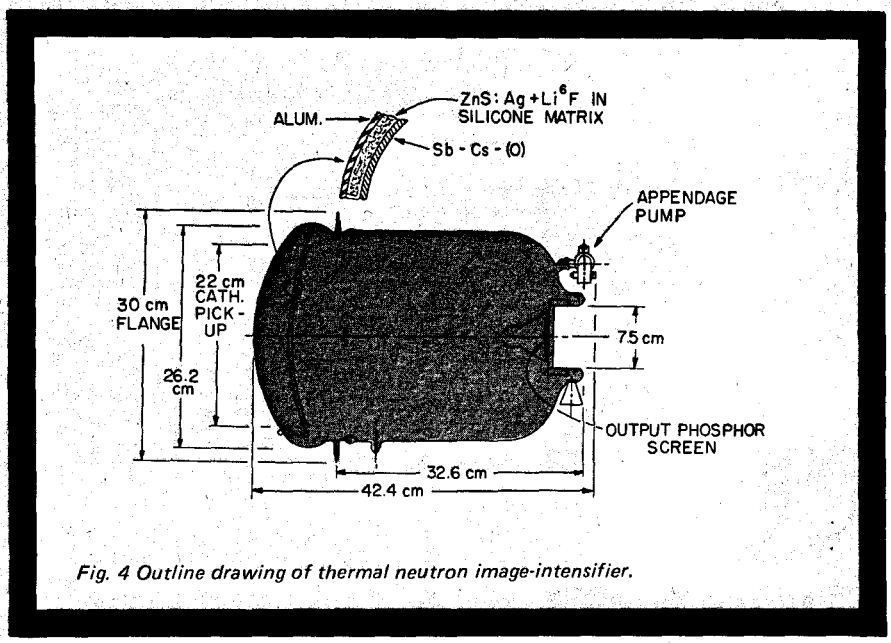

Fig. 4 Outline drawing of thermal neutron image-intensifier.

television camera. Intermediate light amplification by either a light image-intensifier tube or an integrated neutron image-intensifier tube (see Fig. 4) permits the use of an inexpensive vidicon camera. A commercially available neutron image-intensifier tube optically coupled to a vidicon camera can provide thermal-neutron images with incident intensities of about 10^5 neutrons/cm^2-second. However, for dynamic viewing at TV frame rates, one needs at least ten times this magnitude of neutron intensity for good-quality images.

The TV approach is attractive because it offers the possibility of obtaining useful images of an object in motion, and also because it would permit rapid neutron inspection of devices on a production line. Although the TV image has less contrast and spatial resolution than the x-ray film method, the basic information may suffice for many inspection problems.

Neutron radiography is now being used routinely for many inspection problems in the nuclear and aerospace industries. Radioactive materials and explosive devices account for the major efforts in the two industries, although a large variety of materials and components have been inspected by neutron radiography.

In the electronics area, neutron radiography may prove to be useful for observing plastics, rubber, other insulators, or fluids in various devices. As an example, consider the object pictured in Fig. 5.

Here we have radiographs of a BNC connector. The x-radiograph at the left shows the metal components, and the interior insulators are well displayed on the neutron radiograph at the right. Together the two radiographs provide a relatively complete inspection. The break in the insulation at the crossover point, easily observed on the neutron radiograph, could be a potential failure point.

This and other examples illustrate a few specific areas in which neutron radiography could be useful as an inspection, process-control, or research and development tool. Additional application possibilities are almost unlimited.

HOW SAFE?

Neutron radiographic application work presents no significant problem from the point of view of radiation hazard. Shielding of the neutron beam can be accomplished with materials such as paraffin, plastic, or water. The addition of a lead or similar shield for the gamma radiation produced in these hydrogenous materials is often also necessary. Shielding with earth or concrete blocks is very effective.

A radiation hazard unique to neutron radiography is that of radioactivity produced in the objects or detectors used in the neutron beam. There is occasionally some activity produced in radiographic samples, a fact easily recognised with the use of a good radiation survey meter. On these occasions it may be necessary to allow objects to decay a few hours before they are moved out of the radiation-controlled area.

Although there is essentially no radioactivity problem with the detectors described, there are situations (such as an inspection of a radioactive object) which call for a detection method in which film is not exposed directly to the neutron beam. In that case, foils of materials, such as indium or dysprosium, are used to make a radioactive image later made visible by an autoradiograph. Such foils are primarily emitters of beta radiation, easily shielded for handling by a millimeter or so of aluminium. Although there are some radiation hazard problems with neutron radiography, they can be handled in a straightforward manner. ●

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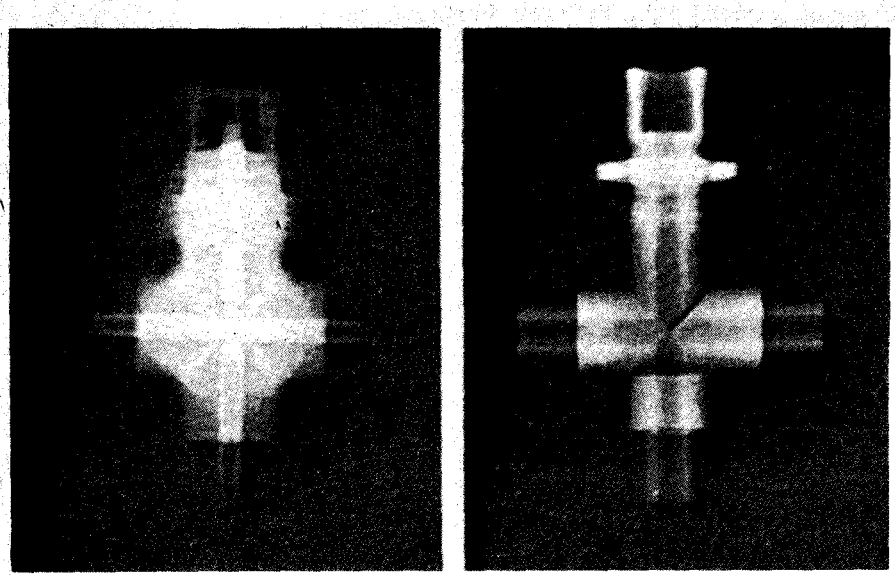
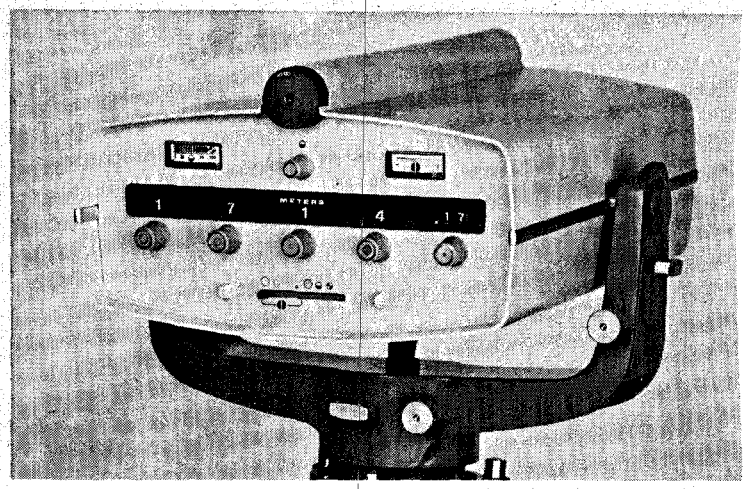


Fig. 5. Radiographs of BNC connector taken at Los Alamos Scientific Laboratory. Note the void in the insulation at right.

New electronic distance measuring instrument has direct readout over distances up to 3000 metres.



DISTANCE MEASURING INSTRUMENT

DISTANCE MEASURING INSTRUMENT

A new low-cost instrument that uses an invisible beam of infra-red light to measure distance up to 3,000 metres has been announced by Hewlett-Packard Australia.

Mr. Bill Thomas of HP Australia, told us that the HP Model 3800B Distance Meter enables surveying crews to operate with greater efficiency. "Any measurement may be made in less than two minutes. As an example of its accuracy, the Model 3800B can measure a distance of 3,000 metres to within 25 millimetres," Mr. Thomas said.

The unit is designed primarily for use in surveying and photogrammetric control. It can also be used to detect and measure sway in large structures.

The instrument measures the length of time it takes a beam of infra-red light to travel from the meter to a reflector and back. It converts this elapsed time into a distance measurement, which is displayed directly in metres. The instrument's unique method of modulating the light beam with four different frequencies eliminates any measurement errors that might be caused by the movement of heavy traffic or pedestrians through the light beam.

Controls on the meter are marked with graphic symbols and colour-coded to permit anyone to operate the instrument after only a few minutes of instruction.

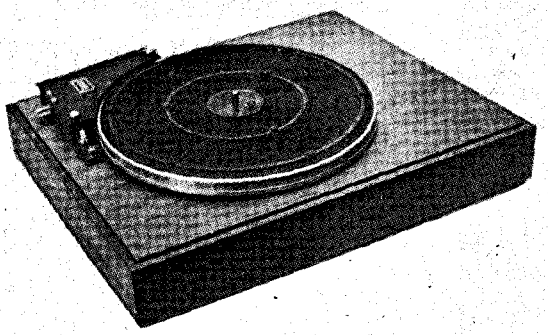
The distance meter may be mounted on theodolites for simultaneous angle and distance readings for such applications as radial surveying. The meter can also interchange quickly and easily with existing theodolites without replumbing or recentreing.

The meter, together with its tripod weights 7.71 kg. The separate, portable power unit weighs 5.90 kg, including the battery. An internal battery charger is included, and an external battery can also be used. All electronic circuitry is solid-state, with pre-aged components. Included in the power unit is a single-dial adjustment for environmental correction.

Full details from Hewlett Packard Australia Pty. Ltd., 22-26 Weir St., Glen Iris, Vic. 3147. ●

INSTROL TURNTABLE VALUE!!

J. H. TURNTABLE (complete)

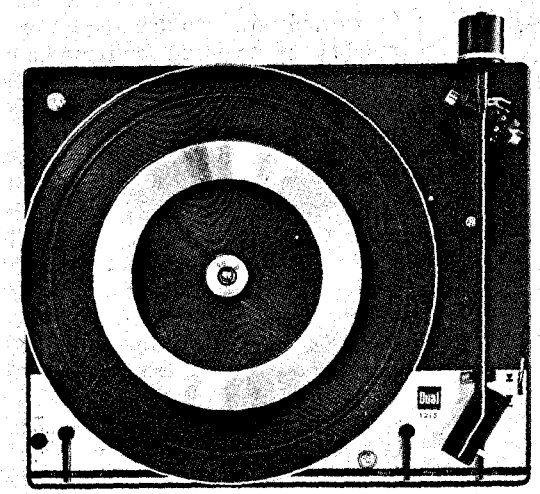


This outstanding turntable consists of:—

(A) J. H. TURNTABLE	Belt drive, synchronous motor, unmeasurably small rumble, wow and flutter of better than 0.04%, negligible hum radiation, with 12" diameter of platter.
(B) LUSTRE ST510D ARM	A high precision universal arm, stylus pressure is adjusted by calibrated counterweight. Oil damped cueing lift is fitted.
(C) A.D.C. 220X	Magnetic cartridge. Tracking force 1½ to 3 grams, extremely linear and smooth frequency response.
(D) INSTROL 45 STAND	This aesthetically designed player stand is available in either oiled teak or walnut.

ALL THE ABOVE FOR ONLY $86.00 (Hinged perspex cover $10.50 extra)

DUAL TURNTABLE (complete)



This outstanding turntable value consists of:—

(A) DUAL 1215	Automatic turntable. Low-mass, torsionally rigid, counter-balanced all metal tone-arm. Continuously variable stylus force 0 to 5.5 grams, coupled with anti-skate adjustment. Hydraulic Cue control. Pitch control, adjustable over one semi-tone. Three speeds.
(B) A.D.C. 220X	Magnetic cartridge, extremely linear and smooth frequency response.
(C) INSTROL 35 STAND	This attractive player stand is available in either oiled teak or walnut.

ALL THE ABOVE FOR ONLY $120.00 (Hinged perspex cover $10.50 extra)

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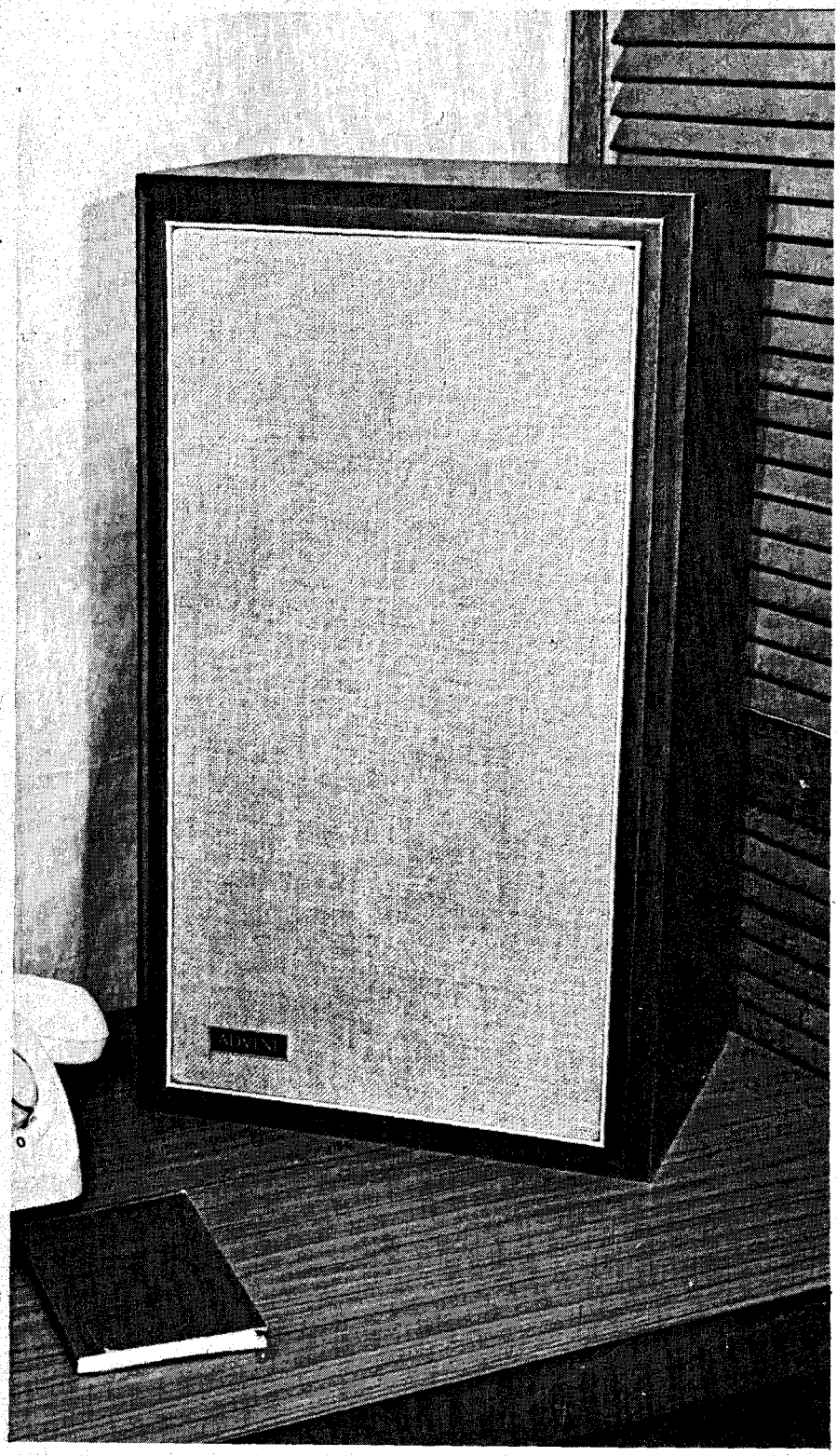
TIII

THE ADVENT



electronics TODAY product test

A FINE PRODUCT FROM A NEW COMPANY

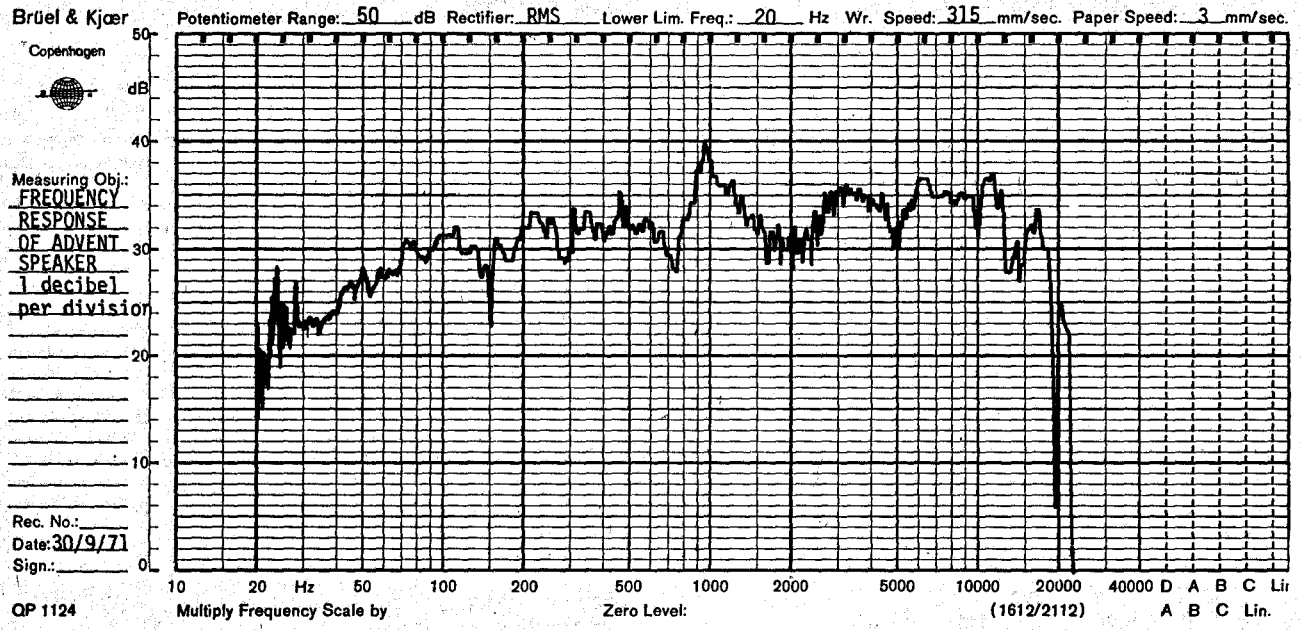
THE Advent Corporation was formed, in the USA, about eighteen months ago by a number of engineers and marketing people who had all come from other well-known manufacturers of high fidelity products.

The standard of the new company's engineering talent is indicated by the fact that their President, Henry Kloss was previously President and a founder of Acoustical Research. Many other staff members have similarly impressive backgrounds.

Some of the new Advent products may rightly be described as technical products incorporating 'state of the art' techniques. The Advent Loudspeaker, on the other hand, is more the culmination of many years experience in designing 'conventional' acoustically suspended enclosures. In many ways it is similar to some of the A&R products.

This speaker is another bookshelf speaker that is bigger than any bookshelf we have yet seen. None the less, while the description "bookshelf speaker" is a misnomer, the size of the speaker is very well suited to the average modern home and far more likely to be acceptable than some of

LOUDSPEAKER



the eight cubic feet units which were the vogue some years ago.

Many companies have made speakers of same size as the Advent unit, but with very few exceptions the performance of these speakers has been deficient in terms of bass performance.

The cabinet of the Advent speaker is rather plain and unpretentious with a flush-mounted buff coloured grill cloth. The timber surround on the front is approximately 1¼" wide. The speaker box is constructed from walnut veneered particle board, which is particularly well fitted and polished. A grey plastic beading separates the grill cloth from the timber and appears a little out of place. The cabinet is a fully sealed enclosure with a recessed terminal panel centrally located in the back panel. The terminal panel also contains a three position toggle switch for adjusting the high frequency end of the spectrum. The three positions are marked "extended", "decrease" and "normal" and provide approximately 3 decibels boost or cut around the normal performance.

The woofer is unusual in that its mounting frame is 11" diameter whilst the cone is only 7½" diameter.

When you form a new business, and are eager to get on with things before the legal vultures get all the papers signed and the incorporation proceedings over with, your lawyers call you an 'advent' company. At least they do in the USA. Henry Kloss felt that the term suited his company's desire to get on with things, and appropriated the title for his company's permanent name.

Normally a frame with these dimensions would have a cone having an effective diameter between 8½" and 9". The tweeter has a 2" diameter cone and is mounted proud of the front baffle face. The crossover frequency from the woofer to the tweeter is stated to be 1 kHz.

It is interesting to look at the stated aims of the Advent Corporation and compare these with the end result.

* To fit the highest category of loudspeaker quality with overall performance at least the equal — in every audible and useful respect — of the most expensive speakers available.
* To do that at about half the average cost of the speakers now generally considered the best available.
* To be small enough, unobtrusive enough, and uncritical enough in placement to fit gracefully and usefully into a home.
* To produce enough output at low distortion to permit listening to music at satisfyingly loud levels in even the largest living room.
* To be driven comfortably by the majority of good amplifiers and receivers now available, with a power margin sufficient for the most demanding musical material.
* To sound convincing not only on

the best recordings but on the great majority of recordings of all kinds. In developing the Advent Loudspeaker, our initial interest was in the category just below the "ultimate" in performance and a long way below it in price — the category in which most serious listeners, believing that further improvements are not worth the added cost decide to buy. We knew that we could produce a speaker that would be both significantly better and significantly less expensive than the speakers considered the best value in that category. Our aim was to do that and establish a new point of diminishing returns that would be closer to the highest level of speaker performance.

HOW THEY PERFORMED

The first tests to which we submitted the speakers were a series of A-B type tests in different living rooms compared against good speakers, of at least twice the selling price of the Advent units. These tests involved a number of well known test records, (including the new J.B.L. PRO496 test record which we would recommend be bought by those people who either want the best demonstration material or who, like us, find the music to be pleasant).

Our first impression was that there was an almost complete absence of colouration at the low frequency end of the spectrum and that the bass was possibly lacking something, but as time went on and we proceeded with our A-B testing it became clear that this was not so.

It was soon apparent that there was also an almost complete lack of colouration in the mid frequency region, and whilst we were expecting the dip in frequency response typical of cheap speakers, it wasn't really there.

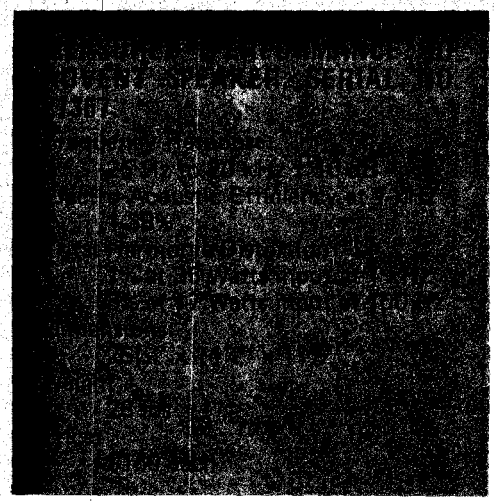
The more we played music through the speakers the more we liked them. We tried low power, medium power and high power amplifiers and it was noticeable that valve amplifiers with a damping factor of about 10 did not show the speakers up as well as did transistor amplifiers with damping factors of over twenty five. Having decided that the speakers were above average in subjective testing, we commenced laboratory testing.

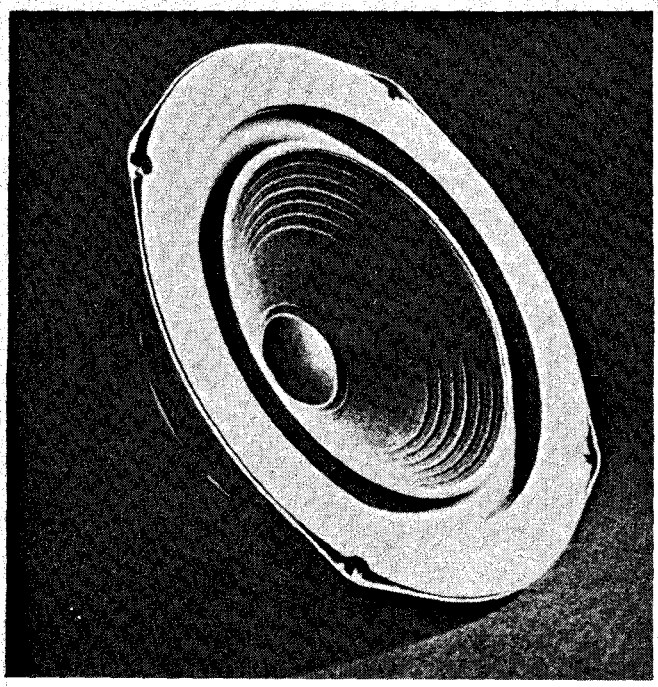
The measured frequency response was an eye opener and with the exception of some of the J.B.L. and A.R. systems was better than most that we have tested. The lack of colouration as evidenced by peaks in response or drop-outs is remarkably good for such a low cost system and possibly better than any other two-speaker enclosure that we have seen.

The distortion characteristics were particularly good, being 1% at 1000Hz with 35 Watts input and 3% at 100Hz with 17 watts input. Dispersion is also excellent.

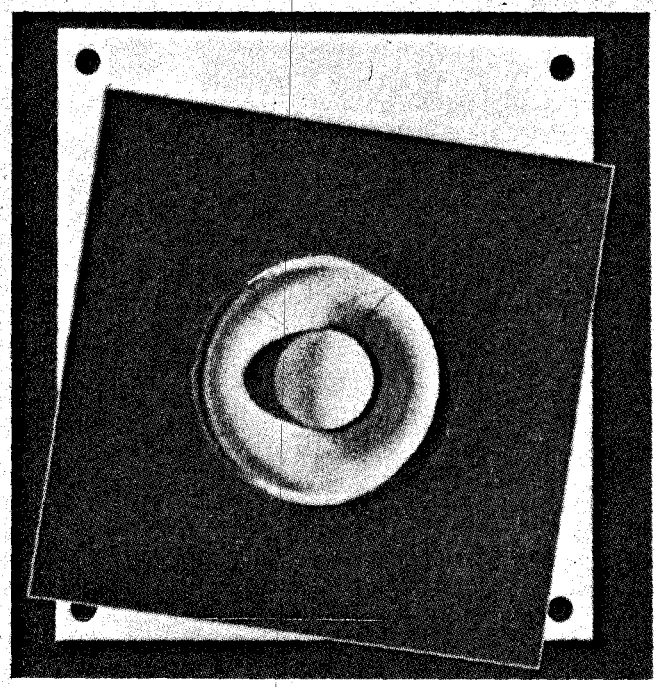
The overall impression of the Advent speaker is that it is an unusually good low cost unit and undoubtedly top of its class in terms of value for money.

The Advent Corporation have achieved what they originally set out to do. ●





The Advent Low-Frequency Driver



The Advent High-Frequency Driver

ADVENT 201 CASSETTE RECORDER

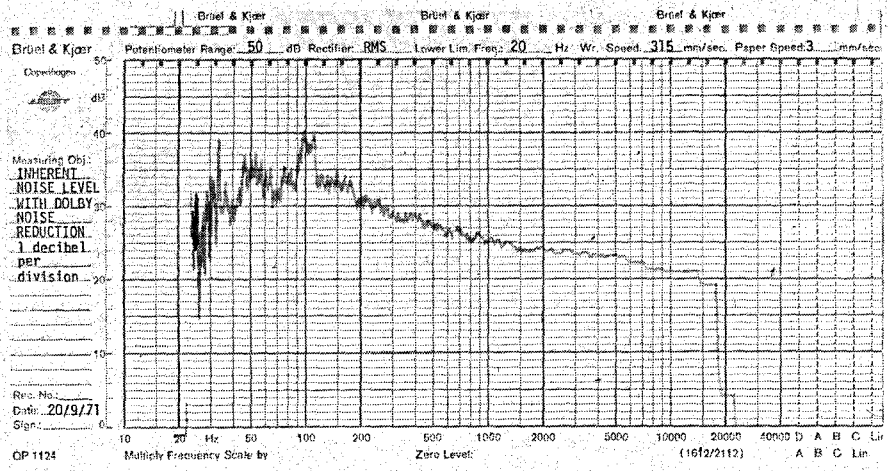
This American cassette recorder has Dolby system built-in.

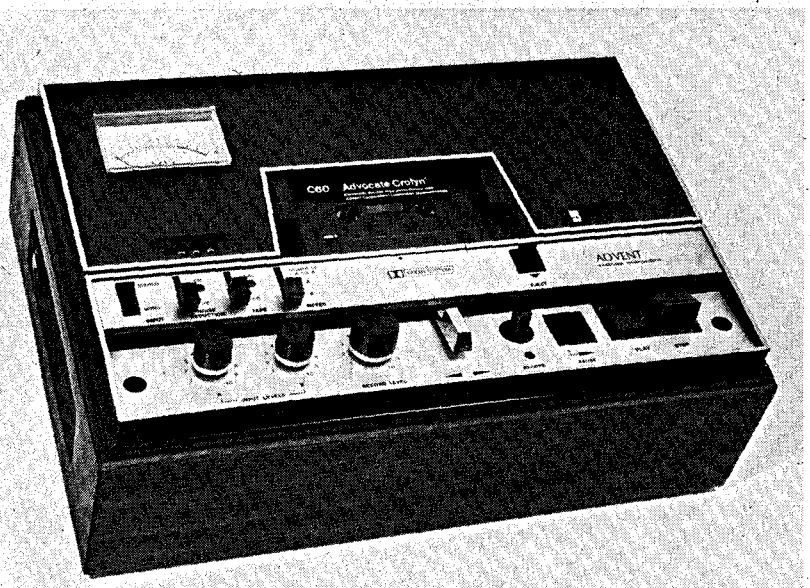
THE Advent type 201 cassette recorder is the first of the second generation recorders that we have tested which incorporate a Dolby 'B' system. As we explained in the last issue of ELECTRONICS TODAY the Dolby 'B' system, or, as it is more commonly known, the Domestic Dolby, does provide a significant reduction in high frequency tape noise, such as hiss, markedly improving the reproduction quality.

The inclusion of the Dolby 'B' system as an integral part of a recorder is now regarded as an essential inclusion for the best domestic cassette recorders. From our experience the time involved in alignment and adjustment for a separate Dolby 'A' system with a suitable recorder is time consuming and is often confusing, especially to the novice. Our review of a Dolby 'B' system in the last issue of ELECTRONIC TODAY discussed only some of these problems.

It is because of these problems that the majority of the American manufacturers are releasing fully *"Dolbyised"* machines.

ADVENT 201 CASSETTE RECORDER





The Advent 201 cassette recorder is an unusual machine in many ways. The most striking difference between it and other stereo machines is the provision of only one very large V.U. meter instead of two. By providing a number of options in switching, the meter can be fed with the record or replay signal from either channel, or, more importantly, from the channel with the higher signal level. This feature is clever, and really worthwhile. It allows the user to set the relative levels of channel A and channel B by adjusting the respective control knobs, and then to set the meter switch to "higher of A or B" and maintain the desired record level by the single "record level" knob. This "record level" knob varies each channel equally, thereby maintaining the present relationship between A and B determined by the input level control knobs.

The front panel of the recorder, which is divided into two distinct sections, is rather austere in appearance. The top section is a black plastic panel with silver trim around the edge. The V.U. meter is located in the top left hand corner with a three digit tape counter immediately below it at the bottom. A sliding power on/off switch is located at the bottom on the right hand side. The aperture for the tape cassette is centrally located at the bottom of this panel. The cassette is inserted angularly and pushes home.

The level of the bottom section is stepped forming two distinct panels finished with brushed aluminium escutcheons. The narrow upper section has the following controls:—

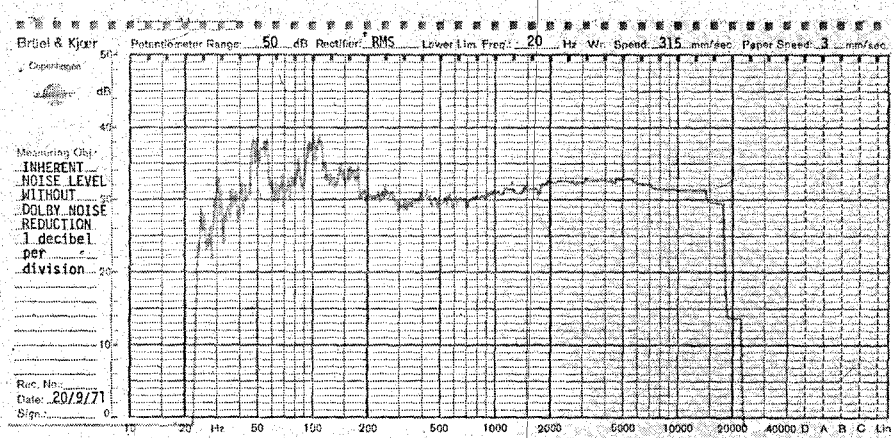
a) input stereo or mono select switch
b) noise reduction on/off switch with a red bezel light
c) tape bias selection switch for regular or Cr_20. tape (also fitted with a bezel light).
d) V.U. meter switch with A, B or higher of A or B positions; located at the left hand end and cassette eject switch at the right hand end.

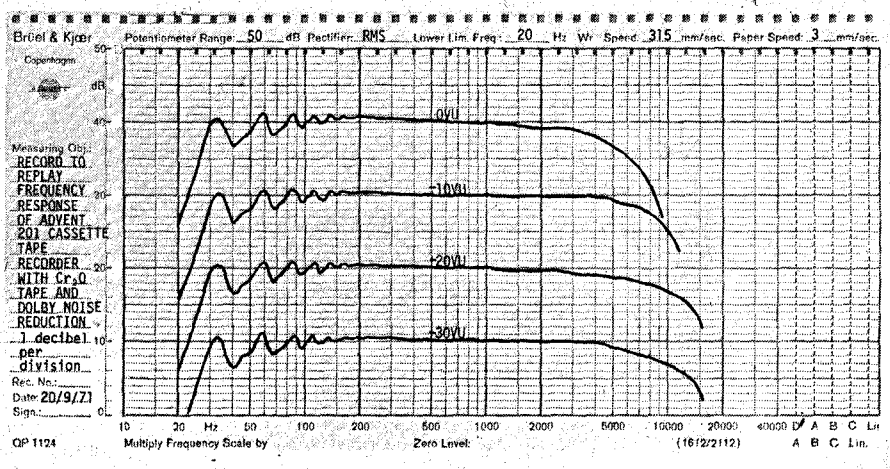
The lower panel which has a reverse downwards slope, contains the following controls:—

On the left hand side the "input level" control knob, and in the centre, a chrome plated lever for fast forward or reverse.

The right hand side has a record push button with bezel indicator pause lever with lock position and separate play and stop switches.

The line inputs and outputs (which are RCA sockets), are sensibly located on a recessed panel in the left hand side of the oiled timber base. This panel also contains a common output





Measured Performance of Advent Cassette Recorder Model 201 Serial No. C1878

Frequency response with Advocate Crolyn tape supplied —
25 Hz to 7 kHz + 0, -3dB at 0 VU.
25 Hz to 12 kHz + 1, -5dB at - 20 VU and at -30 VU
Total harmonic distortion at 0 VU

100 Hz	2.6%
1 kHz	1.6%

Channel separation re 1 kHz at 0 VU
51 dB
Weighted signal-to-noise ratio re 1 kHz at 0 VU
56 dB

Wow and flutter	0.2%
Speed stability	±1.5% for ±10% voltage change
Dimensions	14" x 9½" x 4½"
Weight	13 lbs.
Price	$485

level control knob, an 18 volt supply socket, and the 400 Hz calibration tone push button.

Other controls, such as bias adjustment and Dolby calibration potentiometers, are located on the rear. Adjustment procedures for these controls, and recording and play back procedures, are more than adequately covered in the 20 page owner's manual.

This owner's manual covers such topics as recording and playback instructions, general information, special adjustment details and a trouble shooting chart. The circuit diagram is fixed to the bottom of the cabinet but is not included in the hand book.

The Advent recorder is supplied complete with a roll of self-adhesive labels which are marked — DCI DOLBY SYSTEM — for fixing on those cassettes recorded with the Dolby Noise Reduction on. This is a sensible feature that we hope will be followed by other manufacturers.

In using the recorder we were impressed with the simplicity of operation. In particular all of the switches had very positive action and yet required a very low switching force. The record button in particular, also had this feature, and was the most positive we have seen on any cassette recorder. The common record level knob used with the "higher of A or B" meter mode allowed us to make good recordings without those noticeable changes in level which inevitably occur with the more common arrangement of two meters and two level controls. The only control with which we had to get accustomed, was the pause switch which could be "held on" or could be "locked on" by pushing to the right. One feature which we found intriguing was the power on/off switch which automatically switched "on" when the "play" switch was pressed.

The measured performance of this recorder is good, with a frequency response slightly less than that claimed by the manufacturers. Wow and flutter (at 0.2%) was exceptional for a cassette machine. This is partly due to the heavy flywheel which measured approximately 4" in diameter by ¾" wide.

The harmonic distortion figure was not exceptional but was good enough. There would not be any noticable distortion on replay.

Channel separation was comparable with many reel to reel recorders and better than most other cassette recorders. The noise reduction with "Dolby on" agreed with the figures stated by the manufacturers and proved to be a very worthwhile addition.

This machine is the first of the second generation cassette recorders to arrive on the Australian market. It considerably reduces the gap that used to exist between the cassette recorder and the reel to reel recorder. In particular, the frequency response is better than that obtainable with many reel to reel machines operating at 3¾ i.p.s. and only just falls short of the frequency response attainable at 7½ i.p.s. on similar machines.

Overall the machine makes it possible for the average hi-fi enthusiast to record and play reasonable quality recordings without the problems normally associated with reel to reel tape recorders. ●

The Advent 201 supplied to us for test was a standard American machine wired for 120 Volts, 60 Hz. Our frequency results have been mathematically scaled up to allow for the reduction in capstan speed.
All future models sold in Australia will be wired for our standard 240 Volt 50 Hz supply. It is understood that deliveries will commence in January 1972.

SENNHEISER HEADPHONES HD-414

electronics TODAY product test

These headphones offer top quality reproduction at a fraction of the cost of loudspeakers having similar performance.

Headphones have been used for listening to electronically reproduced sounds since the inception of electronics; yet they have never been widely accepted. The trend has always been towards loudspeakers, even if they are less acoustically perfect and far less efficient.

To provide an adequate listening level using speakers requires somewhere between 100 mW and 10 Watts, depending on the efficiency of the speaker. Subjectively comparable sound levels can be obtained from headphones with power levels of less than 1 mW.

A further advantage of headphones is the absence of room colourations. With loudspeakers, the sound that one hears is not only determined by the loudspeaker, but also by the furnishings in the room, the size of the room, and even the number of people in the room.

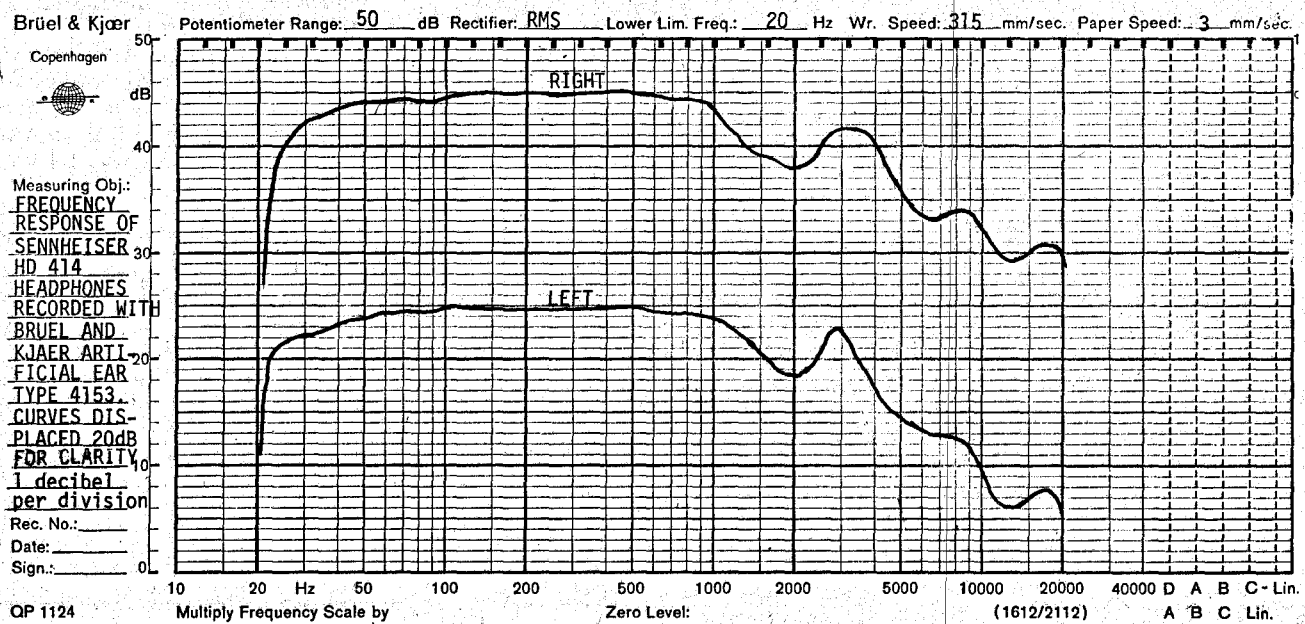
By contrast, the performance of headphones is determined by the two capsules (the electrical to acoustical transducers), and the more or less standard human ear canal.

Why then, is there so much resistance to headphones?

The usual reasons given include, the weight on one's head; the 'cut-off' feeling; the need to have a good seal between the headphones and the ears; and the difficulty in communicating with other people.

The Sennheiser HD 414 headphones have been designed to overcome most of these problems. They weigh only 5 oz. so light in fact, that they are unnoticed after about fifteen minutes use, and rather than sealing around the ear, Sennheiser have deliberately designed the HD 414 headphones to give an 'open air' feel. They have achieved this by using light open-cell foam sponge cushions, thus allowing the ears to remain cool.

These foam rubber cushions interpose a mere 3 dB loss of hearing to the 'outside' world. Two people,



each wearing headphones and listening to programme material at similar levels, can carry on a normal conversation over the programme. And while it may sound rather odd to someone not listening to the programme material, to the two individuals concerned it is quite normal.

Another advantage of the absence of sealing is that this allows people who normally wear glasses to listen through headphones without the loss of low-frequency response that otherwise occurs with more conventional headphones.

MEASURING HEADPHONE RESPONSE

A major problem in measuring the performance of headphones is that they are designed specifically to be clamped against the ear.

There are two ways of performing these measurements: the first is to insert a small microphone into the ear and then place the headphones over it. The second method is to use an 'artificial ear'. This consists of cavities and capillaries that are designed to provide the same acoustical characteristics as the human ear. (Inside the cavity is a ½" capacitor microphone).

The disadvantage of the first method is that the smallest precision microphone available is 1/8" diameter, and even though this is very small, it is still large compared to the ear canal and would introduce some uncertainty into the measurements.

The artificial ear, by comparison, is completely reliable in its operation (but cannot exactly replicate the human ear) — it is the basis upon which international standards have been laid down, and is the method that we use for headphone tests.

HOW THE HEADPHONES PERFORMED

The measured frequency response of the Sennheiser HD -414 is remarkably flat, in fact, we have only measured one pair of headphones with a *better* frequency response, and they were considerably more expensive.

An output level of 120 decibels can be obtained before total harmonic distortion exceeds 1%. As such a level is literally deafening, we would consider this performance to be more than adequate.

The measured sensitivity was 1.4 volts for an acoustical output of 100 dB at 1 kHz. This level can be easily obtained from even the smallest power amplifier designed to run conventional 8 ohm speakers.

The input impedance of the headphones is two thousand ohms. This allows them to be connected directly across the normal 8 ohm amplifier output terminals, and yet still obtain sufficient drive. Note however, that whilst most transistor amplifiers may be used with no load across the output (and two thousand ohms is practically no load), nearly all valve amplifiers will require a dummy load resister switched across the amplifier output terminals whenever the headphones are used alone.

Subjective tests on the Sennheiser HD-414 headphones produced very favourable results.

Of the six people whom we asked to try the Sennheiser headphones, only one was not convinced that they were worth using. He maintained that he could not get used to wearing headphones, and said that he would rather invest in better speakers, despite their 40:1 price differential. The general reaction was, however, an expression of surprise at the realistic reproduction of sound and the absence of the more annoying aspects of wearing headphones.

These headphones represent particularly good value for money when their exemplary performance is compared against even the best speaker systems available today. ●

MEASURED PERFORMANCE OF SENNHEISER HEADPHONES TYPE HD. 414

Frequency response:
25Hz to 10 kHz ± 6 dB
Nominal Impedance:
2000 ohms
Input Sensitivity at 1 kHz:
1.4 Volts per capsule for 100dB
Total Harmonic Distortion:
1% at 120dB
Weight:
5 oz.
Price, $23.26

Deitron

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SLIDE POTENTIOMETERS
Available in A or C curves

Single gang type VSU : 1K - 2 meg
Dual gang type VSG : 10K - 2 meg

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MAXWELL
Special low noise
high quality cassettes

C - 60 — $1.90
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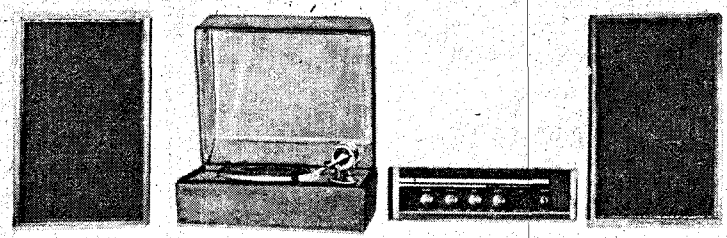
Speakers

3" Tweeter 3TC	4.25
6" Twin Cone	6.50
8" Twin Cone 8UR	9.50
8" Deluxe - 8-30	18.50

SYSTEM No. 1
(4 piece teak or walnut)



NORMAL PRICES
2 speakers : 50.00
1 amplifier : 35.00
1 Record player : 49.50
$134.50

Special price if you buy the entire system complete. Only $99.00
Save $35.00

DE-35 SPEAKERS
Speaker : 6" Twin Cone
Power : 5 watts

DE-1 AMPLIFIER
Power Output: 6 Watts Stereo
Freq. Resp. : 65 - 18,000 Hz

DE RP-1 RECORD PLAYER
Turntable: 7"
Tone Arm: Counterbalanced
Cartridge : Sapphire

SYSTEM No. 3 (6 piece teak or walnut)

DE-80 SPEAKERS
Speaker : 1x8", 1x3"
Power : 10 watts RMS

NORMAL PRICES
2 speakers : 70.00
1 amplifier : 75.00
1 tuner : 65.00
1 Cassette Deck : 115.00
1 Record player : 69.00
$394.00

Special price if you buy the complete system
$299.00
Save $100.00

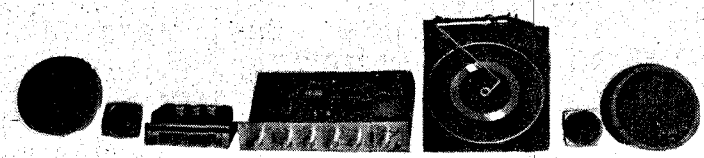
SOUND SAQ-203
Power output : 10 watts RMSx2
Freq. Resp. : 55-20,000 Hz

TUNER
550-1600 KHz

SHARP CASSETTE DECK
Freq. Resp. :

DE-418 RECORD PLAYER
GARRARD: 2025TC
Cartridge : Ceramic

STEREO SYSTEM KIT No. 5 (No cabinets supplied)



NORMAL PRICE
2x8 WR speakers : 19.00
2x3 TC Tweeter : 9.00
1x Amp chassis : 59.00
1x Tuner chassis : 45.00
1x Record player : 49.00
$181.00

Special price if you buy the complete system.
$159.00
Save $22.00

SPEAKERS
2 x 8 WR
2 x 3 TC

AMPLIFIER CHASSIS
Power output: 10 watts RMSx2
Freq. Resp. : 55-18.000 Hz

TUNER CHASSIS
550-1600 KHz

RECORD PLAYER
GARRARD: 2025T
Cartridge : Ceramic

DEITRON
Sockets

2.5 mm Chassis Jack	20c
3.5 mm Chassis Jack	25c
Phone Chassis Jack mono	40c
Phone Chassis Jack stereo	50c
2 pin Din Socket	25c
3 pin Din Socket	30c
5 pin Din Socket	35c
RCA Chassis Socket	25c
RCA Line Socket	35c
3 pin Din Line Socket	60c
5 pin Din Line Socket	70c
2 pin McMurdo Socket	25c
4 pin McMurdo Socket	30c
5 pin McMurdo Socket	35c

CAPSTAN
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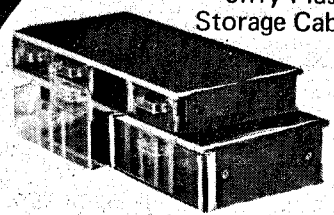
Storage Cabinets



JB-4A 4 draws W.2¾" H.1¼" D.5½"
$1.70 ea.tier

JB-4C 4 draws W.2¾" H. 2" D. 5½"
$2.50 ea. tier

JB-4D 2 draws W.5½" H. 2" D. 5½"
$2.50 ea. tier

DEITRON
Plugs

2.5 mm Plug	25c
3.5 mm Plug	35c
Phone Plug	50c
Stereo Phone Plug	70c
2 pin Din Plug	60c
3 pin Din Plug	65c
5 pin Din Plug	70c
RCA Plug	35c
2 pin McMurdo Plug	10c
4 pin McMurdo Plug	20c
5 pin McMurdo Plug	25c

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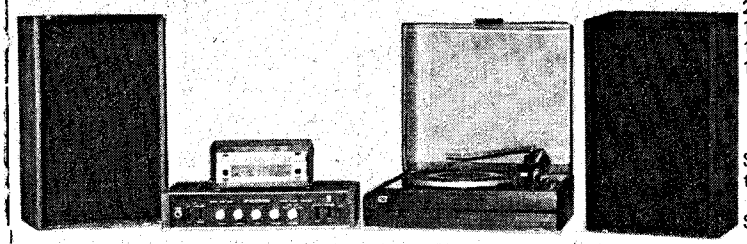


NORMAL PRICES
2 speakers : 70.00
1 amplifier : 69.00
1 tuner : 65.00
1 Record player : 65.00
$269.00

Special price if you buy the complete system
$199.99
Save $70.00

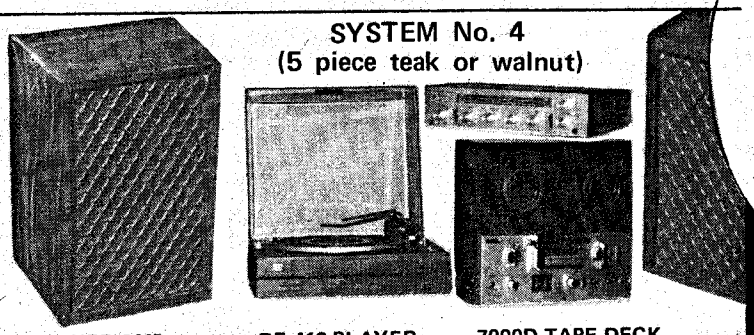
DE-80 SPEAKERS
Speakers : 1x8" 1x3"
Power : 10 watts RMS

PHODIS AMPLIFIER
Power Output : 8 watts x 2
Freq. Resp. : 55 - 18,000 Hz

TUNER
550-1600 kHz

DE-418 RECORD PLAYER
GARRARD : 2025T
Cartridge : Ceramic

SYSTEM No. 4 (5 piece teak or walnut)



NORMAL PRICE
2 speakers : 145.00
1 Amp-Tuner : 115.00
1 Tape deck : 189.00
1 Record player: 89.50
$538.50

Special price if you buy the complete system
$399.00
Save $140.00

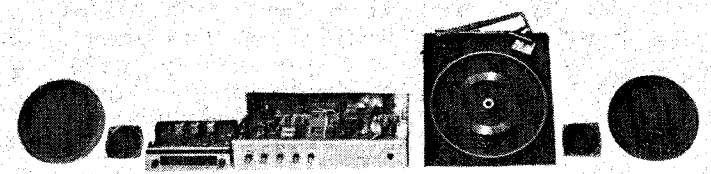
DE-77F SPEAKERS
Speakers : 2x8" 1x3"
Power : 20 watts

C-200 TUNER AMP
Power output: 8 watts x 2
Tuning : 550-1600 KHz
Freq. Resp. : 35-22,000 Hz

DE-419 PLAYER
GARRARD: 40B
Cartridge : Magnetic

7000D TAPE DECK
Freq. Resp.:

STEREO SYSTEM KIT No.6 (No cabinets supplied)



NORMAL PRICE
2x8 WR : 19.00
2x3 TC Tweeter : 9.00
1x Amp Chassis : 69.00
1x Tuner chassis : 45.00
1x Record player : 69.00
$211.00

Special price if you buy the complete system
$181.00
Save $30.00

SPEAKERS
2 x 8 WR
2 x 3 TC

AMPLIFIER CHASSIS
Power output: 10 watts
Freq. Resp. : 55-22,000 Hz

TUNER CHASSIS
550-1600 KHz

RECORD PLAYER
GARRARD: 40B
Cartridge : Mag

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Stereo Headphones

SH-1500 with tweeter control	18.50
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SH-850	9.95
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Polyester Guaranteed

3"	300'	.70	5¾"	2400'	3.00
3"	600'	.90	7"	1800'	3.50
3"	900'	1.30	7"	2400'	4.50
5"	600'	1.50	7"	3600'	6.00
5"	1200'	2.00	7"	4800'	8.50
5"	1800'	2.50			
5¾"	800'	1.80			
5¾"	1200'	2.00			

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BC-109	50c		
AC-126	60c	EM401	20c
AC-127	60c	EM402	25c
AC-128	70c	EM404	30c
AC-127/128	1.20	EM408	50c
AC-187/188	1.50	IN914	20c
2N 3054	1.50	OA91	20c
2N 3055	1.70		
2N 3646	50c		
2N 3638	50c		

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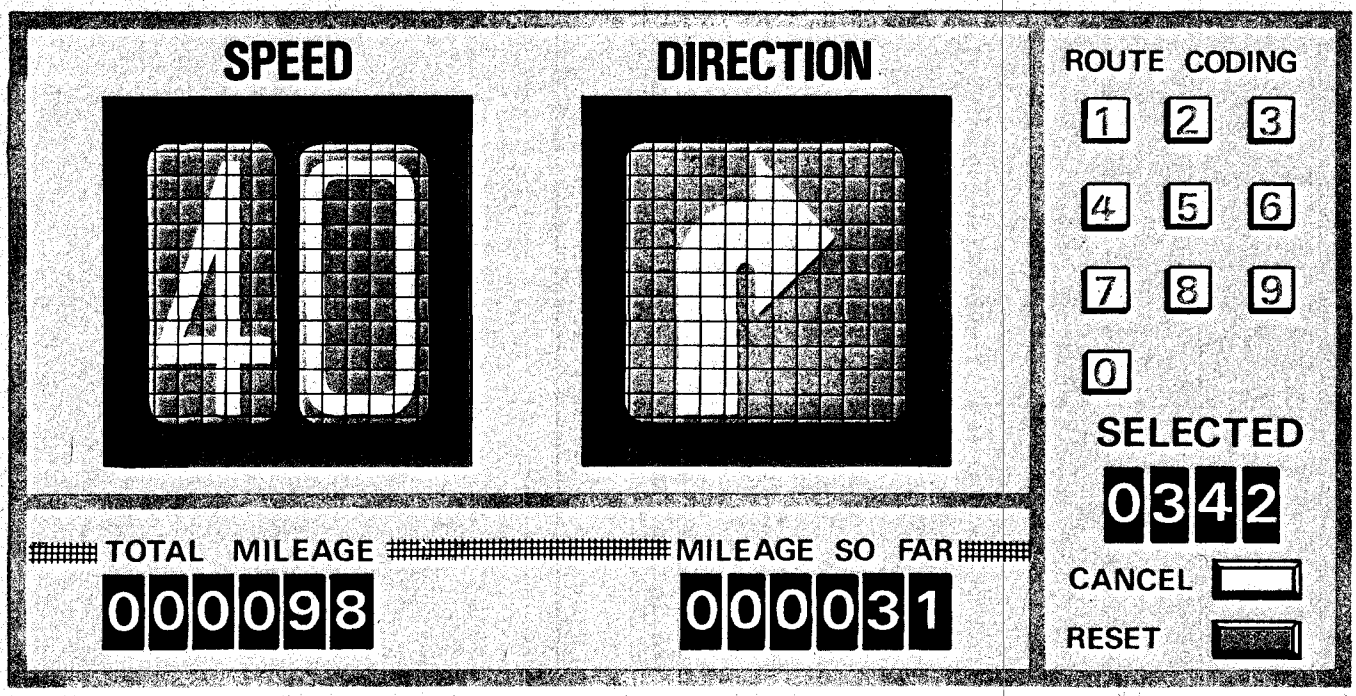
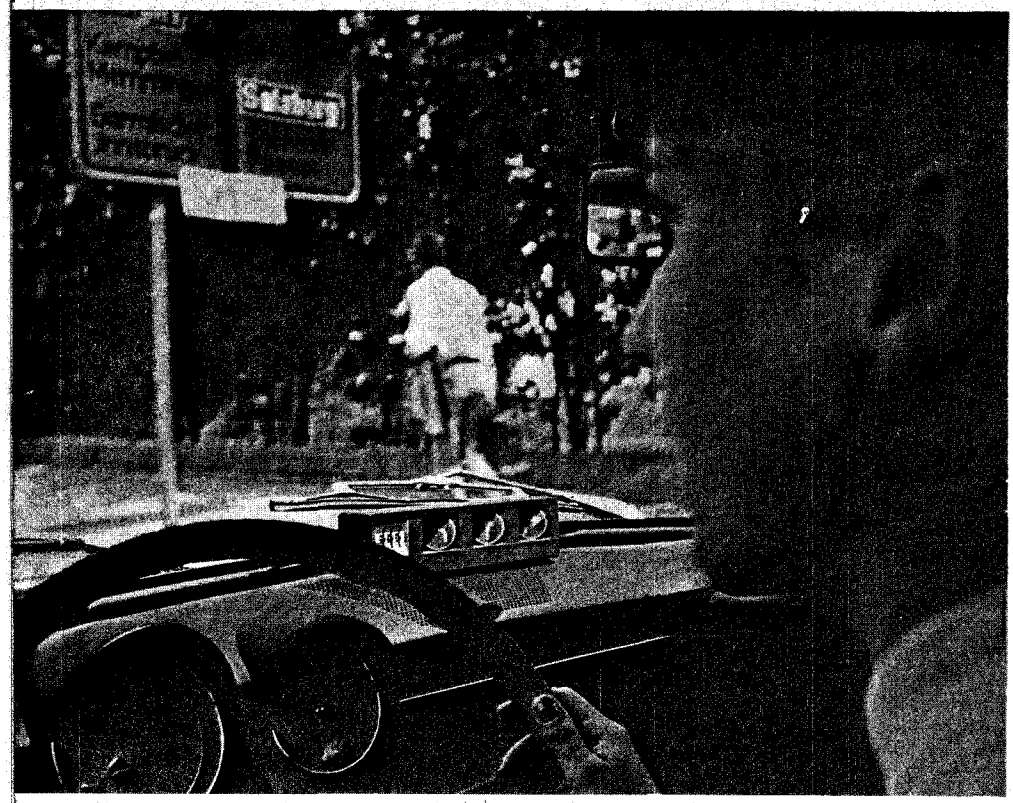
COMPUTER



Sophisticated console has push-button route selector, distance indicators and Nixie tube route and direction read-outs.



This unit is currently being evaluated in Germany.

A car navigation system that automatically tells the driver which way to turn, how fast to travel, and what route to take to avoid traffic, has been designed and developed in Germany by Siemens Ltd. A limited version of the system is currently being evaluated in Munich.

The basic concept of the system — call *Autonav* — is the collection of location and destination references of all road traffic users within a city area in one central control computer. And since the central computer knows all traffic references for all road users in its area, it can then continously direct each individual vehicle during every phase of its journey.

Before beginning a trip, the driver sets up a six-digit number, representing his destination, on a small switching panel. This number is taken from the city street directory. As with a telephone number it contains a locality reference number and a destination address. This destination address nominates the street section to which the driver wants to travel.

When the driver moves off he can start in any direction. The destination number is then continually transmitted along the whole route by a small mobile transmitter in the vehicle.

PATHFINDER

NOW IT'S DIAL-YOUR-DESTINATION FOR CARS

Induction loops are buried at frequent intervals along all streets within the controlled area, and these loops are connected to stationary receiver/transmitters located at the edge of the road. The instant that a car traverses a loop, the destination address that it is transmitting is recorded by the associated receiver/transmitter and sent via land line to the central computer.

The computer accepts the destination number and establishes the location of the receiving station from which the destination number has been received. The computer then establishes the most favourable route from the present location of the vehicle to the desired destination.

In this way it is determined whether the vehicle should travel straight ahead, or turn left or right at the next intersection. If this intersection has traffic lights, the computer will also calculate the speed at which the driver must travel in order to encounter a green signal.

Fractions of a second after receipt of the destination number, the computer transmits the calculated most favourable route and vehicle speed.

This data is sent back to the same receiving station and inductive loop that received and retransmitted the earlier information from the vehicle, and is picked up by a sensor on the rear of the vehicle. And even though the vehicle might be travelling at 40 to 50 mph, the computer's speed is so fast that the vehicle will only have travelled four or five feet in the intervening period.

A vehicle mounted receiver now projects a direction arrow, and an indication of optimum driving speed onto the windscreen directly ahead of the driver.

The driver now knows that for optimum arrival at his destination he must, for example, turn right at the next intersection and continue travelling at 35 mph in order to pass through the next five sets of traffic lights whilst they are green.

The driving instructions indicated by the computer remain as described until the vehicle crosses the next information loop, at which point the whole process is repeated and the information updated.

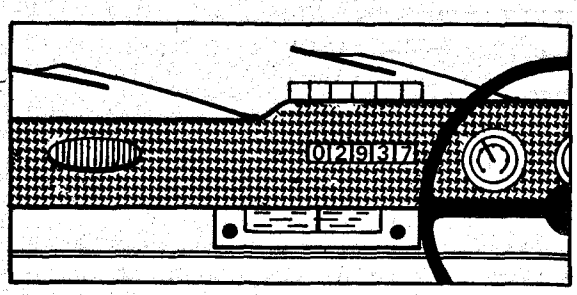
As the computer continuously knows the location and destination of all vehicles within the system, it can determine the optimum route for every vehicle.

When the driver finally reaches his destination the central computer can direct the driver to the nearest vacant parking spot.

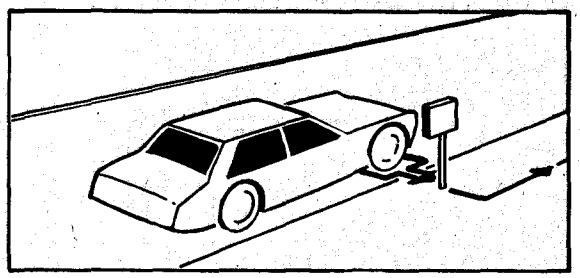
Technically there are no problems in putting the system into use, Siemens admit that it would be costly — though in comparison with the extra road utilisation and safety it would almost certainly be a profitable investment.

The company claims that to install the system throughout Western Germany would cost around five billion Australian dollars — about twice the Bonn Government's annual budget for road construction.

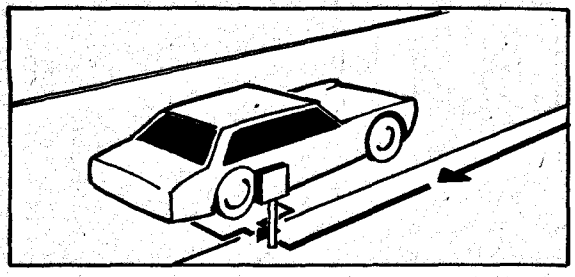
There is, of course, one snag. If the system can assist you in getting to where you want to go, it can equally well make a permanent record of where you have been! ●



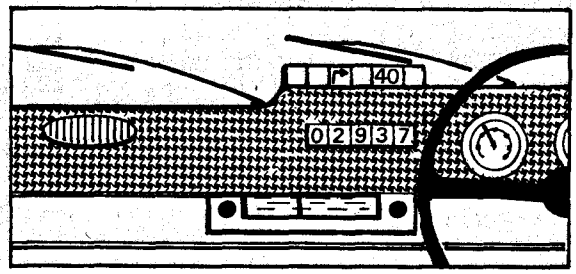
FOUR-PHASE auto-navigation — Stage One. Simply dial up your street, area, suburb and even city code on the digital selector.



STAGE TWO: Proceed onto the road. Your car passes over a buried loop which flashes your coded destination to a central computer.



STAGE THREE: By the time your rear wheels reach the same buried loop the computer has processed your route and flashed the direction signal to your car's receiver.



STAGE FOUR: Route numbers and direction of next turn is flashed onto your visual read-out on the dash (or projected onto the windscreen). Subsequent "buried loops" give progressive route instructions.

LIGHT OPERATED SWITCH

This simple light operated switch has many applications.

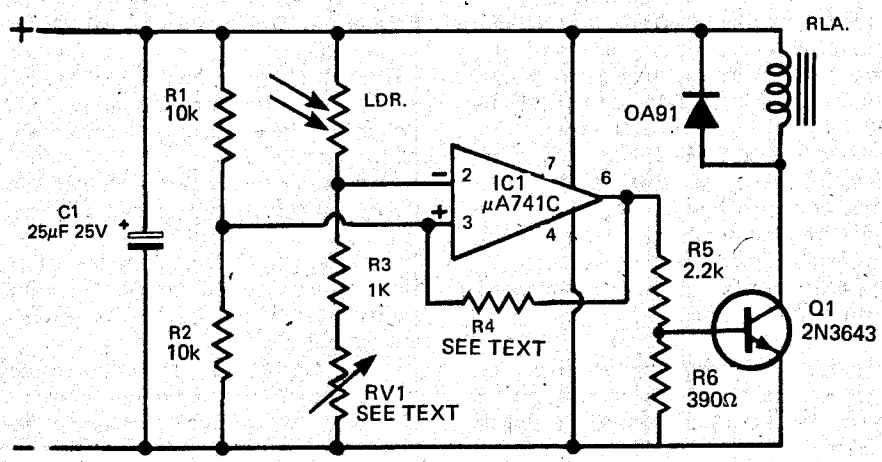


Fig. 1 — Circuit diagram of complete unit.

This is an ideas project as much as a constructional article.

Basically, the circuit shown in Fig. 1 will cause a relay to drop out when light falls onto the light dependent resistor (LDR). Unlike most circuits of this type this unit is very sensitive but also quite stable.

The circuit has many uses including turning on house or vehicle lights at nightfall, acting as a light detector in strong rooms, or with other types of resistive transducers, acting as an accurate temperature control system.

The level at which the circuit operates is set by potentiometer RV1. Resistor R4 determines the level at which the circuit reverts back to the former state. This prevents annoying flickering if the level sensed by the LDR changes very slightly about the set point. The value of R4 should be determined by experiment — values between 4.7k and 2 Megohms may be required depending upon the application.

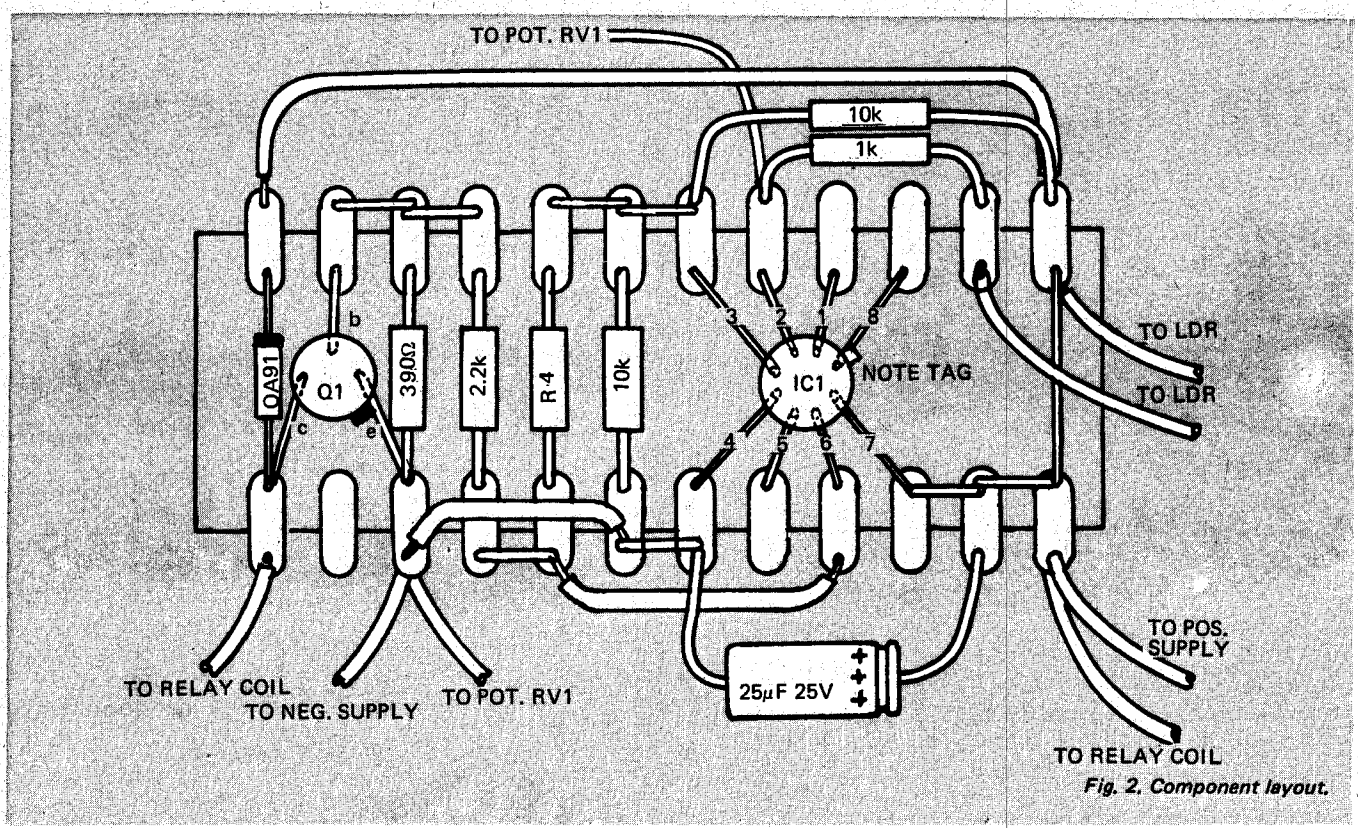


Fig. 2. Component layout.

CONSTRUCTION

The simplest way to assemble the unit is to mount all the major components on tag strips (as shown in Fig. 2). Note that the integrated circuit and transistor shown in Figure 2 are drawn as seen from above.

If the circuit is used with a light dependent resistor, this component must be shielded from any light switched by the unit. If this is not done, the unit will continuously switch the lights on and off.

As shown in Fig. 1 the relay coil is energized when the resistance of the LDR is high (when it is dark). The opposite action may be obtained by reversing the positions of the LDR, R3 and RV1.

The unit may be operated either by a 12 Volt battery, or by the simple mains power supply unit shown in Fig. 3. If the mains supply is used, the 25 μF capacitor shown as C1 in Fig. 1 may be omitted. ●

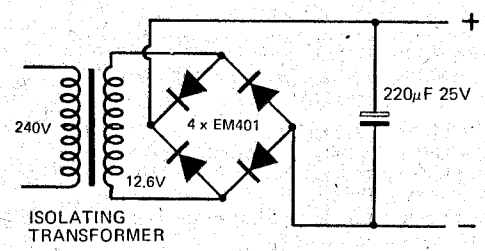


Fig. 3 – Power supply.

ET PROJECT 304

PARTS LIST ET304

R1	–	resistor, 10k, ½ Watt, 5%
R2	–	" " " " "
R3	–	" 1k " " "
R4	–	resistor, ½ Watt – (see text)
R5	–	" 2.2k, ½ Watt, 5%
R6	–	" 390 ohms " "
RV1	–	potentiometer, – (see text)
C1	–	capacitor, 25μF, 25 Volts electrolytic
IC1	–	integrated circuit, μA 741C
Q1	–	transistor, 2N 3643, TT 3643 or similar.
LDR	–	light dependant resistor, Philips 2322-600-95001 or similar.
D1	–	diode – OA 91 or similar.
RLA	–	relay single or double pole change-over – approx 230 ohm coil, contact rating to suit application.

HOW IT WORKS

Integrated circuit IC1 is connected as a Schmitt trigger, this is a regenerative bistable circuit whose output state depends on the amplitude of the input voltage. Like all bistable circuits, the output has only two possible states, high or low (or on and off).

The input level at which the output goes high is different from the input level at which the output goes low. This difference is used to eliminate the effect of noise and small variations at the input terminals. In the circuit shown here, this difference is adjustable by altering R4.

The Schmitt trigger input is derived from the potential divider formed by the sensor and the potentiometer RV1. The point at which the Schmitt trigger will change state is approximately when the sensor resistance is equal to the setting of the potentiometer. For this reason the value of the potentiometer should be greater than the value of the sensor at its maximum working resistance. If a light dependent resistor is used as a sensor, RV1 should be around 100k.

The value of R4 depends upon the application. If a large differential in operating points is required, the value of R4 should be low (but never less than 4.7k). If a small differential is required then values up to 1 or 2 Megohms may be used.

For LDR operation R4 should be about 22k.

The output of the integrated circuit is directly coupled to an output transistor that in turn operates the relay.

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Only Philips use it. For these reasons.

Superior quality Hi-Fi International stereo systems are specifically designed to exceed the demanding specifications of the internationally recognised standard of High Fidelity Reproduction (DIN45500), together with Philips own high standard of perfection born of vigorous research and development in electronics.

Philips have long led the field internationally, in electronic and technical developments and their experts intend to keep it that way.

Philips design, develop and manufacture—and only fully qualified dealers handle Philips hi-fi systems. So, when you see the Hi-Fi International symbol on Philips stereo hi-fi systems, you'll know why Philips earned the right to use it.

PHILIPS

1. RH493/496/497/499 Ranging from 15 litre speaker enclosures. 20w R.M.S. with 8" woofer and 1" tweeter; to 74 litre volume/40w R.M.S. fitted with 12" woofer, 4 x 5" mid range, 4 x 1" tweeter. All 8 ohm V.C.

2. N4500 4 track 3 head stereo tape deck. Mixing, duo-play, multi-play and echo facilities. Mono/stereo and parallel playback. Before and off-tape monitoring. Sep channel mike controls. Electronic tape position selector. 7½, 3¾, 1⅞ speeds. High S/N ratio. High stability tape transport. Fast wind/rewind.

3. GA308 HI-FI turntable unit with tubular tone arm, precise, stylus force adjustment and hydraulic lift. 2 speed, belt drive, slow running synchronous motor. Side thrust compensation. Floating suspension.

4. RH591 High powered all silicon transistor stereo amplifier 2 x 20w R.M.S. cont. Frequency response ± 0.5 db 20-20,000 Hz. S/N 90 db. T.H.D. 0.15% (2 x 15 w). Rumble and two stage scratch filters. 2 position contour. All-input selector.

5. RH590 Solid State Stereo Amplifier. Music Power 2 x 15w; 2 x 10w R.M.S. Freq Resp 20-20,000 Hz ± 1.5 db. S/N 80 db. Rumble and scratch filters. Mono/stereo switch. Auto contour control. Separate volume, balance, treble, bass. All-input selector.

6. RH691 Super sensitive tuner. AM/FM Stereo. Switch-able AFC. Switchable A.M. band-width. 3 international shortwave bands.

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DUAL

By BARRY WILKINSON

Specifically intended for powering experimental integrated circuit projects, this power unit features independent positive and negative supplies — but with automatic tracking when required.

ET PROJECT 105

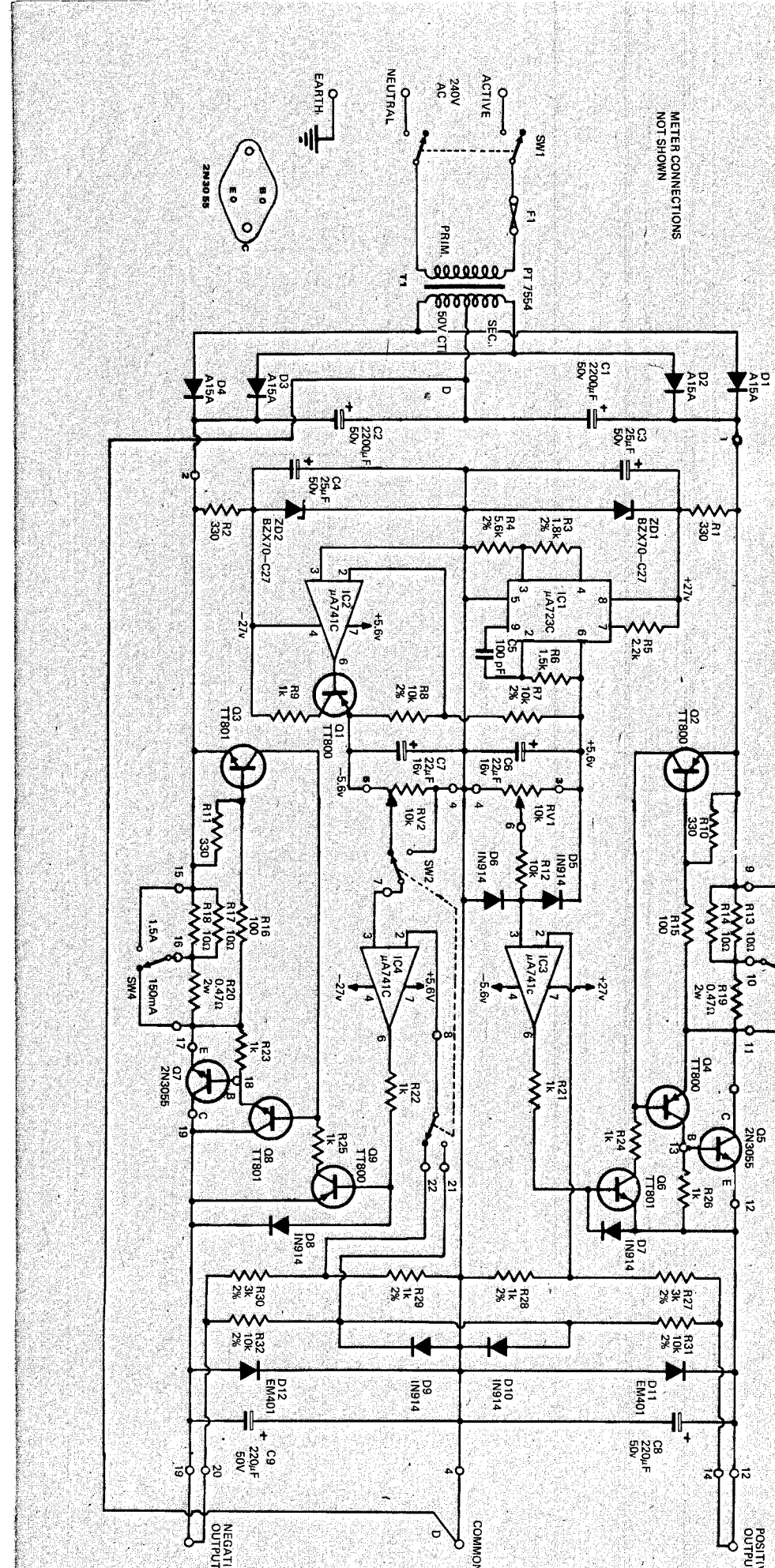


Fig. 1. Circuit diagram of complete unit.

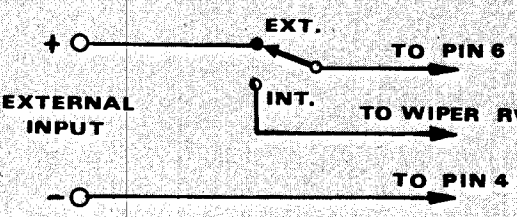
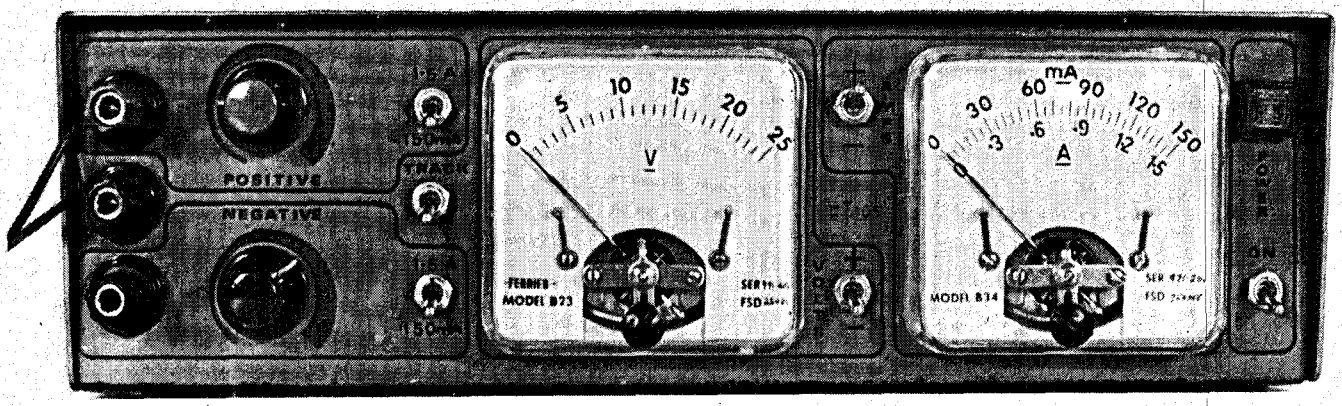


Fig. 2. Circuit modifications for externally programming positive rail (see text).

POWER SUPPLY



UNTIL recently, integrated circuits were priced beyond the reach of the average enthusiast, and very few constructional projects specified their use.

But as with so many electronic components, mass production and wide-spread commercial acceptance has resulted in quite dramatic price reductions, and integrated circuits costing twenty or thirty dollars a couple of years ago, are now readily available for well under two dollars. Many cost less than a dollar.

From the enthusiast's point of view this is a most exciting development for it opens up the possibility of constructing far more ambitious projects than were previously feasible using discrete components. Many such projects will soon be featured in this magazine.

But there is one minor drawback to integrated circuits and this is that many of them require both positive and negative power supplies. These supplies must also have a better level of line and load regulation than was previously necessary.

The power supply described in this project has been designed specifically for this purpose. It is intended for both the serious enthusiast and the professional development engineer.

As may be seen from the specifications, its performance is equivalent to many commercially built units at many times the price.

The unit has two outputs, one positive, and one negative — each separately adjustable from zero to 20 Volts, or settable in such a way that the negative supply automatically tracks the positive supply.

CURRENT LIMITING

Both the unit, and your experimental circuits, are protected against damage by current limiting networks incorporated within the power supply.

A panel mounted switch is used to select the maximum desired power at either 190 mA or 1.80 Amps. If this level is reached, the output voltage will drop and current will be held at the selected limit.

For the professional user of this unit,

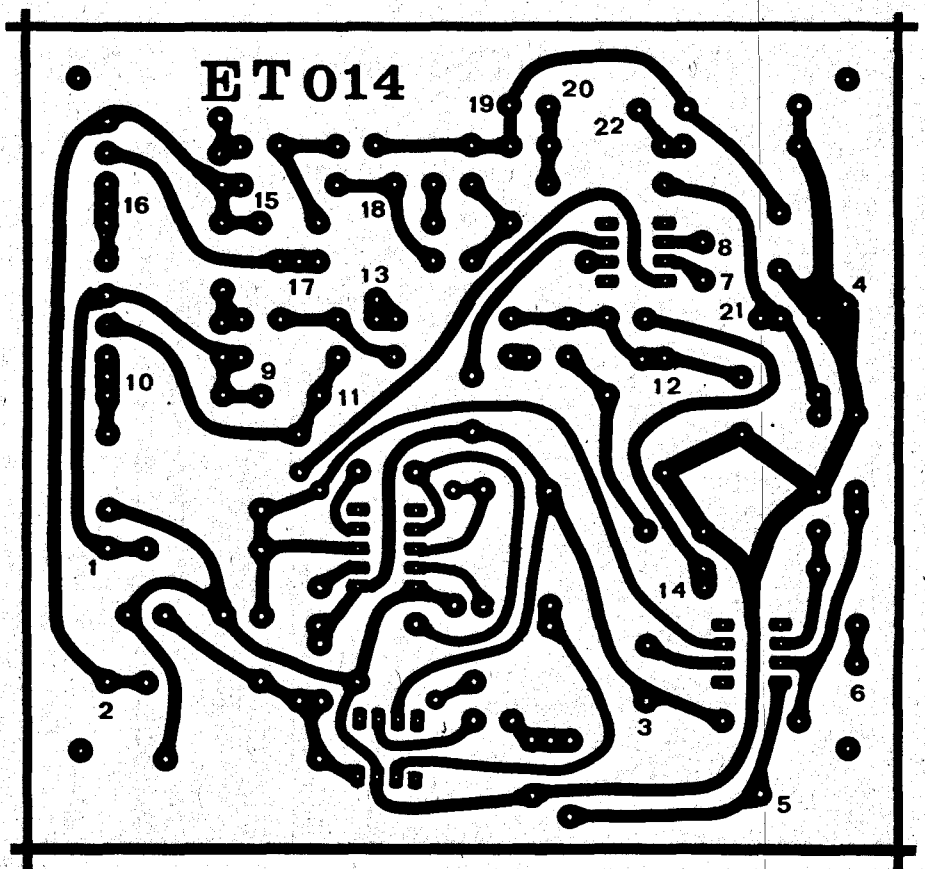


Fig. 3. Foil pattern of printed circuit board (full size).

DUAL POWER SUPPLY

provision has been made for the positive regulator to be externally programmed. The necessary wiring changes are shown in Fig. 2.

Due largely to the use of externally mounted heatsinks, and the use of integrated circuits in the control and voltage reference circuits, the complete power supply unit is quite small and compact. Yet despite this, the internal layout is spacious and all major components are readily accessible.

CONSTRUCTION

Construction is reasonably straightforward if work progresses in the correct manner. The unit may be assembled on matrix board, but we strongly recommend that the correct printed circuit board be used. The foil pattern of the p.c. board is shown in Fig. 3.

Assuming that the printed circuit board is used, commence construction

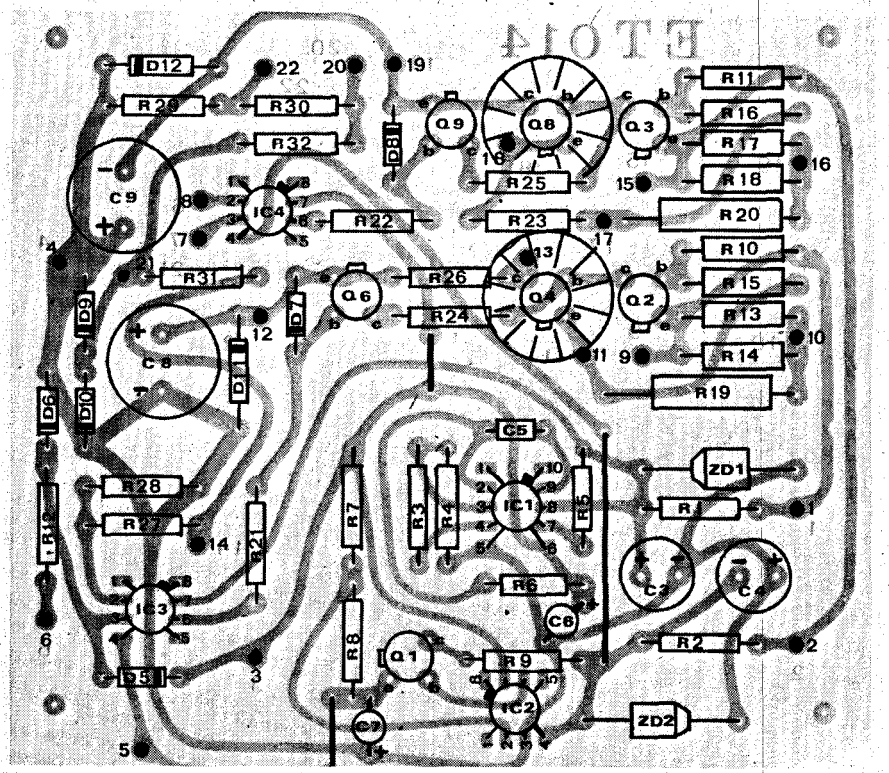


Fig. 4. How the components are mounted on the printed circuit board. Compare this with Fig. 3.

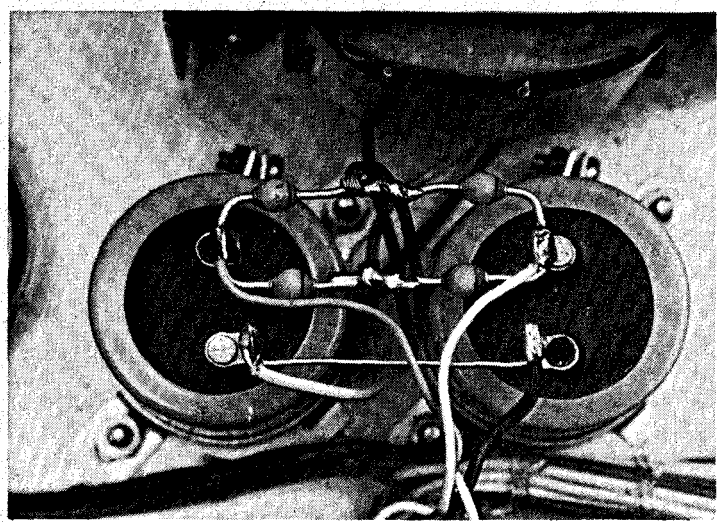


Fig. 5. Diodes D1 – D4 are mounted on top of the filter capacitors.

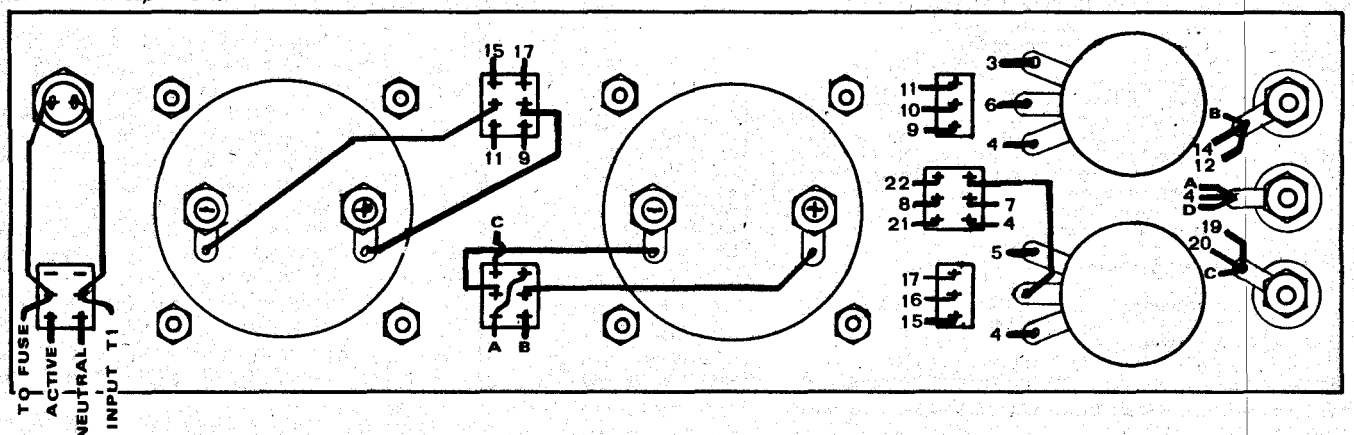
by inserting the pc board pins into the positions numbered on the board. These pins should be inserted with the flange (if flanged) on the component side of the board. All external wiring to and from the printed circuit board will be attached to these pins on the foil pattern side of the board.

When installing the integrated circuits ensure that they are orientated correctly before soldering. (Note that Fig. 4 shows all components, including integrated circuits, as seen from the **component** side of the board.)

Small heatsinks are fitted over transistors Q4 and Q8. Ensure that these do not contact any other component by mounting them about 1/8" above other nearby components.

When all components have been mounted on the board, recheck for correct orientation and polarity.

Fig. 6. This drawing shows front panel wiring details. Wires A, B and C are interconnecting wires on the front panel. Wire D goes to the common of the filter capacitors.



DUAL POWER SUPPLY

PARTS LIST ET 05

R1	—	resistor 330 ohm
R2	—	" "
R3	—	" 1.8k, 2%
R4	—	" 5.6k, 2%
R5	—	" 2.2k
R6	—	" 1.5k
R7	—	" 10k, 2%
R8	—	" 10k, 2%
R9	—	" 1k
R10	—	" 330 ohms
R11	—	" 330 ohms
R12	—	" 10k
R13	—	" 10 ohms
R14	—	" 10 ohms
R15	—	" 100 ohms
R16	—	" 100 "
R17	—	" 10 "
R18	—	" 10 "
R19	—	" 0.47 ohms, 2 Watt, ASW2
R20	—	" 0.47 " " "
R21	—	" 1k
R22	—	" 1k
R23	—	" 1k
R24	—	" 1k
R25	—	" 1k
R26	—	" 1k
R27	—	" 3k, 2%
R28	—	" 1k, 2%
R29	—	" 1k, 2%
R30	—	" 3k, 2%
R31	—	" 10k, 2%
R32	—	" 10k, 2%
		(all resistors are ½ Watt 5% unless otherwise stated. The 2% resistors are Pye type TR5 or equivalent)
C1	—	capacitor, 2200 µF, 50 Volt, Elna type RG
C2	—	" " " " " " " "
C3	—	" 25 µF, 50 Volt, Elna type RB
C4	—	" " " " " " " "
C5	—	" 100 pF.
C6	—	" 22 µF, 16 Volt, tag tantalum type
C7	—	" " " " " " "
C8	—	" 220 µF, 50 Volt, Elna type RB
C9	—	" " " " " " " "
D1 — D4	—	diodes type A15A or equivalent.
D5 — D10	—	" " " 1N914 " "
D11 — D12	—	" " " EM401 " "
ZD1	—	zener diode type BZX70 C27
ZD2	—	" " " " "
Q1	—	transistor type TT800
Q2	—	" " "
Q3	—	" " TT801
Q4	—	" " TT800
Q5	—	" " 2N3055
Q6	—	" " TT801
Q7	—	" " 2N3055
Q8	—	" " TT801
Q9	—	" " TT800
IC1	—	integrated circuit type µA 723C
IC2	—	" " " µA 741C
IC3	—	" " " µA 741C
IC4	—	" " " µA 741C
		(all the above ICs are metal can type).
SW1	—	miniature switch, double-pole changeover, 240 Volt, Plessey C & K type 7201 or similar.
SW2	—	" " " " " " "
SW3	—	" " single pole changeover, C & K 7101
SW4	—	" " " " " " "
SW5	—	" " double pole changeover, C & K 7201
SW6	—	" " " " " " "
T1	—	transformer, A & R type PT 7554, 50 Volt, centre tapped, 1.5 Amp.
RV1	—	potentiometer, linear, 10k, Plessey type E or equivalent.
RV2	—	" " " " " " "
Sundries	—	

TO5 Heatsinks, 2 off, McMurdo TXBF 032 025 CB Power transistor heatsinks, 2 off, Mullard 35 DB 3C drilled to suit. Two transistor covers, McMurdo 9151 09 01. Two anodised insulating washers, McMurdo type 2210 01 01. One set of metalwork. One front panel. 240 Volt neon panel light. Three terminals. Two potentiometer knobs. One fuse holder for size 00 fuse. One 1 Amp size 00 fuse. One 3 core flex and plug. One cable clamp. One printed circuit board ET 014. Twenty two pc pins McMurdo type 5737 54 08. Three grommets. Four rubber feet. Four ¾" spacers. 14/0076 connecting wire (insulated) various screws, washers, nuts etc.

Voltmeter	—	25 Volts fsd, 2½" square, Ferrier type B 23 or equivalent.
Ammeter	—	750 mV fsd, 1mA, scaled 1.5 Amps and 150 mA. Ferrier type B34 or equivalent. (when ordering, specify that meters should be scaled for steel panels).

Now mount the transformer and the filter capacitors onto the chassis. Locate diodes D1 – D4 on top of the filter capacitors as shown in Fig. 5.

The heatsinks must now be drilled to take the two 2N3055 output transistors. Carefully remove any burrs from around the holes and then mount the transistors preferably using McMurdo type 2210-01-01 anodised insulating washers. If available, use a smear of silicon grease between transistors and the heatsinks – this will further improve heat transference. Finally, check insulation between the transistor and the heat sink, and then fit the McMurdo type 9151-09-01 transistor covers.

On our prototype unit we

HOW IT WORKS

The mains input voltage is reduced and isolated by transformer T1. The 25-0-25 Volt output from the transformer is then rectified and filtered by diodes D1-D4, and capacitors C1 and C2 to provide an unregulated ± 40 Volt dc supply.

Series regulators are used in the main control system. The two regulators – one for each supply – are almost identical in operation, therefore only the positive regulator will be described in detail.

The series pass transistor Q5, is mounted on an external heat sink. Transistors Q4 and Q6 provide current amplification for Q5 giving the combination a total current gain exceeding 50,000. The voltage gain is approximately unity.

The main reference supply is generated by IC1 which is a precision voltage regulator. The reference level required is obtained by potentiometer RV1 which is connected across the 5.6 Volt regulated output from IC1.

Power for the IC voltage reference is supplied by R1, ZD1 and C3. This maintains a constant voltage across the IC, eliminating variations due to changes in mains voltage. The 27 Volt supply from this circuit is also used to supply power to IC3.

The reference for the negative supply is obtained from operational amplifier IC2 which is connected so as to track the positive reference supply. The 5.6 volt output from this circuit is just as accurate as the output from the main regulator. Power for this operational amplifier is supplied from a 27 volt zener which is also used to supply IC4.

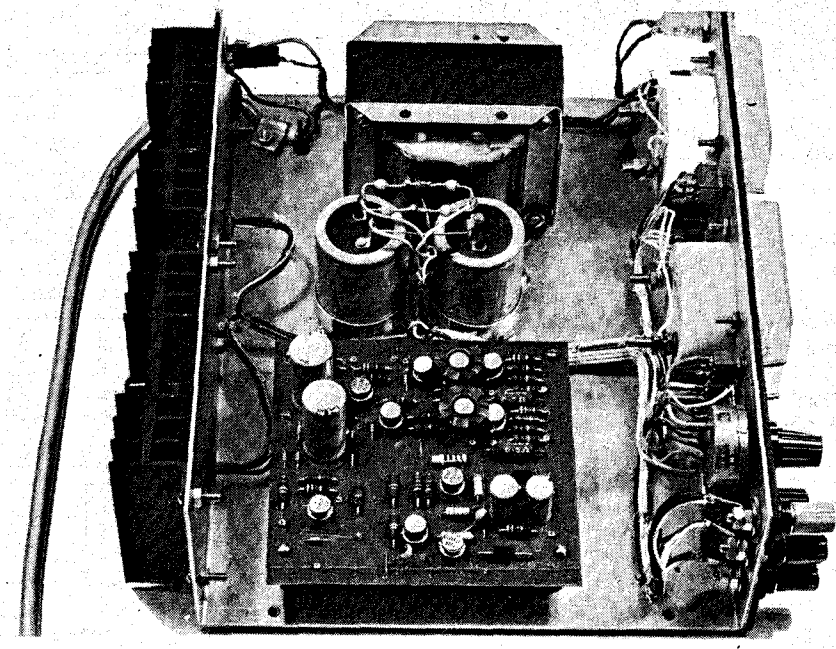
The power supplies for IC1 are + 27 Volt and 0 Volts; for IC2 and IC4, the supplies are + 5.6 Volts and - 27 Volts; for IC3, +27 Volts and - 5.6 Volts.

Resistors R27 and R28 divide the output voltage by four. This voltage

constructed our front panel by sandwiching a line drawing between the chassis and a piece of smoked perspex. This provides a very professional looking appearance. For those who wish to do the same we have reproduced this artwork full size (on semi-gloss paper) on page 114 of this issue. An even better finish can be obtained by using an anodised aluminium panel, and these may be available from parts suppliers.

Having determined the method of finishing the front panel, assemble all the relevent components onto the panel.

Wires should now be attached to the pins on the underside of the printed circuit board. Insulated 14/0076 wire



is compared against the voltage set by RV1 by operational amplifier IC3. The output of IC3 controls the series regulator configuration, and hence the output voltage. The action of IC3 is to keep the two voltages at its input at the same level. Thus, the output voltage will be four times the input voltage, and virtually independent of load current.

When load current approaches the level set by the limit switch, transistor Q2 becomes forward biased sufficiently to cause it to conduct. This bypasses current from the base of Q4 and causes IC3 to lose control of the output. If the load continues to increase, the output voltage will fall and the current will remain effectively constant.

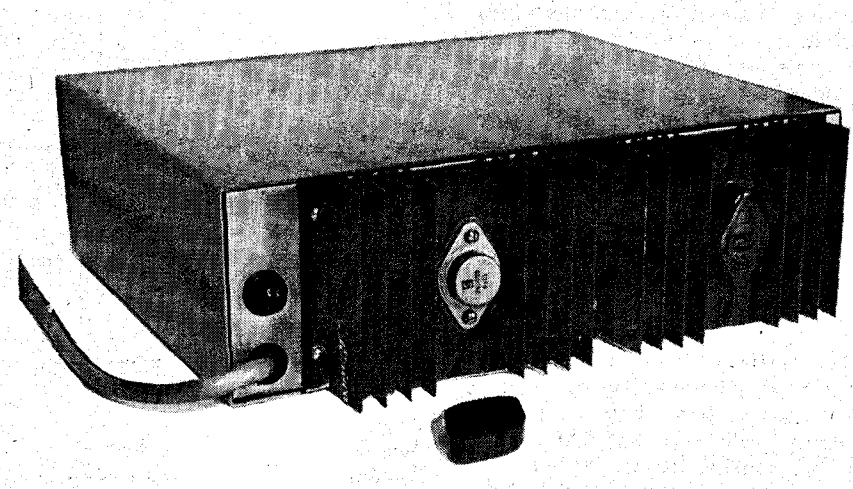
The negative regulated supply works in the same manner when the power supply is used in the normal mode.

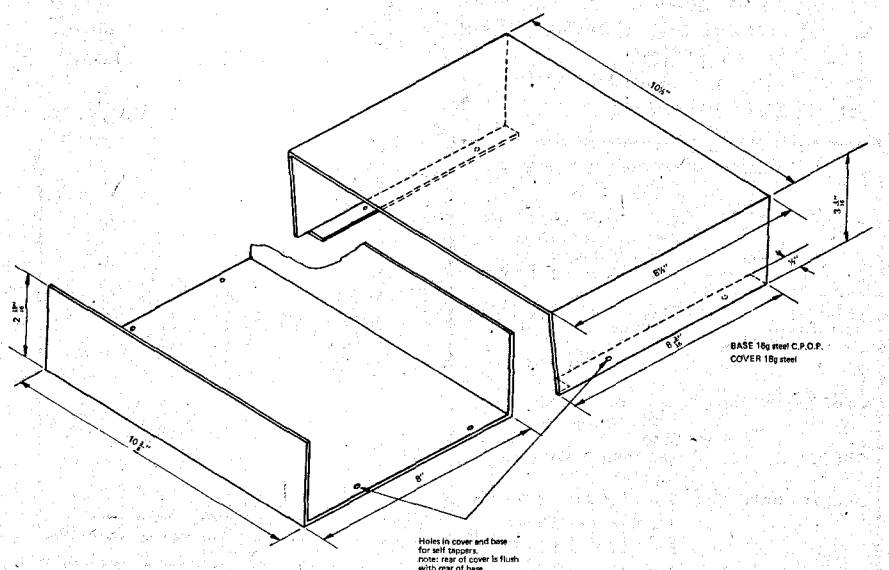
A tracking mode of operation is also included, and in this mode the negative supply tracks the positive supply. If, for example, the positive regulator is set at + 14.5 Volts, then the negative supply will automatically be set at - 14.5 Volts.

In the tracking mode of operation, the reference voltage is zero volts and the voltage used as the output voltage reference is the centre voltage of the two supplies. And since the IC tries to maintain both inputs at the same level (in this case zero volts) then the two output voltages must be of the same value.

Diodes D7 through D12 are used to protect the integrated circuits and output transistors against various forms of misuse, including shorting the positive and negative outputs together.

Provision has been made in the design for externally programming the positive regulator. If this facility is required, alter the wiring as shown in Fig. (Resistor R12, and diodes D5 and D6 protect the IC when this mode of operation is employed).





DUAL POWER SUPPLY

should be used for this purpose. Two wires should be attached to pins 9, 12, 17 and 19, three wires attached to pins 11 and 17, and four wires attached to pin 4. All wires should be either colour coded or marked so that they may be clearly identified.

The printed circuit board should now be mounted onto the chassis and the wires loomed to their respective destinations. Note that one each of wires 11, 12, 17 and 19, together with wires 13 and 18 go to the back of the uhit and to the heat sinks. Wires 1 and 2 go to the filter capacitors and a wire D comes from the common of the filter capacitors up to the loom and to the common terminal on the front panel.

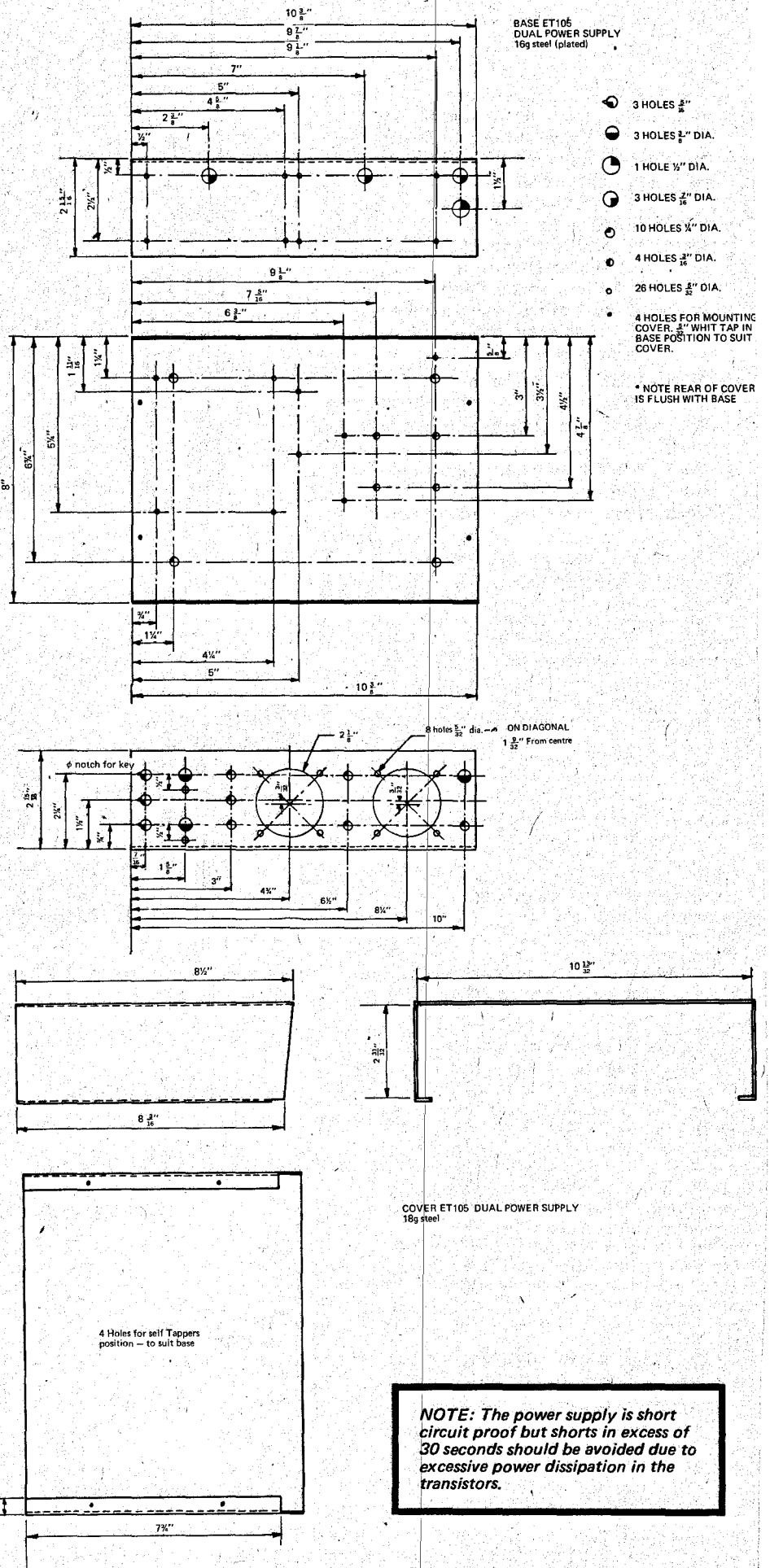
The front panel can now be wired as shown in Fig. 6.

The wires to the heat sink mounted transistors are taken through the grommetts provided, and the already assembled heat sinks mounted into position.

Complete all remaining wiring taking care that all leads carrying 240 Volts are adequately insulated. The mains lead must enter the case through an insulating grommett and the lead must be securely anchored to the case. It is not sufficient merely to tie a knot in the mains cord — this is a dangerous practice.

The supply should now be ready for use, but before connecting to the mains, recheck all point-to-point wiring and all soldered connections.

One point that may not be commonly realised is that meters are calibrated specifically for one panel material. A meter calibrated for mounting on a steel panel may be as much as 30% out if it is mounted on an aluminium panel — and vice-versa. We recommend that a steel chassis is used for this project — but if you decide to use aluminium notify the meter supplier accordingly. ●



SPECIFICATION — POWER SUPPLY — ET 105	
Output Voltage	0 — 20 Volts positive 0 — 20 Volts negative
Output Current	0 — 1.5 Amps
Current Limiting	190 mA and 1.80 Amps
Meter Ranges	
(current)	150 mA and 1.5 Amps
(voltage)	25 Volts
Line Regulation	better than 1 mV for 15 Volt input voltage change
Load Regulation	less than 10 mV drop from no-load to full-load
Ripple	less than 2 mV peak to peak
Output Impedance	7 mΩ @ dc — 1.5 kHz 14 mΩ @ — 3 kHz 56 mΩ @ — 15 kHz 200 mΩ @ — 100 kHz

NOTE: The power supply is short circuit proof but shorts in excess of 30 seconds should be avoided due to excessive power dissipation in the transistors.

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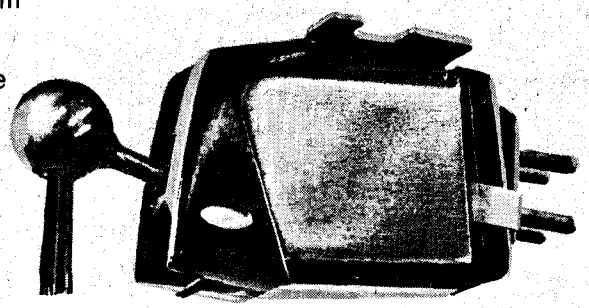

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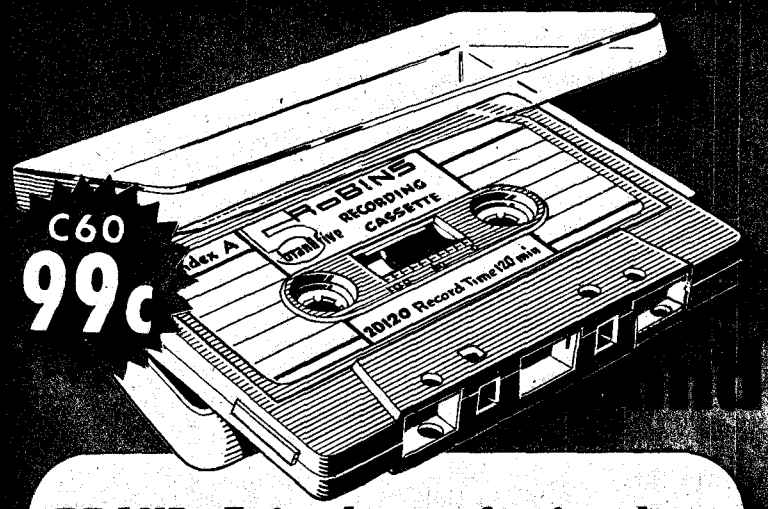

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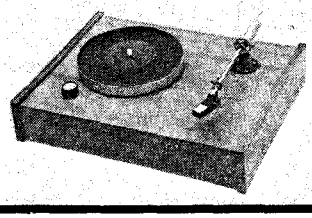

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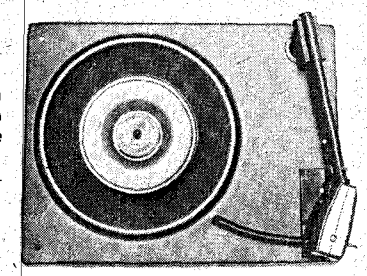

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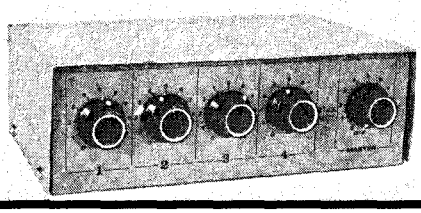

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ET PROJECT

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It needs a minimum of components, all of which are easily obtainable; it is cheap and can be built in a very short space of time.

THE CIRCUIT

The circuit is shown in Fig. 1. A single transistor (Q1) is arranged as an amplifier with resistor R2 providing the necessary bias. The resistance of the carbon microphone will vary as sound is impressed upon the diaphragm, thus varying the voltage across R1.

Resistor R1 is ac coupled to the base of the transistor Q1. This transistor amplifies the signal and drives the speaker.

CONSTRUCTION

All the minor components are easily mounted on a single tagstrip (as shown in Fig. 2). This tagstrip may be bolted to one wall of the loudhailer enclosure and wiring taken to the microphone, speaker, pushbutton and battery.

Any suitably enclosed box of the right dimensions, may be used to house all the components including the battery and the speaker.

Generally, the larger the speaker the better, but remember this is a loudhailer not a public address system!

The back of the carbon must be enclosed to prevent feedback from the loudspeaker — if this is not done the system will oscillate. *(See over)*

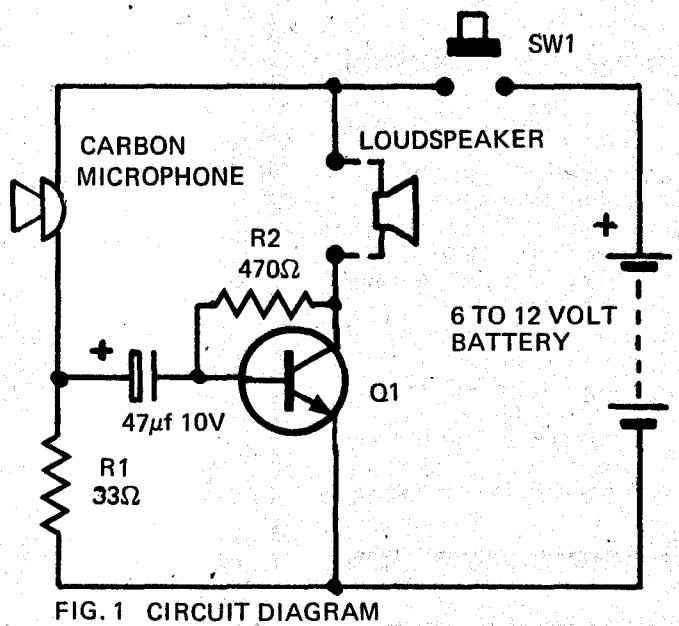


FIG. 1 CIRCUIT DIAGRAM

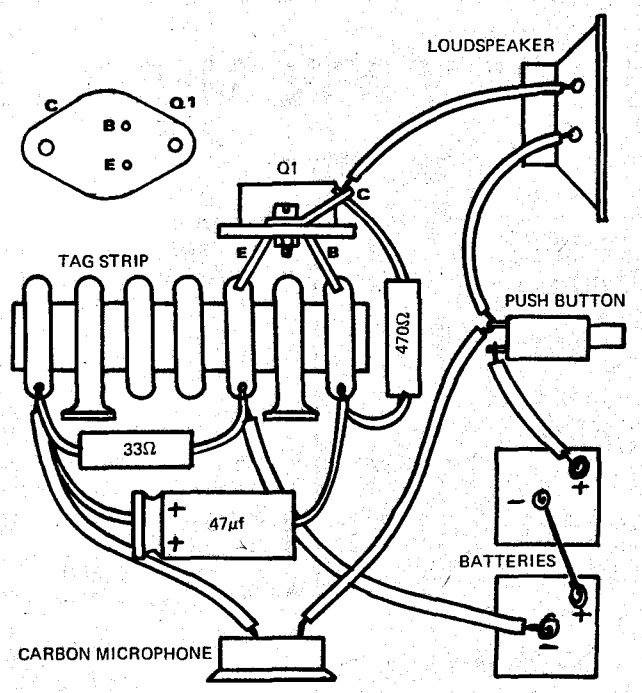
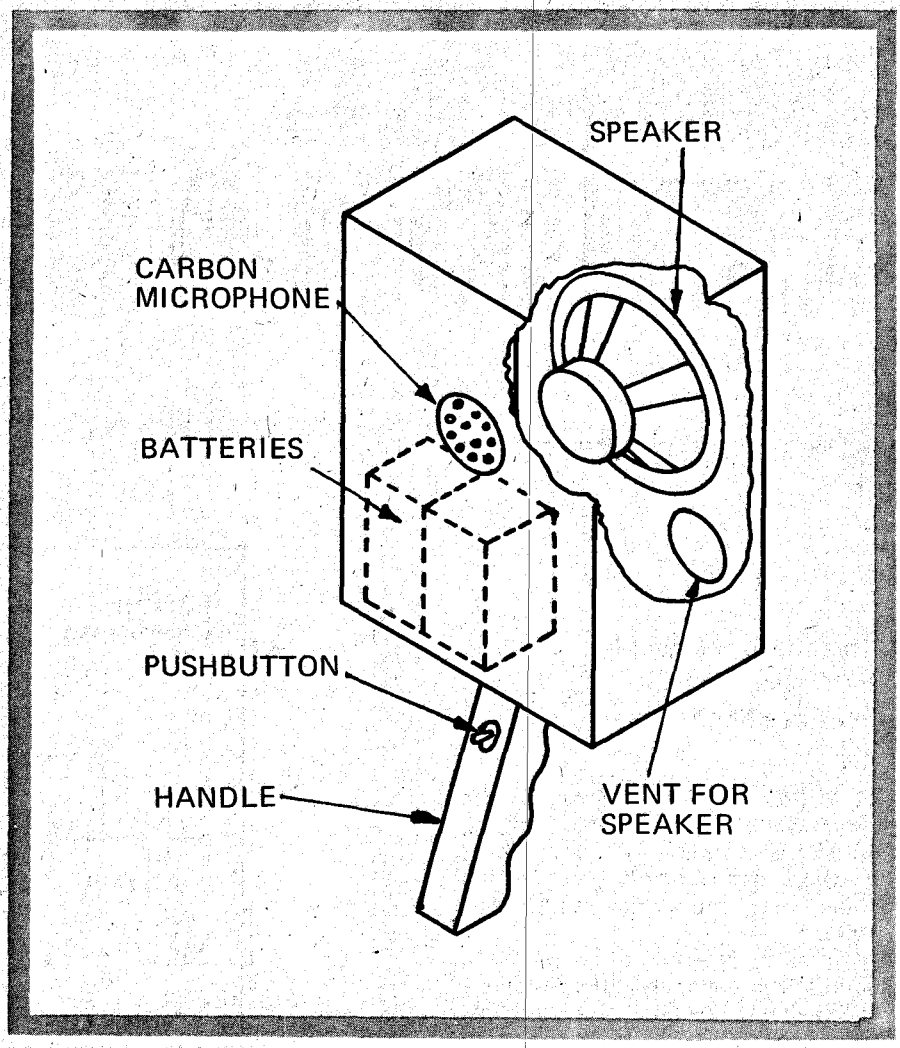


FIG. 2
COMPONENT CONNECTIONS

SIMPLE LOUDHAILER

A sketch, showing one suggested arrangement for mounting the components, is shown in Fig. 3. The layout is not critical however. Practically any arrangement that is convenient to you will work satisfactorily.

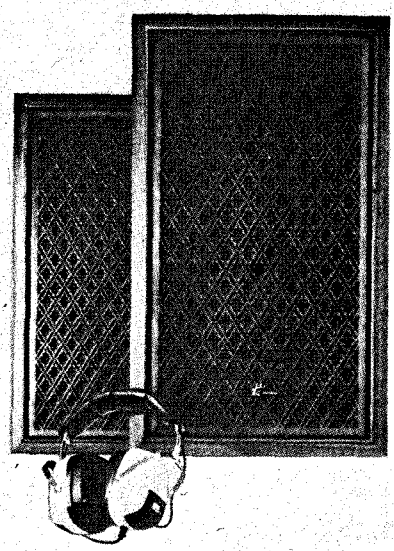
The unit is surprisingly effective — and quality is excellent — despite the bias caused by some dc energization of the loudspeaker voice coil. ●



PARTS LIST ET 208

R1 resistor, 33 ohm, ½ watt, 5%
R2 resistor, 470 ohm, ½ watt, 5%
SW1 small push-to-make switch
C1 capacitor 47 μF,10 Volt electrolytic
Q1 transistor type 2N 3055, 40250, 2N 3054, SE 7010 or suitable equivalents.
Loudspeaker — 3" to 8" diameter, 4 ohm to 15 ohm impedance.
Batteries — two type 509 lantern batteries.
Carbon microphone — Zephyr type 196 (or similar).
One seven lug tagstrip, connecting wire, box, etc.

SWIMMING POOL SAFETY CONTEST



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.

Eleven children, under the age of five, drowned in NSW private pools in 1970. This was nearly twice as many as in 1969.

The purpose of this competition, full details of which were published in the July and August issues of Electronics Today, is to design an effective and reliable system that will provide audible warning if a child falls into a swimming pool.

Entrants are reminded that the final closing date is November 23.

FIRST PRIZE
$1000
WORTH OF HI-FI EQUIPMENT FROM
SIMON GRAY
Pty. Ltd.

Sansui turntable — two speeds, four pole synchronous motor. Magnetic cartridge with 0.5 mil. diamond stylus.

THE ADVENT LOUDSPEAKER

What they're saying about The Advent.

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

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

PRICE $169 each.

JULIAN D. HIRSCH

The shape of the curve above 6 kHz corresponds almost exactly to the calibration curve of our microphone . . .

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

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

ELECTRONICS WORLD

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

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

STEREO REVIEW

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

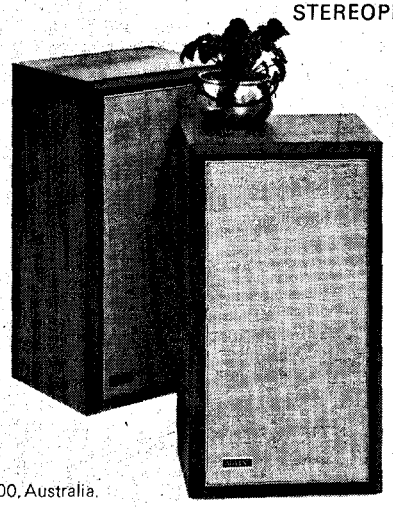
One could say that at twice the price The Advent speaker would be a good value.

AUDIO

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

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

STEREOPHILE



Trade Enquiries Welcome.

Sole Agents
AURIEMA (AUSTRALASIA) PTY. LTD.

549 Pittwater Road, Brookvale, N.S.W. 2100, Australia.

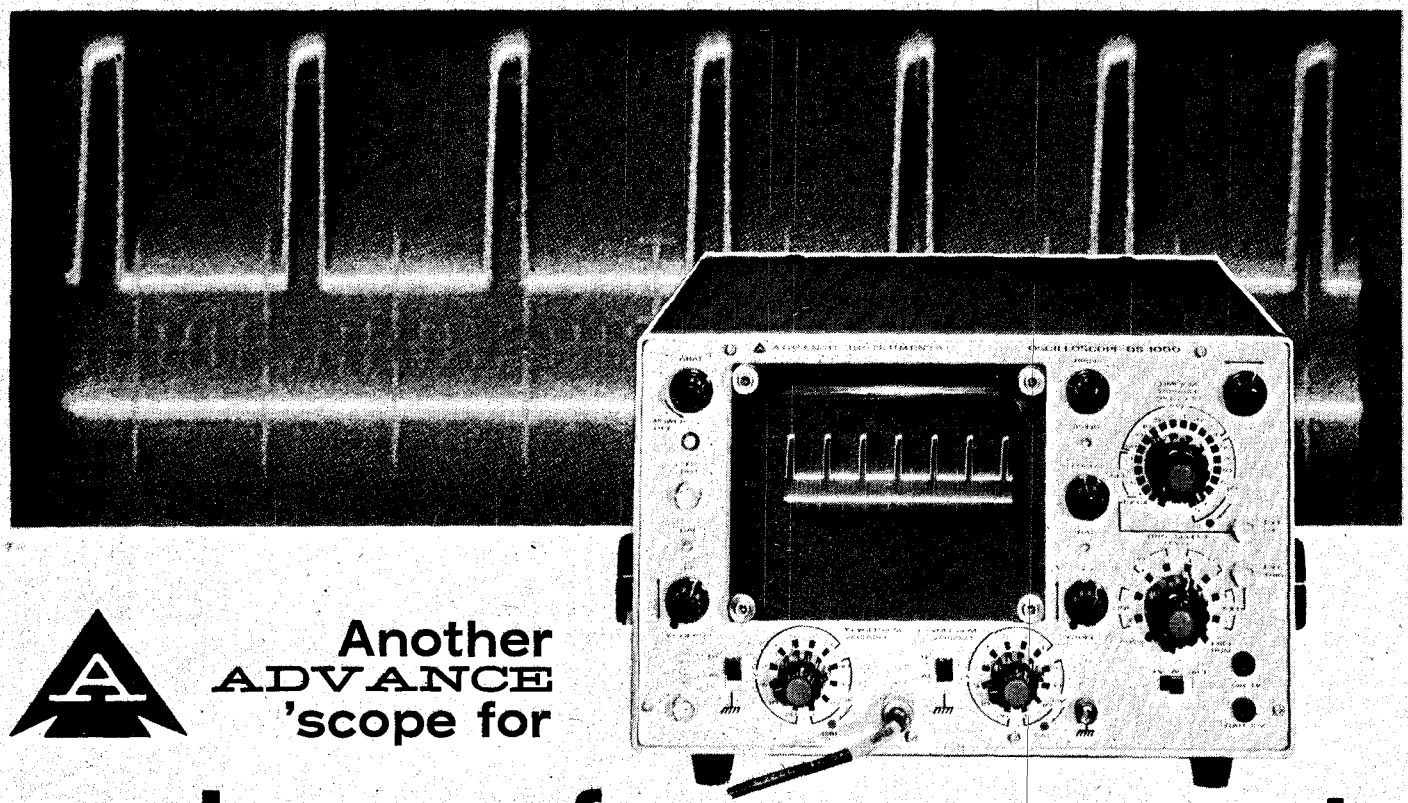
Please send me further information on The Advent Loudspeaker

Name_____

Address_____

State_____ Post code_____

AUTO9



Another ADVANCE 'scope for

precise waveform measurements

OS1000 oscilloscope
15MHz, 7" high

Here is a small size, lightweight 5mV/cm dual trace oscilloscope offering wide time base ranges and comprehensive trigger control combined with broad bandwidth and calibrated deflection factor. Solid state circuitry makes the OS1000 ideal for servicing or laboratory use.

Probe Kit

An accessory probe kit is available for use with the entire range of Advance oscilloscopes. This provides for a standard compensated test lead which may be terminated at one end with BNC or UHF type connectors and at the probe end may be fitted with probe bodies of x1 and x10 ratio. Spring-loaded hook, needle, 4mm plug and alligator tips may be fitted to the probe, which also has provision for a grounding lead connection adjacent to the probe tip. All the parts are supplied in a plastic wallet suitably compartmented.

DISPLAY:
10cm x 6cm rectangular tube with 4Kv overall E.H.T.P.31 (standard) or P7 (long persistence) phosphors available. With dark grey filter as standard. Brilliance, Focus and Graticule illumination by normal controls.

EXTERNAL Z MOD:
AC coupled rear panel socket. 1vpk.pk for visible modulation, 60V for blanking. Input impedance 1MΩ.

DISPLAY MODES:
SINGLE TRACE: Y1 or Y2.
DUAL TRACE: Alternate sweep or chopped mode (250KHz) automatically selected by time base setting:
Alternate sweep—0.5μS/cm to 0.5mS/cm,
chopped mode—1mS/cm to 1 sec/cm.
X-Y mode—via Y1 and Y2 inputs—selected on time base range switch.
Bandwidth DC to 1MHz.

Y DEFLECTION:
Dual channels—
Sensitivity—5mV/cm to 20V/cm ± 3%.
BANDWIDTH: DC to 15MHz.
INPUT Z: 1MΩ/30pf.
INPUT COUPLING: AC/DC/Ground.

X DEFLECTION:
TIME BASE: Ranges 1 sec/cm to 0.5μS/cm with X10 Expansion ± 5%.
TRIGGER MODES: (i) Internal Y1 + or − (ii) Internal Y2 + or −. (iii) External + or −. (iv) Line + or −.
LEVEL CONTROL: (i) Manual or (ii) Auto with automatic free run in absence of signal.
EXT. TRIG.: Input Z. 100kΩ 15pf.
EXTERNAL X: Via external X input, sensitivity 1V/cm. Input resistance 100kΩ, bandwidth DC to 2MHz.

GENERAL INFORMATION

CALIBRATORS:
(i) CAL.: Line frequency square wave 1V pk.pk ± 2% rise time approx. 20μS.
(ii) PROBE TEST: Time base gate waveform + 10V.

SUPPLIES:
95-111/103-121/111-130.
190-222/206-242/222-260.
Selected by rear panel switch.
45-440Hz. Approx. 35VA.

OPERATING TEMPERATURE RANGE:
0 to + 40° C.

WEIGHT:
20 lb.

SIZE:
7" x 11¼" x 17".
(H) (W) (L)

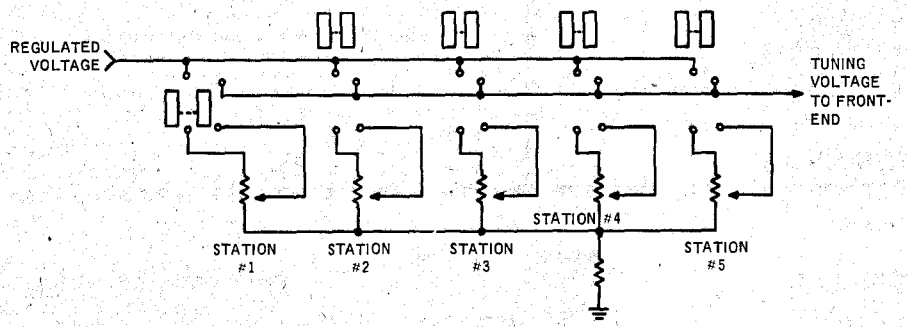
Further information available from:

JACOBY MITCHELL

SYDNEY	630 7400	BRISBANE	21 0586
MELBOURNE	30 2491	PERTH	28 5725
ADELAIDE	93 6117	LAUNCESTON	2 5322

JM/61-71

Fig. 9. Five individual potentiometers, singly selected by pushbuttons, tune the varactor-diode front-end to preselected station frequencies.



across C-904 rises, Q-906 resumes reverse biased operation and the i.f. amplifier becomes operative once more. The release time during which the i.f. amplifier is muted by Q-906 must be long enough to allow the receiver to tune off its previous station setting, but short enough to prevent station skipping. Variable timer transistor Q-904 progressively loads the base of Q-906 to lengthen the release time at 108 MHz, compared to the release time at 88 MHz, since the varactor diodes are not completely linear in frequency vs. voltage relationship. To sweep the receiver 1 MHz at 88 MHz requires approximately ½ volt change of dc tuning voltage, whereas at 108 MHz, approximately 1½ volts change of dc tuning voltage is required.

REMOTE CONTROL OPERATION

From the foregoing, it is obvious that a simple duplication of the "advance" switches on the end of a long cable would constitute an excellent means of providing remote control tuning for such a receiver and, of course Fisher provides just such a "remote control" attachment. Manual tuning is also easily accomplished, by simply including a continuously variable potentiometer to which is fed the highest dc tuning voltage required. The "arm" of the potentiometer then supplies tuning voltage depending upon its setting or point of rotation.

The more advanced form of Autoscan featured in Fisher's 500 TX makes provision for an ascending as well as a descending dc tuning voltage, enabling the user to scan up-scale or down-scale in frequency by means of two separate push buttons, but the basic principles of operation are the same and will not be detailed here.

CONCLUSION

All of the refinements embodied in these automatic tuning methods depend upon the fact that specially fabricated diodes can now be produced with controlled values of junction capacitance accurately determined by the dc voltage applied as reverse bias to them. Whether this development will lead to the complete abandonment of mechanical, variable-capacitor tuning of AM and FM tuners by all manufacturers of tuners and receivers in the future depends upon cost factors and the engineering ingenuity of each manufacturer. But it's nice to know that the choice is there and we can foresee a variety of interesting and novel tuning schemes based upon this simple component as more and more manufacturers begin to experiment with it. ●

This article has been reproduced from the May 1971 issue of AUDIO by arrangement with the publishers.

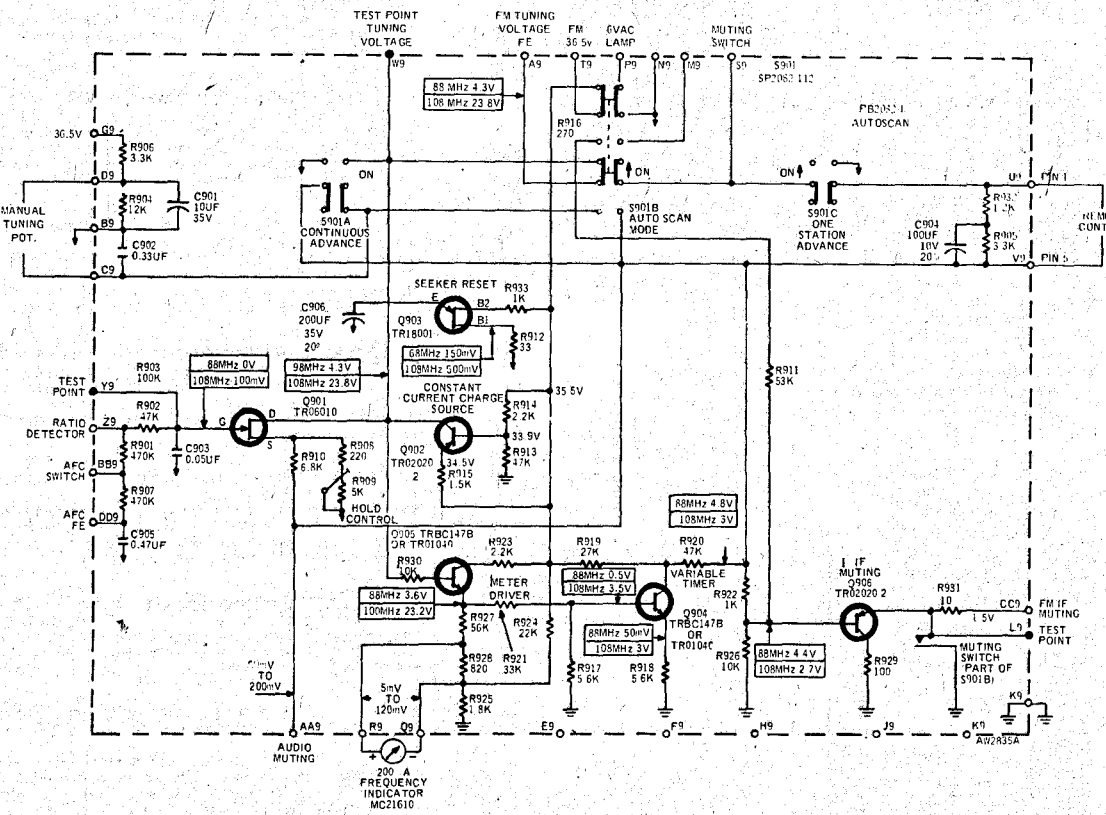


Fig. 10. Complete circuit diagram of Fisher Radio's "Autoscan" as used in the Model 450-T.

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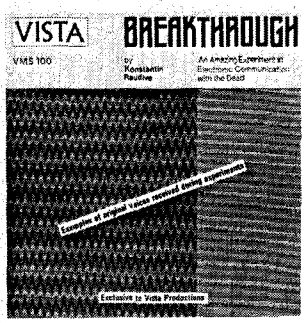

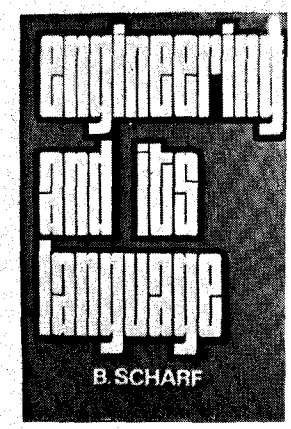

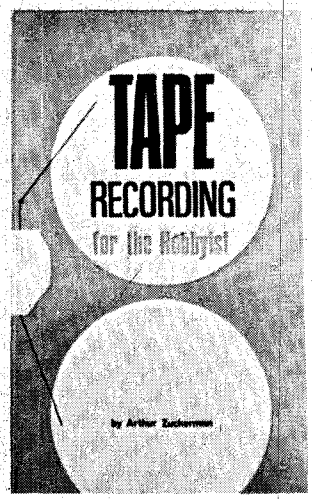

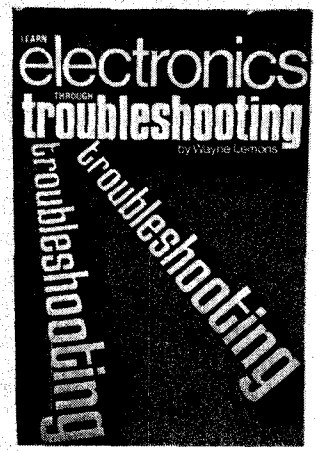

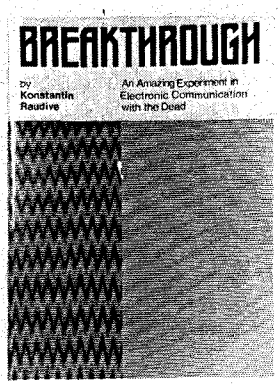

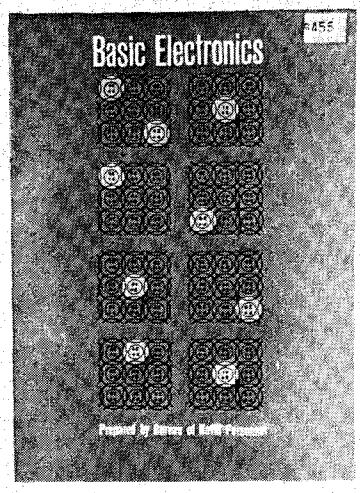

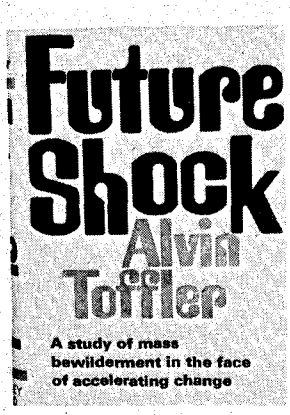

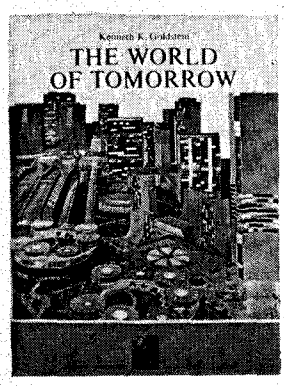

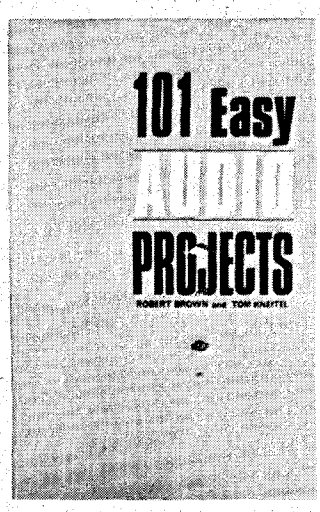

E10 BREAKTHROUGH — DR. KONSTANTIN RAUDIVE. BOOK & L.P. RECORD. 391 pp. 8½" x 5½" $13.90.
Dr. Raudive's research points to the fact that seemingly there is life after death and with the aid of tape recorder, radio and microphone a "breakthrough" has been achieved. This book and the recording of the voices from the dead has been the subject of world wide discussion. Available October. Order your copy now!

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Future shock is the most startling survey on the present weakness of our society and its future yet written. It is about change and how we adapt to it. It is about the future and the shocks that its arrival brings.

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Board a Time Machine and travel a century into the future. Explore the oceans and outer space. Imagine creating and living in tomorrow's world! An excellent gift book for budding young scientists and engineers.

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Covering an exceptionally wide range of background engineering knowledge this book will provide industrial translators, technical writers and those without a complete technical training with information frequently required in commerce & industry.

E.24. BASIC ELECTRONICS — PREPARED BY BUREAU OF NAVY PERSONNEL. 9½" x 6", 538 p.p. $4.55.
This covers every important aspect of applied electronics using no more advanced material than principles of applied electricity and elementary maths. This course is as valuable to hobbyists as to beginning students of electronics.

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By constructing these audio projects you will not only have fun while working with your hands and constructing something with many uses but you will achieve a practical knowledge and understanding of basic electronics.

E.28. TAPE RECORDING FOR THE HOBBYIST — A. ZUCKERMANN. 9" x 5½", p.p. $4.40.
This book suggests not only WHAT you can do with a recorder, but HOW. Apart from the hobbyist there are many ideas on what a recorder can do for anybody's home and business life.

E.29. LEARN ELECTRONICS THROUGH TROUBLESHOOTING — WAYNE LEMONS. 8½" x 5½", 576 p.p. $12.75.
In this excellent book, illustrated by many photographs and drawings, the subject matter is presented in terms of practical troubleshooting situations and simple, reproducible examples. These facts will be indispensable to the technician entering the electronics field.

PATCHING UP PHOTOGRAPHS OF FUNDAMENTAL PARTICLES

Physicists working at the Rutherford Laboratory, near Oxford, with the particle accelerator, Nimrod, are using a device called a light-pen to speed up their research on fundamental atomic particles. The apparatus improves the quality of photographs taken of the tracks of these particles.

The results of atom-smashing experiments are frequently recorded by fixing a target in front of a tank of liquid hydrogen ("bubble chamber"). When the atomic target is smashed by the beam of protons which have been accelerated to very near the speed of light by *Nimrod,* the particles produced by the disintegration of the target fly off through the tank in different directions. As they do so they leave tracks in the form of tiny bubbles and these are photographed by a battery of cameras from several angles. A large number of photographs are taken in this way every day and examined by physicists, searching for the tell-tale tracks of the particular particle they are hunting for. Whenever they find such a track, referred to as a "significant event" — all the information about it is fed into the memory store of a computer. Later it combines the data about these events and provides information from which the scientists can work out the details of the structure of the atomic nucleus.

Occasionally, this semi-automated process is slowed up or impaired through faults in photography. An imperfect or damaged negative, for example, can mean that part of one view of a "significant event" is missing in one or more of the photographs which should have recorded it in full. When a piece of the track is missing in this way, the Rutherford's computer is trained to recognise it and to make, so to speak, a mental note that this particular event is not fully recorded. But it is now possible to give the missing data to the computer.

It is done in this way. The computer selects from its memory store the incomplete set of figures describing an event which was imperfectly photographed. It then turns these figures back into a set of pictures like the original photographs. These pictures are flashed up on a television screen, in front of which sits an operator holding a light pen. When the photograph with part of the significant track missing appears in front of him, the operator simply draws in the missing part of the track on the TV screen with the light pen. This correction is automatically turned into figures and fed back into the computer's memory store so that it now has a complete set of data describing the significant event. Although the electronics involved are extremely complex, the device itself is surprisingly simple to use and, as the scientists themselves put it, it is proving invaluable in "patching up physics". ●

Technology Satellite-G

THE National Aeronautics and Space Aministration is planning to launch a satellite, in the mid-70s, designated 'G' in the series of Applications Technology Satellites.

It will have a geostationary orbit over the equator and will carry a 30 ft parabolic dish antenna.

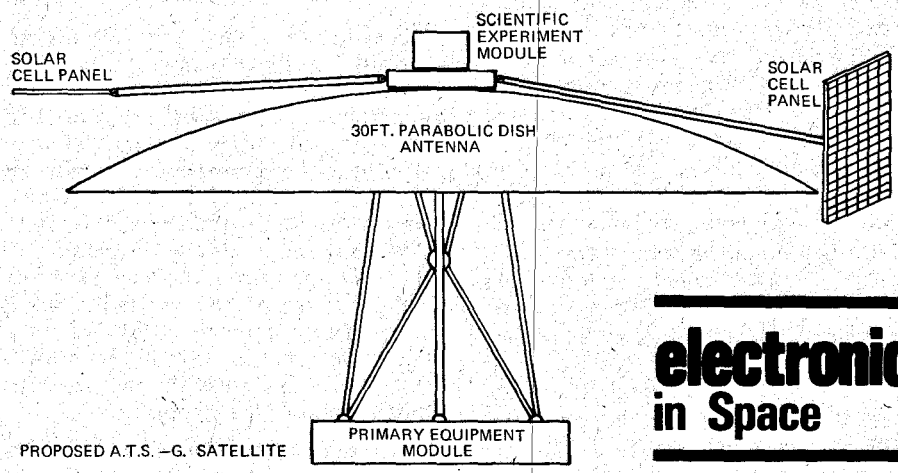
The ATS series of satellites are being used to investigate the use of space technology in improving earth communications, navigation and weather forecasting, and NASA has recently called for experiment proposals that will make use of the large antenna.

The Radio Amateur Satellite Corporation (AMSAT) is proposing a relatively sophisticated communications experiment. It involves placing a channelised repeater on board the ATS-G satellite having an up-link in the 144-148 MHz band, and a down link in the 420-450 MHz band. Channeling will allow numbers of stations to use the repeater simultaneously. This will avoid the problem of one high-powered station capturing the power capability of the repeater and reducing levels of all the signals in the repeater pass-band.

The experiment is designed to demonstrate the feasibility (or otherwise) of satellite communications using relatively simple, low power, low cost terminals for point to point communications on earth.

Simple, low cost terminals have obvious advantages for developing nations, and for long distance mobile communications from ships or aircraft.

If the AMSAT proposal is brought to a successful conclusion, it could lead to other, non-amateur satellites providing improved communications for a number of existing services that presently have to rely on HF communications, with all its attendant problems. ●



PROPOSED A.T.S. –G. SATELLITE

electronics in Space

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.

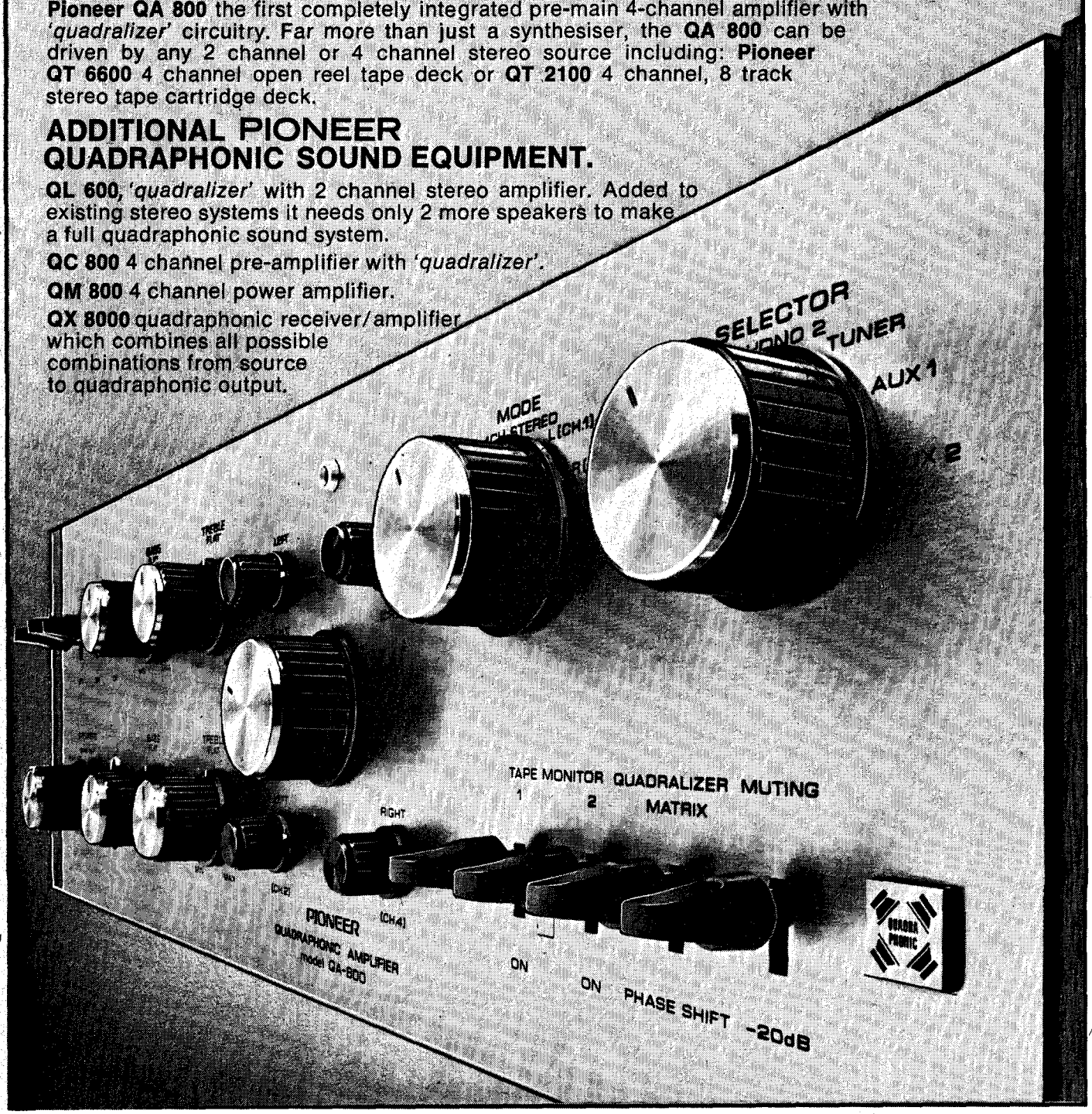
ADDITIONAL PIONEER QUADRAPHONIC SOUND EQUIPMENT.

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'*.

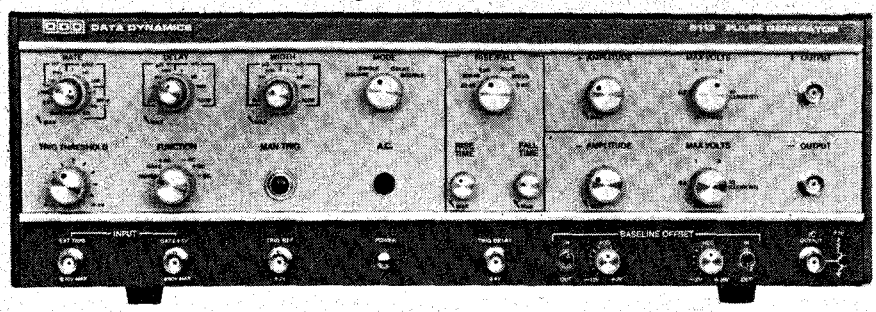
QM 800 4 channel power amplifier.

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



EQUIPMENT NEWS

50 MHz PULSE GENERATOR



The Data Dynamics Model 5113 Variable Rise and Fall Time Pulse Generator produces pulses at rates varying continuously from 1 Hz to 50 MHz in eight ranges with 10:1 variable control within each range.

There are positive and negative pulse outputs, each having a variable rise and fall, continuously adjustable from 6 nanoseconds to 5 milliseconds. The base line offset is variable from -10 volts to +2 volts for the positive output, and -2 volts to +10 volts for the negative output. By adjustment of the base line offset for both the positive and negative outputs, a 100% duty cycle output is available. Single, delayed or double pulses are available with provisions for adjusting the delay between pulses, output pulse width and pulse amplitude.

The Model 5113 provides a separate output, specifically designed for TTL, RTL or DTL integrated circuits. All the functions of the pulse generator with the exception of the base line offset and the variable rise and fall time controls are available at the IC output at all pulse repetition rates up to 50 MHz without the concern of overdriving the IC circuits under tests.

Full details from Warburton Franki Pty. Ltd., Box 182, Chatswood. NSW 2067.

EHT POWER SUPPLIES

EMI (Australia) Limited have been appointed the exclusive Australian distributors of the highly stabilised vernier controlled EHT Power Supplies, manufactured by Miles Hi-Volt Limited of England.

Sample units have been imported for demonstration purposes. These units are particularly suitable for users of photo-multipliers and for inclusion in test equipment associated with the manufacture of cathode ray tubes or equipment using high-voltage tubes.

Full details from Commercial & Advanced Electronics Division, EMI (Australia) Limited, 14-18 Parramatta Road, Homebush, N.S.W. 2140.

NEW LINEAR HYGROMETER

Direct dial readings of moisture content, dewpoint or humidity at up to four different locations can be provided by a new hygrometer, which is claimed to be almost instantaneous in its response and completely linear.

By the use of standard dials and the appropriate sensors, the hygrometer, which was developed by a British firm, can be arranged to indicate any proportion of moisture from plus 100°C dewpoint down to less than one part per million in air, gases or liquids, such as hydrocarbons. Its measurement of relative humidity is said to be accurate to within 2°C dewpoint.

Sensors are set at each location, and for a reading are brought into the hygrometer's circuit simply by turning a selector switch. Response time is less than one second.

The sensors differ in design detail according to duty, but have several basic features in common. These include high sensitivity, an exceptionally large capacitance of about 0.1 microfarad – 100 times greater than that of any other capacitor-type hygrometer sensor, says the manufacturer, long-term stability, and sensing elements with an average life of at least ten years.

The large capacitance means that the length of the cable linking sensor and instrument is not critical. It can be 100 yards long and more without affecting sensitivity and accuracy.

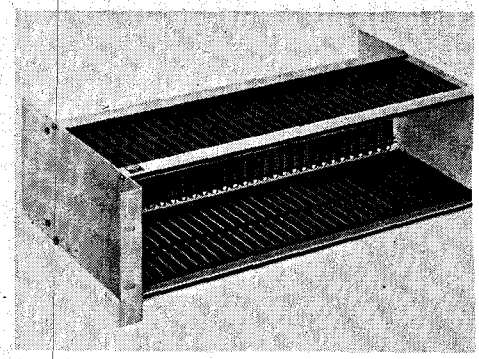
The makers say that the system is so stable that the hygrometer can be used for many years without adjustment or attention. Accuracy can be confirmed at any time simply by operating a check switch on the instrument's panel.

Only water vapour can penetrate the minute pores of the sensing element. The sensor therefore operates effectively in oils and petroleum, without risk of contaminating the element's dielectric layer.

The hygrometer, which has a circuitry made up largely of printed circuit board and silicon solid-state devices, is produced in two models, one portable for laboratory or works use, the other for permanent rack mounting.

Full details from Tecnico Electronics, 53 Carrington Road, Marrickville, N.S.W. 2204.

CARD FILE KIT



Newest addition to the rapidly expanding line of electronic circuit hardware at A P Incorporated is a quick-assemble PC Card File kit. These accommodate 4-3/8 inch and 4½ inch PC cards. Only two to five minutes are required for assembly.

Other unique features are support rails that eliminate inter-row supports and the use of self-tapping screws for instant installation and removal of edge-board connectors.

The assembled card file fits into standard 5¼ inch by 19 inch cabinet space. Each file holds up to 32 PC cards 1/16" inch thick, up to 6½ inches long, on ½ inch centres. Kits accept standard 22-position, double-readout connectors (which may be purchased separately) with either conventional solder tails or wrapping posts.

Each file is composed of four pair of moulded card guide modules – each module holding up to eight cards. Passages between card slots assure ample air flow for system cooling. Strips of card-position and connector position numbers are supplied with each kit.

Full details from A P Incorporated, 72 Corwin Drive, Painesville, Ohio, USA 44077.

ULTRASONIC DISINTEGRATORS

Four ultrasonic disintegrators with power outputs of 50, 200, 300 and 600 watts are being introduced to world markets by a British firm.

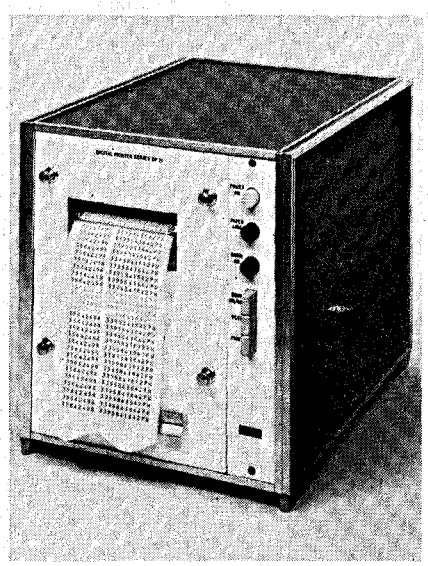
They make up what is believed to be the widest available range of such equipment.

Designed for laboratory use, mainly in the pharmaceutical industry, hospitals and research centres, the disintegrators disrupt tissue cells and micro-organisms by intensive cavitation energy.

Each consists of a generator and a bench stand with a pillar-mounted transducer head. The generator, a solid-state module with an integral thyristor-controlled power pack, is housed in a small cabinet and has only two controls – an illuminated on/off switch for the ultrasonics and a power setting dial. Its frequency is 20 kHz.

The transducer head has a magneto-strictive transducer with a stainless steel probe attached. The transducer, made of laminated nickel alloy and guaranteed for ten years, is cooled by a fan within its housing.

Full details from Chemical Plant & Engineering, P.O. Box 1700P, Melbourne, Vic. 3001.



DIGITAL DRUM PRINTER

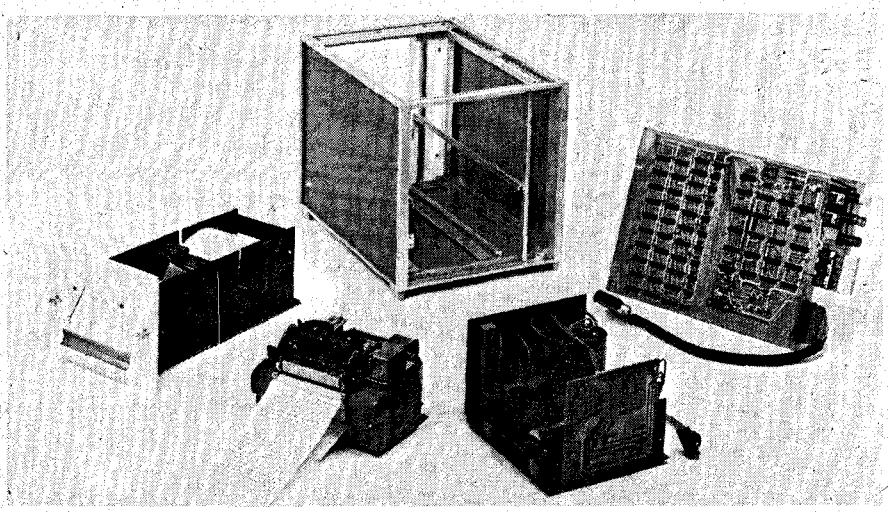
Aimed at both laboratory and original equipment markets, a new drum printer from Smiths Industries will print at up to three lines per second.

The printer, provides 19 data columns (decimal point available on all 19 columns permits fully floating point) plus two alpha columns. Columns not required are suppressed automatically. Print speed is three lines per second and the input will accept binary coded logic at TTL/DTL levels. Sharp definition and long life of the print-out is ensured by use of a typewriter ribbon, which also permits remote selection of red or black print. Pressure-sensitive paper or fan-fold paper may be used as an alternative medium. Internal logic can be linked to provide spacing between print lines of 0.1 inches up to 2 inches, in steps of 0.2 inches.

The existing model will accept normal or complementary parallel-entry logic and a further development is planned to provide for serial entry. Plans are also laid for the production of a 'top case' presentation of the print-out (like a typewriter) and provision of the instrument in kit form.

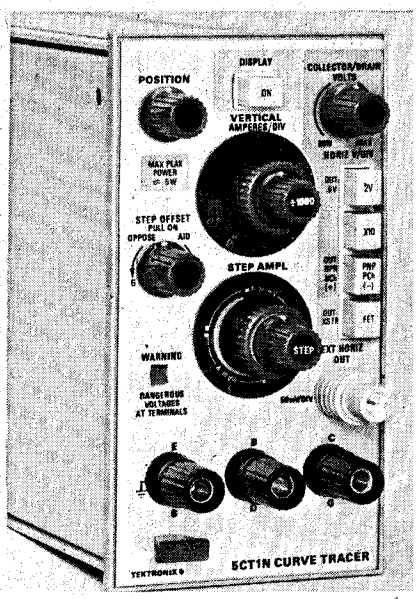
The Industrial Instrument Division of Smiths Industries have done their market research very thoroughly and expect large sales for their new unit in process control, automation, productivity, chemical and material analysis, dispensing and other data monitoring applications in the original equipment and engineering laboratory markets.

Full details from Smiths Industries Ltd., Industrial Instrument Division, Kelvin House, Wembley, Middex, England.



EQUIPMENT NEWS

PLUG-IN CURVE TRACERS



Tektronix Australia , Pty. Limited announces the 5CTIN Curve Tracer – a plug-in unit used in Tektronix 5100-Series Oscilloscope Systems for displaying characteristics curves of small-signal semiconductor devices to power levels up to 0.5 watts.

A variable collector/drain sweep produces a maximum peak voltage of at least 250 volts; a base/gate step generator produces up to 10 calibrated current or voltage steps. Ranges of step amplitudes are 1 uA/step to 1 mA/step for current and 1 mV/step to 1V/step for voltage. In addition, the unit has a vertical display amplifier with deflection factors ranging from 10 nA/div to 20 mA/div and a horizontal amplifier output compatible with other 5100-Series Plug-ins.

Full details from Tektronix Australia Pty. Ltd., 80 Waterloo Rd., Nth Ryde, NSW 2113.

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.

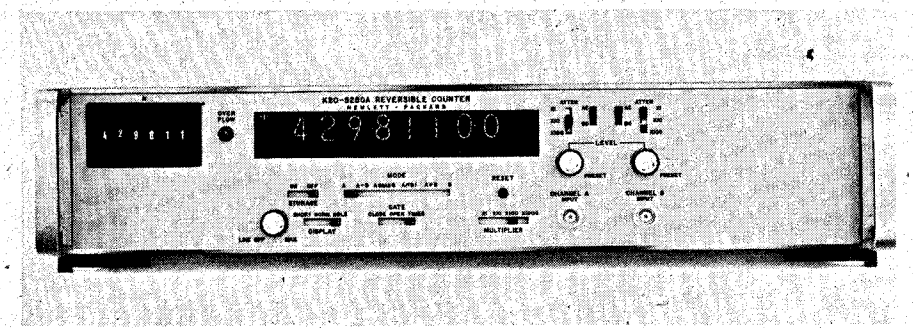
High performance and many options make Hewlett-Packard's Model K20-5280A Reversible Counter one of the most flexible instruments of its type. Among its options is a crystal time base with gate times of 0.01 to 1000 seconds, useful for measuring frequency (rate) and frequency difference. There's also 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, the unit can be ordered with two 7-digit thumbwheel-switch limit settings. Lamp 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 7-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 counters, such as 10 MHz counting rate, built-in input attenuators, adjustable trigger levels, 7-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 the 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.

Full details from Hewlett Packard Pty. Ltd. 22-26 Weir St., Glen Iris, Victoria 3147.

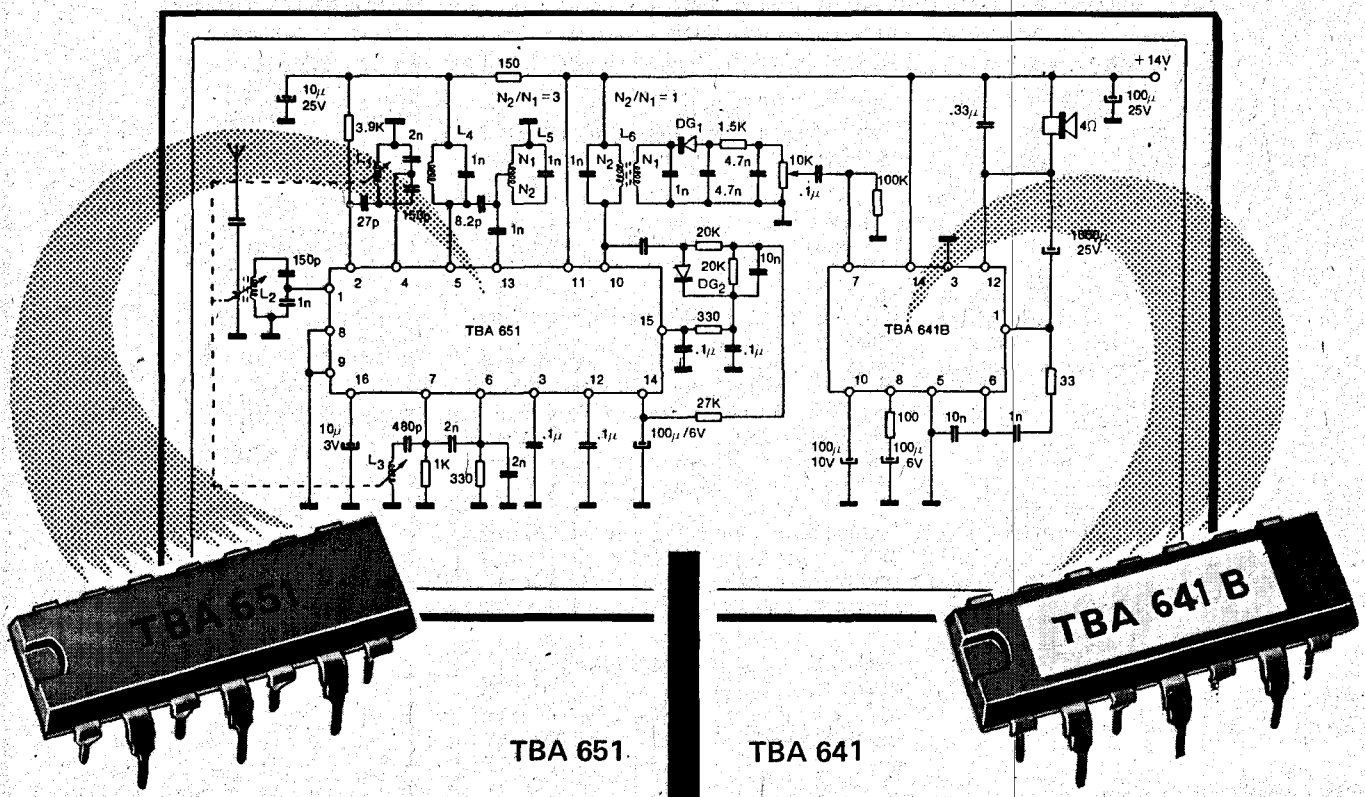


SGS

low cost IC's FOR CONSUMER APPLICATIONS

APPLICATION: CAR RADIO RECEIVER

Diagram shows the circuit details for a high quality AM car radio receiver.



TBA 651

A linear integrated circuit that processes the whole high frequency signal in AM receivers. It is particularly intended for car radios and high quality radio receivers. The TBA 651 consists of five stages: RF amplifier, mixer, oscillator, IF amplifier and AGC control. It features high gain wide voltage supply range (4.8 to 18V), low noise and high sensitivity.

TBA 641

A monolithic integrated circuit primarily designed for use as a low frequency amplifier. The TBA 641 is particularly suitable for use in radio receivers, record players, tape recorders, intercom systems, sound film projectors and industrial applications. Variable or pre-set components external to the chip are not required.

OTHER *LOW COST* DEVICES AVAILABLE FOR —

■ RADIOS ■ RECORD PLAYERS ■ CAR RADIOS ■ HI-FI PRE-AMPLIFIERS ■ POWER SUPPLIES

Full range available from:

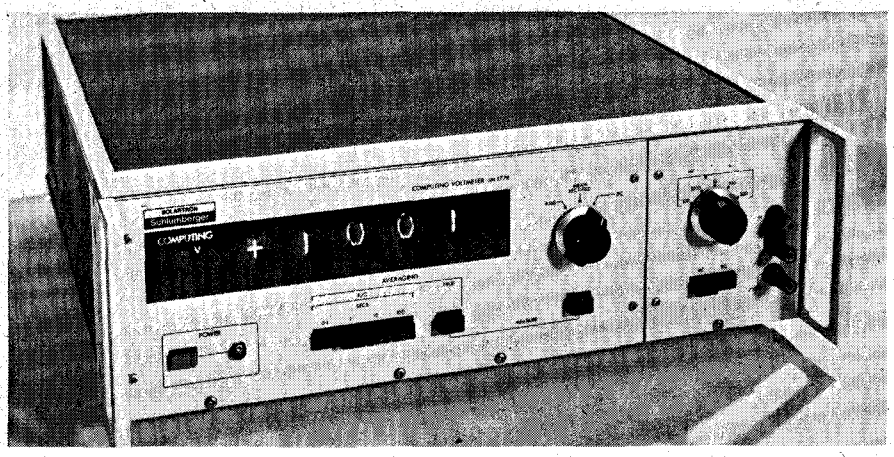
WARBURTON FRANKI

● ADELAIDE 56-7333 ● BRISBANE 51-5121 ● HOBART 23-1841
● LAUNCESTON 31-3300 ● MELBOURNE 69-0151 ● NEWCASTLE 61-4077
● MOUNT GAMBIER 2-3841 ● SYDNEY 648-1711
● WHYALLA 45-0216 ● WOLLONGONG 2-5444

WF3071

EQUIPMENT NEWS

COMPUTING VOLTMETER



A new computing voltmeter from Schlumberger/Solartron uses a new and patented technique that allows previously impossible measurements to be made with accuracy and repeatability.

The instrument – known as the JM1776 Computing Voltmeter – computes the TRUE dc, TRUE rms and TRUE mean rectified components of any signal from dc – 10 kHz. Computation offers significant advantages over conventional circuitry, since the instrument may always be dc coupled. When measuring ac signals such as noise or low frequency sine waves, this is imperative. Because the unit electrically models the mathematical equation of rms measurement, the readings obtained are repeatable and accurate whatever the frequency content or distortion present.

Most engineers and scientists know that there are significant difficulties in the measurement of natural phenomena corrupted by wide band noise and time varying dc signals. Conventional DVMs do not always provide the optimum measurement solution in such circumstances since the integrating digital voltmeter only rejects mains derived interference.

When measuring dc components the Schlumberger unit has infinite rejection of interference and noise at all frequencies.

In the ac mode the unit will measure the true rms and the true mean rectified components of any signal in the range 0Hz – 10 kHz this enables signals in the previously impossible band 0 – 20 Hz to be measured accurately and repeatably.

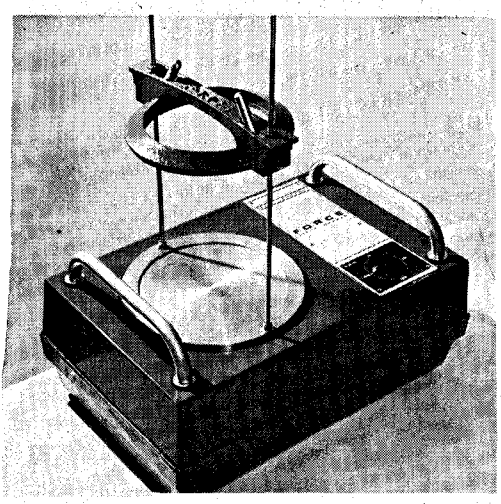
Because the computation time extends to over 3 hours the JM 1776 may be used to perform stable accurate long term integration without the problems of overload and drift associated with analogue integrators.

The measurement time may be externally commanded by using logic signals. This enables the measurement of dc, rms and mean rectified components to be synchronised to external devices.

Typical applications are in the measurement of random and natural phenomena and also low frequency deterministic signal evaluation.

The JM1776 is intended for use in all fields of measurement, acoustics, hot wire anemometry, oceanography, bio-medicine and environmental engineering.

Full details from Schlumberger Instrumentation Aust. Pty. Ltd., 112 High St., South Kew, Vic. 3101.



LABORATORY SIEVE SHAKER

A new laboratory sieve shaker, designed and manufactured in Australia by Foss Electric Pty. Ltd., has a unique sieve clamping mechanism.

The upper platen is free to slide up down stainless steel guide rods but can be instantaneously locked in any position.

The sieve stack is then compressed by moving two small levers a couple of times. The entire operation of clamping or removal is said to take less than three seconds.

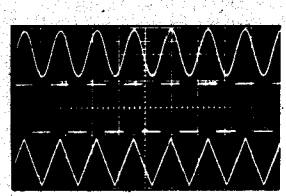
The sieve shaker will accommodate up to eight 8" diameter sieves. A 60-minute time switch is included as standard.

Unlike many other types of sieve shaker the Foss unit is virtually silent and vibration free in operation.

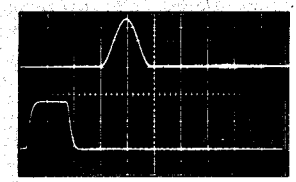
Full details from Foss Electric (Aust) Pty. Ltd., 96 Penshurst St., Willoughby, NSW.

outperforms any signal source from 0.0001 Hz to 11 MHz

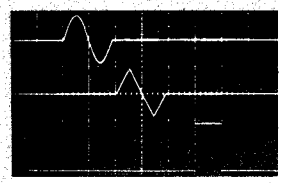
new function generator works harder, operates easier



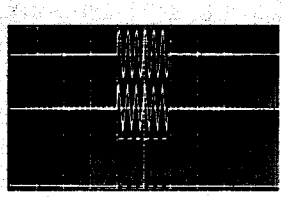
Sine, square and triangle waveforms.



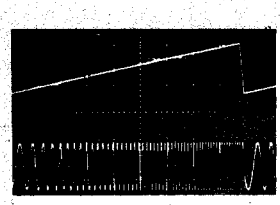
Sine² pulse (top waveform) and 100 ns pulse (bottom waveform).



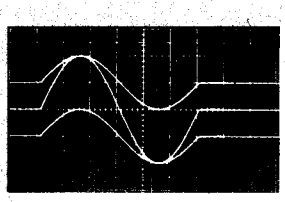
Single shot waveforms.



Burst mode.



Sweeping with internal ramp.



Fixed D.C. offset halves amplitude and offsets waveform positive or negative in relation to ground.

The new Exact Model 7060 Waveform Generator is the first in a series of higher performance instruments designed to be more useful in more test applications.

Its frequency range, from 0.0001 Hz to 11 MHz, expands the versatility of function generators into new areas. For instance, the Model 7060's ability to produce sine² waveforms at 8 MHz now provides a signal source for transmission line testing. Frequency response is flat all the way out to 11 MHz, with high quality waveforms even at the highest frequencies.

For sweep applications, the Model 7060 offers "start" and "stop" frequency controls that let you precisely set starting and stopping frequencies. Accurate Kelvin-Varley dividers tell you exact frequencies without using a counter.

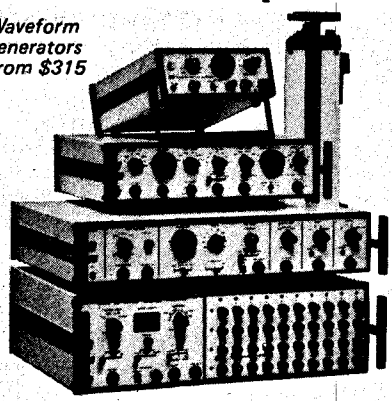
As a pulse generator, the Model 7060 produces pulses with widths variable from 100 ns to 1000 seconds, and repetition rates from 0.0001 Hz to a full 11 MHz. Ramp waveforms with ramp times from 100 ns to 1000 seconds are another first in this instrument.

The Model 7060 sets the pace in D.C. offset, too, with the ability to select either fixed positive or negative or variable ±10 V offset. Offset also can be externally programmed with an analog voltage.

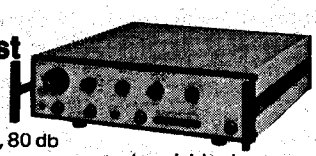
Two complete generators in one, the Model 7060 generates sine, square, triangle, ramp, pulse and sync waveforms, sweeps over a 1000:1 range and has pushbutton control of the operating modes of both generators. The main generator can operate in internal and external trigger modes. In the internal trigger mode, the ramp/pulse generator triggers the main generator. Other features include 80 db attenuation, V:f (voltage proportional to frequency) output, search mode, floating output, sync input for locking to an external frequency or clock and 30V P-P open circuit (15V P-P into 50 ohms) output.

Model 7060 VCF/Sweep Generator . . . . . .

Waveform generators from $315



high frequency, low cost



New Model 7230 VCF Generator with 0.0001 Hz to 20MHz frequency range, 1000:1 VCF/Sweep capability, 80 db attenuation, Kelvin-Varley divider frequency control, variable time symmetry control, search mode, and fixed positive or negative or variable ± 10 V D.C. offset.

EXACT
electronics, inc.
Box 160
Hillsboro, Oregon 97123

ELMEASCO INSTRUMENTS PTY. LTD.

P.O. Box 334, Brookvale, NSW and P.O. Box 14, St. Kilda South, Victoria

Tel.: Sydney 93 7944 – Melbourne 26 1552

ADELAIDE – Phone 64 3296 BRISBANE – Phone 71 3366

EQUIPMENT NEWS

FREQUENCY RESPONSE ANALYSER

The Model 1310 Frequency Response Analyser recently introduced by Schlumberger is a low cost instrument. It is designed specifically for use in educational or research work which does not require the accuracy of measurement of automatic facilities offered by the more sophisticated instruments.

The extensive use of integrated circuits has given the instrument a performance and stability that the manufacturers claim was not previously attainable with discreet components.

The 1310 unit consists of a wide range oscillator (0.02 Hz to 20 kHz) with output variable from 10 mV to 10V rms. The output from the oscillator is floating and isolated. It is possible to lock the oscillator in frequency and phase to an external reference, such as a mechanical system. AC modulation facilities are also provided.

The measuring section of the unit features a correlation process to isolate the fundamental signal from the noise and harmonic distortion. This combined with the floating input circuit, gives a noise rejection of >40dB at all frequencies. The results are displayed in polar form in two panel meters, one indicating the amplitude (either linearly or logarithmically) and the other phase.

Full details from Schlumberger Instrumentation Australia Pty. Ltd., 112 High St., Sth Kew, Vic. 3101.

PHOTO-ELECTRIC TRANSMITTER

A photo-electric pulse transmitter, designed primarily for use with positive displacement meters, provides an analogue signal as well as two pulse signals.

Fields of application include the petroleum, chemical, brewery, paint and soft drink industries, and the unit can be used where remote transmission/control of shaft speed is required, such as on conveyors and pumps.

The analogue current signal, proportional to full or part of the shaft speed range, is available in the standard output of 0-10mA, 4-2mA, 10-50mA, or any other band in the 0-50mA range.

In addition to the high-speed output obtained by chopping the light falling on a planar photo-transistor, a reed switch output is available at a lower rate, normally in 100 to 1 relationship. This separately-generated output is normally used for totalisation.

Power supply is 12V dc (± 10 percent at 200mA) and the unit, which can be supplied in either weatherproof/PTB or flameproof/weatherproof housing, weighs 20 lbs with the heaviest T-adaptor. A strong cast aluminium housing protects the glassfibre printed circuit board assembly, with silicon planar transistors and photo-elements.

Optional extras are a remote indicator calibrated to give flow rate to an accuracy of ± 1 percent; a flameproof ac mains power pack suitable for supplying up to two units; and adaptors with quick-release clamps for meter proving applications.

Full details from Eastern Instruments & Electronic Services, 460-468 High Street, Prahran, Vic. 3181.

NIM BINS

The modular instrumentation approach for nucleonic instrumentation conceived by a special committee established in 1964 by the U.S. Atomic Energy Commission has gained wide international acceptance. In Australia the use of this system has been steadily growing. The advantages of this method of instrument system packaging have become increasingly apparent with the wider range of NIM compatible modules now available.

Apart from the NIM power supply that they have manufactured since 1969, Perini & Scott are now manufacturing NIM Bins for use by research and industry.

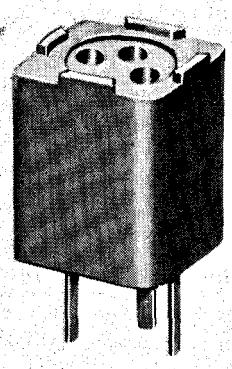
The NIM bin offered complies with the specification T.I.D. 893 and was designed by the Australian Atomic Energy Commission who have licenced Perini & Scott (A'Asia) Pty. Ltd. to manufacture this equipment.

The bins and power supplies ordered as a set come complete with all interface connectors and as a fully wired system ready for the user to insert his instrument modules. The complete bin may be installed in a rack or used on the laboratory bench.

Full details from Perini & Scott (A'Asia) Pty. Ltd., 126a Pacific Highway, Waitara.

COMPONENT NEWS

TO-18 SOCKET



Less than 0.25" square, the Jermyn A23-2044 TO-18 socket from McMurdo (Australia) Pty. Ltd. allows close packing on 0.25" pitch without danger of adjacent devices shorting.

The socket is moulded in glass loaded nylon with contacts of gold plated phospor bronze.

Contact resistance is typically 11 milliohms and capacitance between contacts is 0.7pF.

Insulation resistance between contacts is over 10^4 megohms.

The solder tails are suitable for boards up to 0.125" thick and arranged on 0.2" P.C.D. to simplify the layout of P.C. boards.

Full details from McMurdo (Aust) Pty. Ltd., 17-21 Carinish Road, Clayton, Vic. 3168.

NEW VOLTAGE REGULATORS

SGS has added four new elements to its existing range of power regulators.

Designated TBA 435 and TBA 625A/B/C, these new integrated voltage regulators, encapsulated in the standard three lead TO-5 package, are intended for a wide range of applications that require a regulated power supply, or where problems of common ground coupling, circuit coupling, sensitivity to spurious signals, voltage drops in cables and connectors are particularly important.

The TBA 435 and TBA 625A/B/C, having fixed output voltages of 8.5V, 5V, 12V and 15V respectively, may be used either as simple three terminal regulators or as the control element of higher current fixed or variable voltage regulated power supplies.

In the design of these four new integrated circuits is included an effective protection circuit against overload and permanent short circuit. The TBA 435 625A/B/C do not require any external components apart from the output capacitor.

The devices are claimed by the manufacturer to maintain an output voltage within ±5% of the nominal and a maximum variation of 1% of the absolute output voltage up to a regulated current of 100 mA.

Additional features include a very low output resistance (typ. 0.1Ω), high ripple rejection (typ. 60 dB) and extremely low temperature coefficient (typ. 0.003%°C).

Full details from Warburton Franki Ltd., Box 182, Chatswood, N.S.W. 2067.

INTEGRATED PHOTOELECTRIC SENSOR

Schlumberger/EMR-Photoelectric, a division of Weston Instruments has announced the release of a new Integrated Photoelectric Sensor. Designed for the Synchronous Meteorological Satellite, the unit contains an EMR multiplier photo-tube packaged integrally with a high voltage power supply in a "piggyback" design.

The 16 ounce power supply used in this device converts 28 volts dc into a highly regulated adjustable voltage, up to 3500 volts. In addition to a maximum power consumption of only 100 milliwatts, the supply features constant input power over the entire input voltage range. The supply is both short-circuit and overload protected. All high voltage leads and components are encapsulated within the package, leaving only low voltage leads to be electrically interfaced.

The entire unit, including the multiplier phototube, is capable of vibration levels of 30 G, 20 to 3000 Hz, 50 G shocks of 11 milliseconds duration, and can operate from -10 degrees C to +65 degrees C at both sea level and space environments.

The following shortform catalogues can be obtained by applying on company letter head

(a) Electro-optical Manuals
(b) High Voltage Power Supplies
(c) Integrated photoelectric sensors.

Full details from Schlumberger Australia Pty. Ltd., P.O. Box 138, Kew Vic. 3101.

TV AUDIO CHANNEL I/C

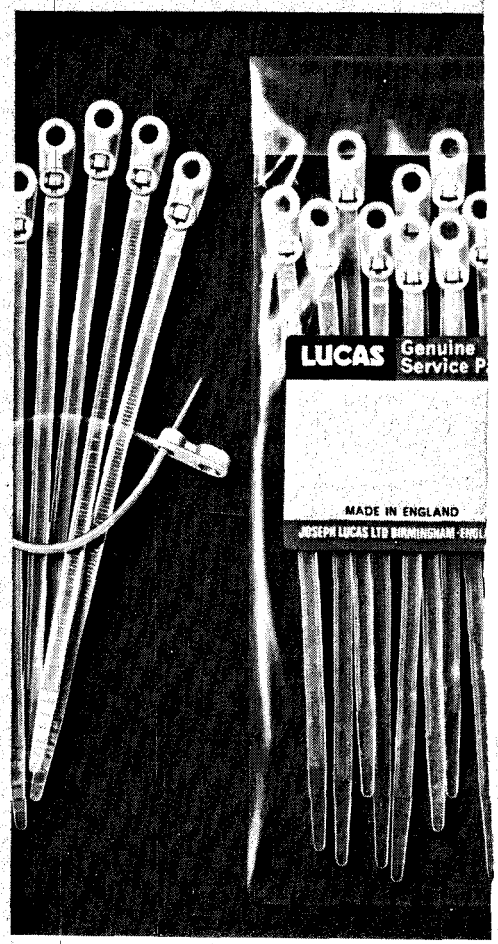
The research and development laboratories of SGS have developed and put into production a new monolithic integrated circuit which is expected to revolutionise the design of the sound section of TV receivers. This integrated circuit, designated TBA 631, includes the following circuit functions:–

- 3 stage limiting amplifier
- FM coincidence detector
- Audio separator
- Audio pre-amp and self-balancing system
- Audio driver
- Power output stage

Thus the TBA 6 forms the complete sound section from video driver to loudspeaker. Encapsulated in the well-known SGS 16-lead plastic power SPLIT-DIP package with external heat-sink, the TBA 631 has been designed to reduce the number of external components to a minimum.

Full details from Warburton Franki Ltd., Box 182, Chatswood, NSW 2067.

PLASTIC CABLE TIES



Many products developed primarily for the Aerospace and Electronics Industries have found their way into the motor car.

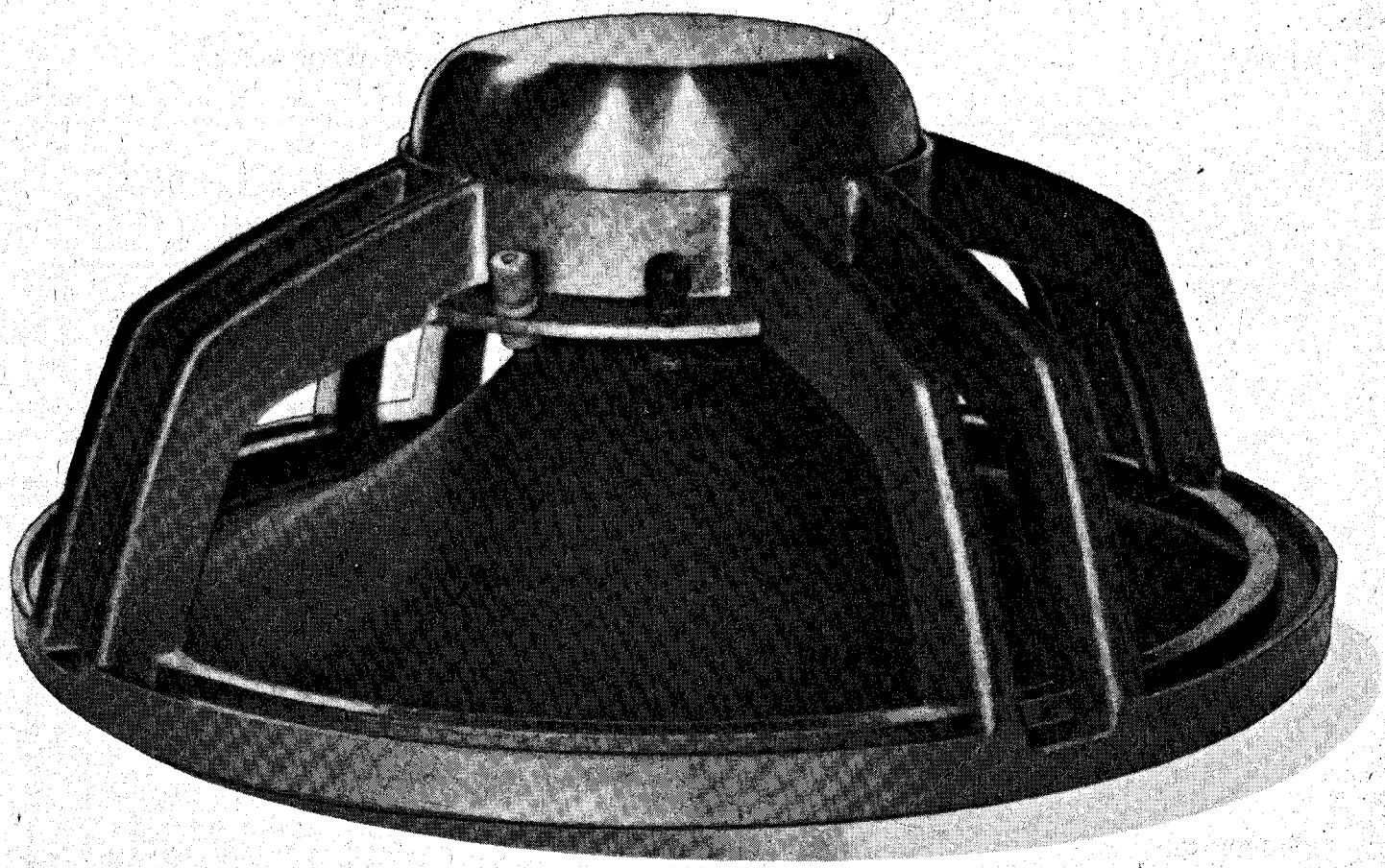
The most recent example from Lucas (UK) are Plastic Cable Ties, simple to use and ideal for the garage, workshops and D-I-Y enthusiast.

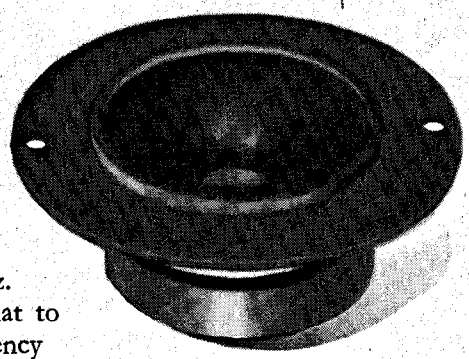
Made from 'heavy' strength plastic, the cable ties are extremely durable; oil, water and heat proof, and will undoubtedly last the life of the car.

To use, simply thread the tongue through the locking head and pull. The Cable Tie is self-locking and cannot be opened by inside pressure upon it.

Full details from Lucas Ltd., Great King St., Birmingham, England.

COMBINATION
-par excellence





MSP 15" Woofer model 15VAC fulfils a requirement where high power handling and quality reproduction of bass frequencies are of prime importance. It features a nominal 35Hz resonance and this coupled with an exponential cone form allows smooth frequency coverage from 30Hz to 6kHz.

2" Tweeter model 2MBC is designed to cover the range from 5kHz to 20kHz. The overall response is substantially flat to 20kHz, and the inherent low frequency roll-off below 5kHz permits the use of a simple 2mfd capacitor in series with the tweeter to accomplish a perfect crossover between bass and treble speakers. Complete speaker specifications & recommended enclosure designs are available on request.

M SP 47 YORK STREET SYDNEY 2000

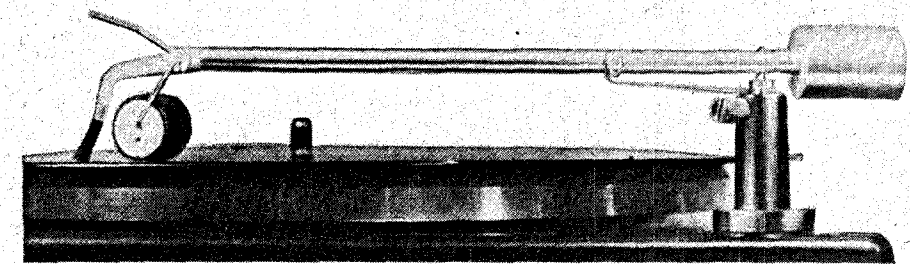
MANUFACTURERS SPECIAL PRODUCTS PTY LTD

ADELAIDE 51 0111 BRISBANE 31 0341 HOBART 34 3836 LAUNCESTON 2 1804 MELBOURNE 67 9161 PERTH 28 6400 SYDNEY 2 0233 & 29 7031

AD16

AUDIO NEWS

GROOVY



Shown above is the latest BIB accessory – the Groov-Kleen model 40. This record cleaning device, like a miniature pickup arm, tracks the disc carrying a brush and a roller to collect dust. Special features are counterweight adjustment and simple self-adhesive fixing to the record cover top-plate. The device works so well that one can almost forgive them for using a name like Groov-Kleen.

SPEAKER PHASING

Loudspeakers in a stereo system must be connected in the proper phase. This means that the speaker diaphragms must move in the same direction when identical inputs are applied simultaneously to both channels.

If the speakers are connected so that they are incorrectly phased the sound will be diffuse, lacking in bass, and producing an apparent source of sound that is jumpy and erratic.

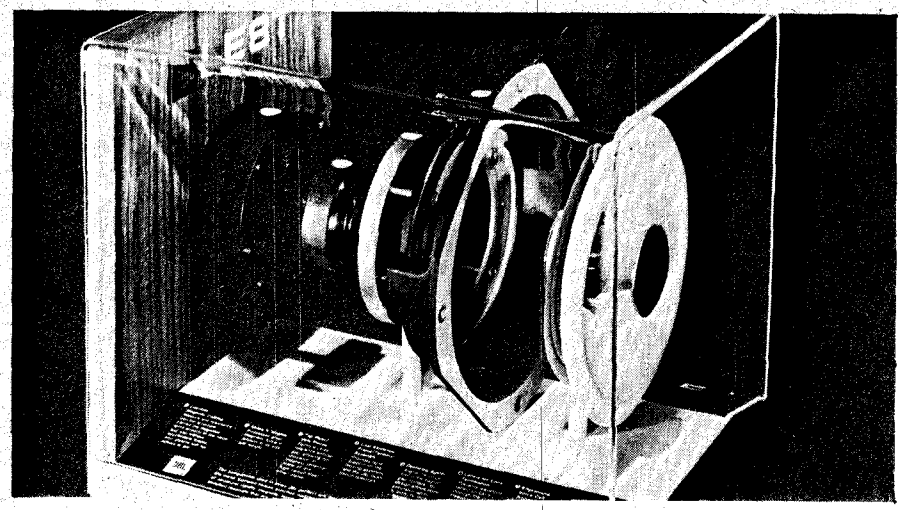
A positive way to check for correct phasing is to place the two speaker cabinets side by side and to listen for changes in the bass response as the leads to one speaker are reversed. The correct in-phase connection will produce the greater bass output.

Once the correct phasing has been established, mark all leads and speaker connections accordingly.

DEMONSTRATION SPEAKER

This dismantled type LE8T has been produced by JBL to illustrate the manufacturing techniques used in the construction of their products.

We understand that the display unit will be available to dealers toward the end of November.



JP RECORD PLAYER

Zephyr Products have announced that the JP Stereo Record Player TP 601 is now available. The unit may be purchased with or without case and lid. The company are inviting trade enquiries – details from Zephyr Products, 70 Batesford Road, Chadstone, Vic. 3148.

HISS!

A new cassette noise reduction system has been developed by Philips in Holland. Unlike the Dolby system, the Philips technique operates only on playback.

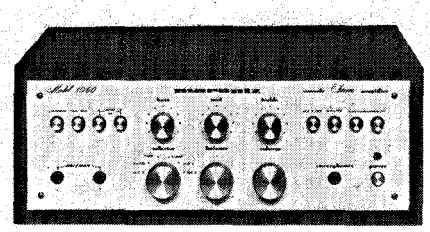
The system operates by splitting high frequency signals into two channels. For signals of 38 dB below reference and higher than 4 kHz the levels in the two channels are of equal magnitude but opposite phase and so cancel each other out. High level signals above 4 kHz are not affected because tape hiss is then masked by the programme material.

The Philips organisation say that their new system (known as DNL – Dynamic Noise Limiting– will add about $25 to the cost of a cassette deck.

In the same way that they licenced other manufacturers to produce their cassette machines, Philips are said to be planning to make their DNL system available to other manufacturers without cost.

AUDIO NEWS

MARANTZ ENTERS LOW PRICE FIELD



The Marantz Company (USA) is entering a new market with a line of low to moderate price components.

The Marantz Model 1060 Preamplifier/Amplifier, offers an impressive list of features for its low price. The two front panel microphone inputs make this model a "natural" for amateur rock groups, combining the capabilities of a stereo public address amplifier with microphone mixing and with those of a complete stereo home music system control amplifier.

The preamp and power amp sections of either or both channels can be operated as separate components. The three-zone stepped tone controls offer more precise accommodation to difficult acoustic environments.

The Model 1060 Amplifier section delivers 60 Watts RMS continuous power, both channels driven at, or below, rated distortion from 20 Hz to 20 kHz, into 8 ohms (30 Watts per channel).

The total harmonic distortion is less than 0.3% for any frequency from 20 Hz to 20 kHz, at full rated power or below.

The compact unit measures 14¼" W x 4¾" H x 12" D.

The Marantz Model 1030 Console Amplifier, with one microphone input is the first truly low priced unit offered by Marantz. It includes many of the features of the Model 1060, with only a decrease in power. The 1030 RMS power rating is 30 Watts into 8 ohms, both channels driven at or below rated distortion, from 40 Hz to 20 kHz (15 Watts per channel).

Either Console Amplifier matches in size and styling the companion Model 110 AM/FM Stereo Tuner.

The new line marks a dramatic move for Marantz into the low and medium priced component market. Although the company will continue to manufacture and distribute the recognized line of components in the higher priced range, the new line also contains the same advanced engineering specifications and the careful attention to detail of all Marantz units. The distinguished appearance of these components are in keeping with Marantz' tradition of styling.

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RECORDINGS... CLASSICAL

REVIEWERS: John Clare, Christopher Wagstaff, John Araneta.

SHOSTAKOVICH — Symphony No. 14 Margarita Miroshnikova (soprano), Yevgeny Vladimirov (bass), Rudolf Barshai, Moscow Chamber Orchestra HMV ASD-2633.

Political considerations have always prevented more objective critical views on Shostakovich's works. A work like Symphony number 12 is a finer work to my mind than either number 11 or the better known number 13 "Babi Yar" but is always underestimated not so much for its obvious banalities but because to most minds it was written to commemorate the 1917 October Revolution.

The myth of the "poor" Soviet artist writing to satisfy the needs of the State dies hard. Everyone seems to forget that the ubiquitous and admired Fifth Symphony was also ostensibly written to commemorate the 20th anniversary of the Russian Revolution. In fact Shostakovich has written "political" works on his own initiative, and the results have sometimes been worse than State-commissioned works (i.e., the "Leningrad" Symphony). The fact that there may be less freedom of choice for the composer, or that quite a number of Russians have produced nothing more than "trash" for State commissions, proves nothing. We are also, after all, not in a position to determine when a composer like Shostakovich writes music simply and then uses this same music for ostensible purposes, much as any composer has done for hundreds of years. But an even more disturbing lack of objectivity is present with the almost unanimous acceptance of Symphonies 13 and 14 as among Shostakovich's finest. Humanitarian documents these symphonies certainly are – but they are not less political for that reason, nor are these recent examples of "protest" fine works because they are humanitarian.

This latest symphony of Shostakovich is attractive mainly because it uses texts unusual for a Soviet artist: Rilke, Lorca, Appollinaire, Kuchelbecker – all condemmned at one time or another as decadent aesthetes by Marxist policy-makers. Even more striking is the fact that the language is always strong and criticism of government can hardly be described as veiled.

But what of the music? Alas, this symphony owes far too much to its dedicatee, Benjamin Britten. Shostakovich is undoubtedly the most important Russian composer for the voice since Mussorgsky, but here even his vocal writing is more reminiscent of Britten. This influence of Britten on a Russian composer should not be surprising in itself since Britten's work is apparently very much admired in Russia, and the success of his Pushkin settings in the cycle 'The Poet's Echo' has undoubtedly sparked interest because of its novel approach to the problem of setting Russian. It is surprising that no critic has to my knowledge compared the vocal writing in this symphony to the less derivative, powerful writing in 'Katerina Ismailova' and 'Stenka Razin.' Even the orchestral writing here is derivative. Shostakovich is not content to assimilate Britten orchestral technique, he must also use very characteristic Britten devices (note especially the orchestral writing in the second song, which is almost literally lifted from the Frank Bridge Variations).

There are undoubtedly very moving moments nevertheless, especially the settings of Appollinaire's 'The Suicide' and 'In Prison'. Performance is excellent – and while two more (!) recordings of this work are soon to be released, one can hardly go wrong by acquiring this one. Recording fine, and the surfaces on my copy are good. – J.A.R.

BARTOK Concerto For Orchestra, Divertimento. Hungaroton, Stereo, LPX1143. Hungarian State Orchestra conducted by Antal Dorati.

My feeling about this performance is that Dorati has got it right – I recommend it without hesitation, despite the dull sound – but that he could have given us a little more. It is if anything a shade too careful. The orchestra is contained, almost to the point of remoteness.

The low strings for instance, seem not quite dark and sombre enough in the introduction, though the playing has the calm gravity one would desire. I thought too that the trumpet statement of that lofty theme which is taken up again in the third movement could have been a little broader, more instinct with restrained passion. Not that I would have wished for rubato, rather a slightly broader treatment of the semi-quavers without time alteration. The high string statement of the theme is suitably grand, with the appropriate hint of resignation, but it could have been made a little more spectacular without distorting its expressive function.

The upward flourish of the main theme and its immediate inversion, signal a splendid play of alternating rhythms and energies, calm interludes and a vigorously rocking canon for brass instruments. The attraction of this movement, and indeed the whole work, is that its rhythmic variety and strength never break the feeling of calm and lucid thought, of passion contained and reflected upon. I felt that Dorati could safely have rendered it with just a little more gusto.

The third movement, which is broadly a continuation of the introduction of the first, contains the most concentrated poetry, and here I think is where restraint is most successfully applied to this work, without cancelling in the listener's mind the possibility of another kind of success. This is like great poetry read into a microphone for radio broadcast rather than from the stage. The beautiful lament which emerges after the soaring entry of the high strings is no less beautiful for being intoned intimately and without a great deal of emphasis. Yet it is also possible to have it emerge groaning with intensity like a great line from Shakespearean tragedy.

The fourth movement contains many seemingly incongruent elements. After a somewhat monumental burst of rhetoric, a brittle and delicate melody is played by the woodwinds in bars of two four time succeeded by five eight; the first bar of five eight being an emphatic triplet, the feeling of a very esoteric dance is created: folk-like yet more subtle, even surreal, in nuance than one would expect of peasant folk – and of course one is always surprised. The beginning of a broad waltz motion stirs with the succeeding melody, but this is deflected by another bar of five eight, keeping the emphasis on the melody, which is a lovely one. All of this is interrupted by a tune of surpassing banality, and there follow various satirical effects, including a jangling dissonance which one could imagine being used at the climatic point of some particularly insane circus act. It is generally held that these coarse interruptions represent the crude liberties taken with Hungary, the composer's homeland. Bartok was in exile in the United States when he composed the work in 1943. It is well that the corny bits have not been overplayed, for the movement is obviously more than a collection of musical send ups.

It is well too that the hurtling release of the final movement is not prodded into frenzy. The playing here is galvanising enough, the ultimate heroic transformation of the trumpet theme certainly enough to bring me to my feet. As I have pointed out before, this work is a serious one, no mere compendium of devices, but it does represent a kind of summary, synthesis more accurately, of the composer's work, and serves too to whet the appetite for more of the music of this century, much of which has hither influenced or been influenced by Bartok.

The Divertimento was also written at a time when Bartok feared for the future of

CLASSICAL

Europe (1940) and it is certainly easy enough to feel the composer's anxieties in the work, but as with all great art it can be fully appreciated with no programmatic knowledge. It is not so harsh as the String Quartets, though very similar figures are occasionally used.

Far from being a depressing work, it is on a sensual level most pleasing, and on the emotional level it strikes me, like the Concerto For Orchestra, as an affirmation that man's existence is 'worthwhile' at least on the subjective level, despite outward uncertainty. This performance evokes perfectly that sense of carefully developed inner calm played over by the nervous stirrings and alerts of a highly tuned sensitivity. The recorded sound seems to be a little better than for the concerto, but it is still far from being satisfactory. Excessive surface noise occurs at various points of the recording. – J. C.

BERLIOZ—REQUIEM OP. 5. London Symphony Orchestra and Chorus, Wandsworth School Boy's Choir, Ronald Dowd (tenor solo), conducted by Colin Davis. PHILIPS 670019.

Colin Davis' ability, vigour and enthusiasm in Berlioz is always impressive.

This is no exception.

From the opening phrase of the "Requiem et Kyrie" to the coda of the "Agnus Dei" Mr. Davis' dramatic conception of the score is strongly evident and his understanding of the whole work (in which each phrase has significance) is outstanding. His ability to interweave the different lines of counterpoint, such as the falling chromatic countersubject of the strings in the "Requiem et Kyrie" or the unvarying chant of the chorus against the long sinuous melodic lines of the orchestra in the "offertorium" is superb. These different lines are themselves beautifully phrased. Pauses are also well handled – the effect of the pause after the mildly radiant climax of "Et ab haedis me sequestra" (from the "Quaerens me") and before the entry of "Statuens in parte dextra" being most moving. Changes of mood (and there are many) are on the whole well managed – the effect of the awed whisper of the choir to the words "Judicanti responsura" after all the excitement of the brass and percussion episodes is notable. I did not feel, however, that there was enough contrast in mood between "Pie Jesu, Domine dona eis requiem" and the feeling before it of being inexorably pushed forward.

The London Symphony Orchestra is in excellent form throughout. The effects of four brass choirs scattered throughout Westminster Cathedral are really splendid, and the thunder of tympani and drums, together with massive brass chord clusters, is breathtaking (helped, no doubt by the acoustics of the Cathedral). Solo playing is often very effective – the sighing phrase of the cor anglais in "Quid sum miser". The strings (especially cellos and double bass) have a luscious tone in the spaciousness of the Cathedral. Some of the pedal notes of the trombones in "Hostias" (and again in "Agnus Dei") are not, however, always exactly in tune with the chorus and this is annoying. Otherwise, the orchestra fully responds to the demands of Davis' interpretation.

The unaccompanied singing of the London Symphony Chorus is very good and the blending of parts (helped again by the acoustics of the Cathedral) is excellent – the chorus does a beautiful rendering of "Quaerens me".

With fine help from the Wandsworth School Boy's Choir the chorus achieves a bold and lusty sound for the loud sections of the work which is quite effective. However, in many of these sections the men's voices (especially the tenors) are often slightly under pitch and in some places their voices sound strained (perhaps due to the shortage of members — ! – Ed)

This is *most* disturbing – especially in the interweaving of different lines. If this fault could have been rectified what an excellent rendering of the Requiem this would have been. Nevertheless, the singing is full of feeling and the chorus responds well to the conductor's demands.

Ronald Dowd sings very expressively in the "Sanctus" and a wonderful effect of stillness is created beneath the soloist by long solo flute notes, soft tremolandi of violas and radiantly celestial phrases by the chorus.

To conform with Berlioz' ideas of "sound within space" the recording was made in Westminster Cathedral (London) and as I mentioned, the acoustical results are often quite thrilling. Philips' engineers have judiciously ensured that there is clarity for the counterpoint, (an essential in a work of this kind) as well as the appropriate depth and atmosphere which helps to hold the work together far more easily than if there was no reverberation whatsoever. The sound is excellently spread and the antiphonal effects of the brass choirs are effectively realized.

Certainly a most valuable addition to the Colin Davis Berlioz cycle. – C.M.W.

IGOR STRAVINSKY — LE SACRE DU PRINTEMPS APOLLO Ansermet, Suisse Romande — Ace of Diamonds SDD-243. Stereo.

Records like this often make one wonder how much music can actually be managed on a single disc if a recording company felt willing enough.

This is not the first time 'Le Sacre' has been coupled with another Stravinsky work on a disc; there is first of all DECCA's older recording of the work now on ECLIPSE and if memory serves an ancient American Columbia coupled its 'Rite' with either 'Firebird' or 'Petrouchka'.

At the price ($4.15) this record is certainly an excellent buy. While the recording has a slightly gummy atmosphere compared to more modern releases, the overall sound of the disc is good enough. Most important, however, this record preserves one of the best Stravinsky interpretations on record. That of 'Apollo'. The grace and strength of Ansermet's reading is only surpassed by the composer's own and it is good to have it back in the local catalogue.

Ansermet's 'Sacre' is another matter altogether. When first released about ten years or so ago, this performance provoked a variety of opinions. I do not remember anyone ever saying it was bad but it is certainly different. Ansermet's 'Suisse Romande' is hardly impeccable but they do manage to put forth an interpretation of this score which is unique in that it is quite lyrical indeed.

Quite frankly, I can think of no 'Rite' in the current catalogue which is actually less than good, and each presents a different conception of the score from the composer's own to Karajan's, Bernstein's and that of Boulez. I happen to like this one very much, along with several others. – J.A.

Improvisations by Pierre Cochereau on the Organ of Notre Dame Cathedral — Paris. Philips (French) 6521008.

Cochereau's "on the spot" improvisations on virtually any theme have always attracted large audiences in France and abroad (including Australia). This disc is a fine example of his improvisatory powers. Here the works performed are based on popular French airs – the first side devoted to ten improvisations on "Alouette, Gentille Alouette" and the second to a suite (Prelude, Air, Gigue, Musette, Sarabande, Menuet, Toccata) each movement based on a popular theme.

What immediately becomes apparent is Cochereau's ingenuity. The diverse treatment that the "Alouette" theme receives is astonishing and the possibilities he opens up seem endless. His style is typically modern French with Dupre, Duriofle, (two of his teachers), Messiaen and Vienne the main influences. Mostly it is a curious mixture but sometimes one composer's harmony and forms dominate: the Toccata (Marche Des Rois) – Vienne, second improvisations on Alouette – Dupre, third improvisation on "Alouette" – Messiaen. Cochereau is not what one would call an original, but then he probably does not pretend to be. What is important is that he has wonderful control over these various harmonies and styles, and integrates them in a satisfying whole. Often he combines a strong rhythmic drive – the Toccata (Marche des Rois) almost sends you marching around the room.

Cochereau here has tamed the monster at Notre Dame and the number of possible combinations of sounds seems inexhaustable. Nothing particularly exciting about the organ except perhaps the strident en Chamarade "Trompettes" (used sometimes in announcing the theme or in full combinations of large chord clusters) or the raucous pedal reeds. For once the organ is in tune – on almost every record I have heard it has been consistently out.

The French frequently boast of their long succession of outstanding improvisers and somewhat reluctantly, here I must agree – Pierre Cochereau is an outstanding improviser. – C.M.W.

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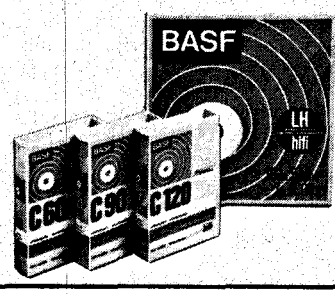

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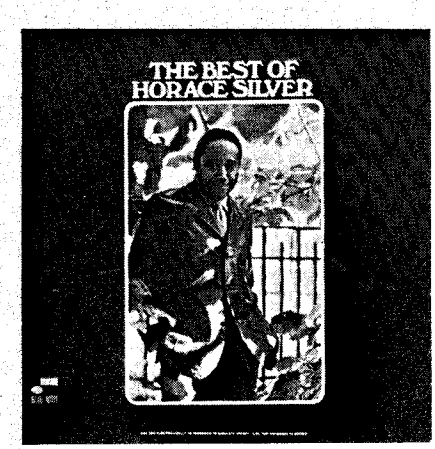
RECORDINGS... JAZZ

REVIEWERS: Merv Atkinson, Graham Bell, John Clare.



HORACE SILVER — The Best of Horace Silver. Blue Note, Stereo BST 84325. Senor Blues, The Preacher, Doodlin', Sister Sadie, Filthy McNasty, The Tokyo Blues. Donald Bird, Hank Mobley, Louis Hayes, Doug Watkins, Roy Brooks, Blue Mitchell.

During the late forties, early fifties, the wild attack and rococco complexity of bebop gave way to the subtle understatements and light swing of 'cool' jazz. By 1954 all these limpid, neat, smoothly planed sounds had begun to pall and the blues came back into jazz with two historic performances: 'Walkin" by Miles Davis, who had been largely responsible for the move to cool jazz, and 'The Preacher' written by Horace Silver and performed by Art Blakey's Jazz Messengers.

Acutally, neither of these tunes were strictly blues. 'Walkin" could be said to have been an abstraction of blues form. 'The Preacher' was based on the chords of 'Show Me The Way To Go Home' (once you know this, every time you hear one, the other will start playing in your mind), but both had the feeling of blues and gospel music, and they were played in what would seem to be the logical blues style of the time: With some of the ideas and attack to bebop, but less of the florid virtuosity.

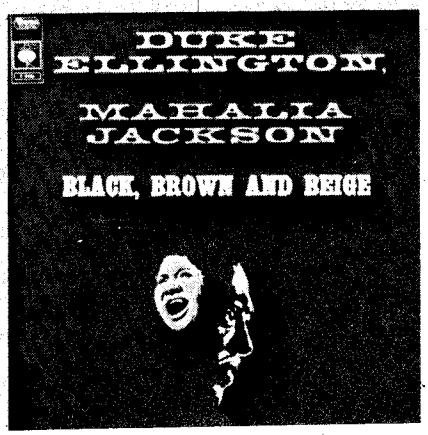
After leaving Art Blakey, Horace Silver led several groups of his own. If the performances on this recording are not the very best given by these groups, they are all excellent. It would, in fact, be difficult to imagine a dull performance by a group which included Silver's driving piano.

Trumpeters Bird and Mitchell are not great originals, but they sound quite distinctive even when playing the same funky cliches. Both are very lyrical, as well as being self-consciously hot. Mobley on tenor is even more his own man. I thought for a while of Flip Phillips and Lucky Thompson, but after playing a few records I decided that Mobley was just Mobley. He has a big airy sound, and he flows along quite irresistably, standing outside the rhythm occasionally to deliver some swelling oratory, before resuming his sinuous muscular progress.

All of these performances are exciting within the confines of a slightly tongue in cheek 'down home' format. Time has treated the music very kindly.

Side one is electronically re-recorded to simulate stereo, while side two was recorded in stereo originally. As usual the stereo simulation tends to gloss over true instrumental timbre, but this is not a bad example.

The sound generally is more than adequate. – J.C.



DUKE ELLINGTON AND MAHALIA JACKSON Black, Brown and Beige. French CBS, STereo S 63363.

Black, Brown and Beige was the first of Ellington's suites. Due originally to a recording ban, and then as a result of Ellington's deciding to discard part of it, the complete work has never been recorded. This version is minus the 'Three Dances' and the record is filled out by an uninspired setting of the Twenty Third Psalm for Mahalia Jackson. There was another recording of Mahalia Jackson singing the 'Come Sunday' section of Black, Brown and Beige, as she does here, which was somewhat superior to this one, as I recall.

However, this is far from being a poor performance and for anyone interested in the music of Duke Ellington, or in American music generally, or in all rare and intriguing music, it is an essential buy. I don't think that this work displays Ellington's orchestral command so strikingly as does that other recent Vanguar import 'A Tone Parallel to Harlem' but the master's reputation would be secure if it rested on work of this quality. What it does more obviously is demonstrate that Ellington, with his late colleague Billy Strayhorn, must be placed amongst the great American melodists, along with Stephen Foster, George Gershwin, Thelonius Monk and the rest.

The 'Come Sunday' theme is foreshadowed in part two when a broad open trombone plays an altered version of it against minor harmonies in the reeds, which rather than creating a mournful atmosphere evokes a kind of remote, barely imaginable peace and quiet. This feeling is interrupted by one of those shining brass chords which suddenly ascend like a periodic fountain. Ray Nance takes you out again to an obscure but fruitful and soothing region with his highly individualistic pizzicato style before playing some rhapsodic bowed violin. The theme is played again by a tenor saxophone (Paul Gonsalves) against trombone harmonies. It is sung by Mahalia Jackson in part four, and played yet again by Ray Nance on violin. It is a lovely melody, one which lulls you with its apparent predictability, then takes you all unawares with an unusual and beautiful turn of phrases.

This is not a great performance by Mahalia Jackson, but it is certainly not a bad one. It is just the difference, it seems to me, between a concert performance and a studio recording, as this one seems to be. Nance plays well. I happen to be one of those who like his playing. Often rather primitive on trumpet, he shows quite a sophisticated harmonic ear on violin. His sound is really very fine, and sometimes he is very moving as on an Ellington recording of the Fifties, 'Ellington Indigos'.

Beautiful Harry Carney solo. This section is full of melody and excitement. I would dearly love to hear it in concert.

Part three begins with the glorious open trumpet of Harold Baker, an unmistakable sound, after which many of the great Ellington sounds pass in a joyful and swinging procession, in fact, a series of variations on a theme for reeds from the first part and the 'Come Sunday' melody. Although it is a suite of separate sections it is unified by this carrying over of melodies from one section to another.

The problem with writing about this music is that one tends to destroy credibility by being too unstinting in one's praise. This is the only reason why I may have appeared to emphasise the negative aspects. This is splendid music, quite adequately recorded, and a must for the serious collector. – J.C.

JAZZ

THE JAZZ MAKERS — "I've Got What It Takes". Lazy Ade and his Late Hour Boys. Ade Monsborough (leader, trumpet, alto sax, tenor sax, clarinet, violin) Neville Stribling (clarinet, alto sax, baritone sax), Des Edwards (trumpet), Bill Miller (washboard), Len Barnard (drums, tambourine, piano, washboard, woodblock), Peter Cleaver (banjo, tenor, guitar), Norman "Bud" Baker (guitar) Ron Williamson (tuba), Joe McConechy (bass), Vic Connor (piano), Swaggie, Stereo S1273.

There is a distinct "Melbourne Style" of jazz just as there is a distinct Chicago style, New Orleans style and English trad. style and this record personifies it.

The music comes under both traditional and mainstream categories and can best be characterised as "happy jazz" like that recorded by small American groups, black, white or mixed in the late twenties and the thirties.

The whole atmosphere is informal, many of the musicians switch about on a variety of instruments and not all play on every track.

To list the various changes on every number would take more space than is available and would serve no good purpose as the whole record is a bonanza for those who go for swinging, light hearted jazz with creativity and taste.

The boys strut through "I've Got What It Takes", on which Ade sings as he does on "Won't You Come Home to My House Baby" and "Who Stole the Lock?". His instrumental work is, thank goodness, far, far superior to his singing and although he plays in a variety of styles from gutsy to lyrical as he changes from one to another, the only one on which he does not seem entirely at home is the violin, an indifferent instrument for jazz at any time.

He plays it, however, on only one track "I Must Have That Man", and then reverts to blowing the wind instruments he has been famed for over the years.

Other tracks include "The Jazz Parade", "Don't Go Away", "Lazy River", "Sunny Side of the Street", "Rain", "Make Believe" and "All Steamed Up".

Des Edwards, who seldom records, makes a welcome appearance playing trumpet in both his melodic and hot styles. In either one his work is easily distinguished from the polished Bobby Hackett sounds of leader Ade, when he plays the same instrument.

On some of the tracks Ade and his old confrere Nev Stribling weave some beautiful effects.

The ensembles which are strictly ad lib – (Ade is no believer in the over-rehearsed, smoothly polished arrangement) – are what you would expect from experienced, stylish jazzmen – hard hitting, accurate and forceful.

In all, the whole performance is a welcome expression of present day Australian small band jazz at its best.

All tracks were recorded in Melbourne on August 1, 1970.

The excellent descriptive liner notes on the back of the cover were written by drummer, Len Barnard. – M.A.

STAN KENTON The Kenton Era. The Creative World, stereo, ST1030. Four record set, including prologue.

Once again this is available only through the CREATIVE WORLD, Box 35216, California 90035. Many Kenton fans will have worn out copies of this fascinating set, which has not been available in this country for about nine years. Accompanied by a lavishly illustrated booklet, these recordings trace the development of Stan's music from the end of the swing era to the late 1950s.

This is not the place for a full scale summary of Stan's successes and failures, but a few remarks seem in order. Kenton was a man not only fascinated by sound but capable of generating through it great intensity. The main artistic problem afflicting him, and those who came under his influence, was a tendency to overheat, to pile on more and more until the impulse underlying the music broke down under the weight of the means used to express it. Kenton's worst efforts were thus gargantuan and cold. His best were either extremely exhilerating or, like the splendid 'Interlude', calmly satisfying.

Many of his innovations did not arise from the main stream of jazz, as did those of Gillespie and Parker (despite the possibly unconscious absorption of classical influences) but were rather grafted onto it. Much of this hybrid music is a valid and absorbing expression of a peculiarly American spirit.

The first side of this set, recorded in 1940 and 1941, sounds very much like an extension of the Benny Goodman style. In fact, it is usually in the introduction to tunes, or occasionally in the verse, that 'modern' voicing is employed. I find this music highly enjoyable, not least for nostalgic reasons. It is a very strange thing when one can feel nostalgic about something that was happening around the time one was born. Then, I feel nostalgic about Benny Goodman and Glen Miller. The answer I suppose is that the music has nostalgia deliberately built into it to begin with, and that is what places it at a slight remove from my idea of great jazz. But one can hear Stan trying to break out of it, to create something more immediate, stronger and more serious. They do sound less like a show band, or a clipped dance band than Benny Goodman's splendidly disciplined team, and I enjoy them more. Some tracks are still very exciting.

"Russian Lullaby" recorded in 1944, is the first track which sound distinctly Kentonian throughout. The arranger was Joe Rizzo. 'Opus A Dollar Three Eighty' arranged by Pete Rugule, again points to the future, particularly in the reed voicing. 'I Know That You Know' arranged by Joe Rizzo, includes some of the brass figures that Kenton uses to this day, as well as ending on one of his most familiar chords. Anita O'Day's vocal on I'm Going Mad For A Pad' is the first departure from the swing era vocal style, though it is a fairly typical swing song, and there is plenty of that nauseating swing-era cuteness in the lyrics.

Generally, though the swing era feeling still predominates, and Stan's sounds continue to be grafted to a swing era concept until around 1948, when it seems that he has probably influenced by the Gillespie band's use of Latin Rhythms, and he also began to incorporate more of the devices of classical music from around the 1920s, notably Stravinsky. This is not such an odd combination. Stravinsky's own purpose, at least in Rite of Spring, was to use savage dissonance in conjunction with a relentless rhythm to unleash a 'primitive' dynamism.

Stan was apt to overdo it, to say the least, and the fire was often smothered by the orchestration. 'Machito' while not great music, is exciting enough, with all its obvious use of dissonance. Chico Alvarez plays beautiful trumpet with a fine steely sound. 'Artistry in Harlem 'Swing' features the fine trumpet of Ray Wetzel who seems to have been influenced by Fats Navarro and is one of the first of Stan's soloists to show a strong bop influence. 'Elegy for Alto', a serious slow piece, is full of interesting sounds and harmonies, which there seems no compelling reason for having together. The rapturous style of the alto bears little relation to the cool panels of sound over which it slurs and throbs.

Several variations of the Latin formula follow, one of which is pretty close to Muzak, some using an orchestra of symphonic proportions. Though it was probably enormously exciting to be there when it was played, much of it does not bear repeated listening. It's best to hear these tracks in isolation from each other.

The final side has some very good stuff. 'Swing House' 'Bill's Blues' and 'Zoot' sweep along unimpeded, and have good blowing from Conte Candoli, Lee Konitz, Zoot Sims, Lennie Neihaus and Richie Kamuca. 'You Go To My Head' presents the coiling stem mutes and the undulating walls of sound of a typical Bob Graetinger short arrangement, and all of it is remarkably apt to the particular tune. Certain dissonant brass chords have a kind of graphite texture. Kenton's brass did have a timbre all their own.

This is quite a representative set, and there are many fine musical moments in it, but I don't feel that it includes the very best of Stan Kenton. There are no tracks, for instance, from 'Kenton Hi Fi' or 'Cuban Fire'. Even the worst of it is worth having, however. I for one, envy Stan his mad exaltation when he stands in front of his truly awesome band. There is quite a bit of surface on the early sides, and even the final tracks do not come up to the best hi-fidelity standards of the Fifties. – J.C.

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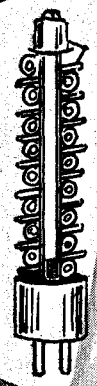

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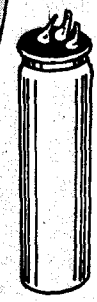

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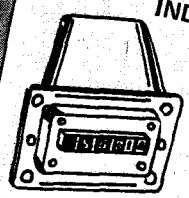

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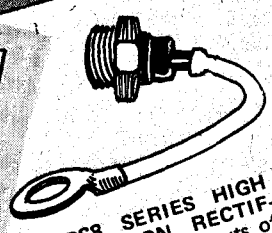

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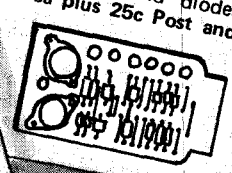

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RECORDINGS... POP TRENDS

REVIEWER:
John Clare.

LITTLE RICHARD — "CAST A LONG SHADOW" Double Album Good Golly Miss Molly, Long Tall Sally, Tutti Frutti, Lucille, Jenny Jenny, I Need Love, The Girl Can't Help It, Don't Deceive Me and many more. Epic 2ELPS 0004, Stereo.

The rock and roll revival has finally arrived in all its lurex glory.

I think it began with Creedence Clearwater, who were mysteriously labelled as a heavy rock group. It is a vindication for those who always claimed that pop music is really about 'Wop-bopalu-bopalop-bam boom' rather than 'Give Peace A Chance' or 'The Times They Are A Changin' or other such portentous messages. Part of me is with them.

No one can pretend now that pop music is our folk music, our art music, our poetry, our all. On the other hand, the pretentions of some pop music did bring its listeners to the point where they would actually listen to some of the enormous wealth of music and literature which seems doomed to remain the property of an often snobbish and undeserving minority.

Anyway, for good or ill, old rock and roll stars are now crawling out of the woodwork everywhere, hoping to be 'revived'. Some of them belong in obscurity, others, like little Richard, are too much larger than life to live anywhere but in the spotlight.

I first heard Little Richard in my early teens, but I have often wondered why I seemed to remember his frenetic cadences from very early childhood. It came to me just the other day as I lay on my back in a suburban garden listening absently to the muffled but rising frenzy of a race broadcast issuing from a portable radio several backyards away. Little Richard is a bit like a souped-up race commentator. But, really he is a bit like all senselessly aroused passion, all uncontrolled rhetoric: the sound of adults screaming at each other inside the house, of an incensed speaker in the Domain; but Little Richard takes that wild fervour and he pokes fun at it, he exaggerates it, and it comes out as a glorious release.

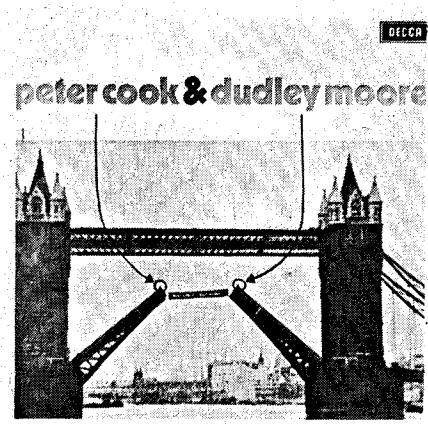
Apart from all that, Little Richard is still, as he claims repeatedly on this recording, the best looking man in show business.

One of these recordings was made at the 'Okeh Club' before an ecstatic and adoring audience. It contains most of the old favourites, and it has previously been issued as "Little Richard's Greatest Hits". Unfortunately, you only get a chorus of most of the songs, only one of Richard's electrifying breaks, and the crazy sax solo. However, the rhythm section throughout is like a big machine and the momentum is irresistible.

Richard's breaks are not quite what they used to be: for delicately controlled abandon and a certain kind of rhythmic sense Richard has only been surpassed by one other singer. He is Ray Charles. If you haven't heard him sing 'Let The Good Times Roll' you've missed the ultimate in this kind of performance. It's on 'The Genius of Ray Charles' and it may be reissued one day. To return to the record in question, the sound is probably as good as you could get with so much audience noise. The excitement is all there.

The other recording is a collection of soul and blues material made in the studio with a very crisp band and a few singers. This has previously been issued under the title 'The Explosive Little Richard'. The Ray Charles influence is very heavy here, even in Richard's fine blues piano. Richard shows that he can really sing the blues as well as rave, and for me this is ultimately the more satisfying record of the set. The sound is sharp and clear.

All in all an indispensable double album for Richard fans, big or little. — J.C.



PETER COOK & DUDLEY MOORE Not Only But Also, Decca, Mono LKA5080. Dud Dreams, In The Club, Lengths, This Is Ludwig Van Beethoven, The Making Of A Movie, O O Dud.

There is not much doubt in my mind that Pete and Dud comprise one of the great comic duos.

They are as good as ever, despite having worked for quite a stretch on TV, a voracious devourer of talent. There are quite a number of remarkable comedians in England who would not stand up to the same exposure, including Ronnie Barker, Marty Feldman and John Clees. They are extremely funny to watch, yet nearly all their acts contain enough verbal wit and continuity to ensure them success had they been presented first on radio or record. The same could not be said of Morecombe and Wise, for instance.

Few comedians of the past presented such a range of situations. None to my mind has been so successful in making even quite esoteric areas seem funny to a fairly extensive audience. But then, few comedians of the past were Oxford graduates.

This recording was taken straight from a recent "Not Only But Also" series, and one hardly misses the visual element.

In 'Dud Dreams' Pete gives a deadly earnest and hysterically funny Freudian analysis of Dud's dream, which involves passing through many doorways and eventually climbing into a cupboard. Let me give one gag away to whet your appetitite. After Pete has explained that the sexual drive underlies everything, giving as an example the symbolic act of rape involved in merely opening the pages of a newspaper, Dud says, "Blimey, I've just given the TV and Radio Times a right going over!"

"In The Club" is a conversation between two drunk and senile old badgers in a gentleman's club. There is a priceless defence by Pete of the sobriety of newts, following a remark by Dud which was snipped out of the TV programme by our vigilant censors.

"O O Dud" is one of their classic routines in which undersized Dudley's fantasy life runs riot as he rehearses for the part of the new James Bond. The funniest and most relaxing record I've heard this year. — J.C.

JOSE FELICIANO Encore, RCA SP-105, Stereo. Hi-Heel Sneakers, Rain, Pegao, Susie Q, Wichita Lineman, California Dreamin', Hitchcock Railway, Destiny, Nature Boy, Malaguena, Life Is That Way, Light My Fire.

Feliciano's is a hybrid style. He's obviously influenced by the blues, by Ray Charles in particular, and by contemporary rock. But there's a hint of the flamenco singer in the timbre of his voice, and in the long wailing ornamentations. He is probably too musical and maybe not powerful enough to be happy as a flamenco singer. I think that what he is doing is probably right for him, and he can be an extremely moving performer. Not everybody likes his SOUND. I do, though it was an acquired taste.

This is not a consistently exciting album. 'Destiny' is a complete loss. 'Nature Boy', one would have thought Feliciano had the naivety to render convincingly, but it turns out to be no more than pleasant. It's no more than a pleasant bit of nonsense anyway, but Nat King Cole managed to inject it with something special. Most of the other tracks are good, easy listening, but 'Hi-Heel Sneakers' and 'Susie-O' have Feliciano near his sensuous best.

'Light My Fire' is a concert performance, and it has all the familiar embellishments, including the almost double-time repetition of the title. Recording quality is generally fair. In summary, a pleasant recording with one or two stand outs. — J.C.

VOLUME BINDERS

Following numerous requests from readers, we are arranging to supply volume binders for ELECTRONICS TODAY. Details of price and availability will be announced shortly.

POP TRENDS

AUSTRALIAN ARTISTS Down Under. Stereo LW 3322. Waltzing Matilda, Oh, the Springtime it brings on the shearing, Botany Bay, While The Billy Boils, Brisbane Ladies, My Country, Down Under, Along The Road To Gundagai, Click! Go The Shears, Wild Rover No more, The Dying Stockman, The Girls of Broome.

Folk music enthusiasts are warned to stay clear; this will give them apoplexy. Which is to say that I think the new Australian label M7 have got a commercial winner on their hands with this recording.

I have heard many lovely Australian songs, such as 'The Banks Of The Condamine' and 'The Wild Colonial Boy' which should be collected on record again. I hope that M7 will consider this. In the meantime, they've gone mainly for the songs which will fit a smooth, singalong format, though, I hasten to add, there are some good ones here. 'Waltzing Matila' is, well, 'Waltzing Matilda'. It's sung in competent straightforward bouncy fashion by the Sundowners, and that is how most tracks are performed. There is no real attempt at authenticity. The Riders From The Never Never who sing 'Brisbane Ladies' are the only ones with even a marked Australian accent.

The only convincing rendition of 'Along The Road To Gundagai' is a slightly drunken one, but the Rhythmaires sing it with no trace even of a hangover. 'The Dying Stockman' should be wildly exaggerated. Warren Williams overdoes it allright, but not enough. He sounds as though he could be serious. 'While The Billy Boils' is sung in a chaste soprano by Ann Sidney.

There is nothing wrong with any of these performances, but do not look for any of the bawdy old Australian spirit which inspired some of the songs. It's a singalong really, and I think a lot of people will want to have it. To each his own. Recorded sound is adequate, but rather shallow. – J.C.

THREE DOG NIGHT Golden Biscuits. Probe (EMI) Stereo SPBA 3019. One, Easy To Be Hard, Mama Told Me, Eli's Coming, Your Song, Celebrate, One Man Band, Out In The Country, Nobody, Woman, Don't Make Promises, Try A Little Tenderness.

Three Dog Night used to be a pretty wild blues-rock group, They've toned it all down these days, and they concentrate on pop standards on this disc. They still get quite a bit of drive into their pop version of gospel harmony singing, but gone are the long wailing guitar solos, and in their place are simple, workmanlike arrangements utilising mellow and pretty sounds, including an instrument which I cannot identify: whatever it is, it makes use of a weird mechanical reverberation, and it reminds me of some very old fashioned instrument which I cannot think of – a calliope, or something of that order. Anyway, I won't torment myself over it anymore; perhaps a reader might know what it is.

Generally, this music needs to be heard at high volume, preferably through headphones, or it becomes mere background. This is because the arrangements are predictable, though satisfying, and the songs are not very compelling. Nillson's 'One' (One is the Loneliest Number) is one song I can do well without, using as it does such Rod McKuen style gimmicks as the treatment of an adverb as a noun, vis the line, "No is the saddest experience".

The most exciting track is 'Celebrate' which uses a repeating phrase against everything they could throw in, including some brass, blended well into the mixture. 'Try A Little Tenderness' is quite tasteless. I am tired of hearing this old song being given an aggressive 'soul' treatment.

All of the vocals are recorded with a great deal of resonance, and all sounds, even that of an ordinary piano, are coated with an electronic gloss. Drums are not to my ear quite sharp enough, and the bass is underrecorded, which is most unusual for recordings of this kind. – J.C.

J. B. LENOIR Alabama Blues. French CBS, Stereo SBP 233977. Alabama March, Alabama Blues, The Mojo Boogie, God's Word, The Whale Has Swallowed Me, I Feel So, Talk To Your Daughter, Good Advice, Vietnam, I Want To Go.

Most people who have used the blues as a vehicle for contemporary social or political comment have smoothed the form out quite a lot, dispensing with the ingenuous but exciting and humorous practice of suddenly cramming a whole string of syllables into the space where there should only be one or two notes, applying conventional 'good vocal technique' to high phrases, instead of those nasal, almost piggish, painfully forced head tones. This last technique can be unbearably moving. I will never forget an old chain-gang song I heard sung in England, one part of which goes: "Oh Lord, those Gorgia girls, they do the sweetest jelly roll". When you sing a line like that, it's got to be swine-toned and earthy.

I think J. B. Lenoir could carry it off. Could have carried it off, rather. He died a few years ago. He was really an old time blues singer, though he sang quite often of contemporary matters, as well as such timeless concerns as women and booze, hard luck and feeling good.

Apparently both John Mayall and Frank Zappa had hailed Lenoir as the greatest living blues singer. I wouldn't have quite gone along with that, but I liked him a great deal. He accompanies himself, apparently on the ten dollar acoustic guitar he prefers, and he is joined on some tracks by a drummer. If you want to hear an authentic blues sound, and if you want to hear how a man can rock the hell out of an eight to the bar beat, relying on mainly his voice and the aforementioned ten dollar axe, I strongly recommend this recording.

Distributed by Avan-Guard Music, it is so far as I know the only complete album Lenoir recorded. Sound is excellent. – J.C.

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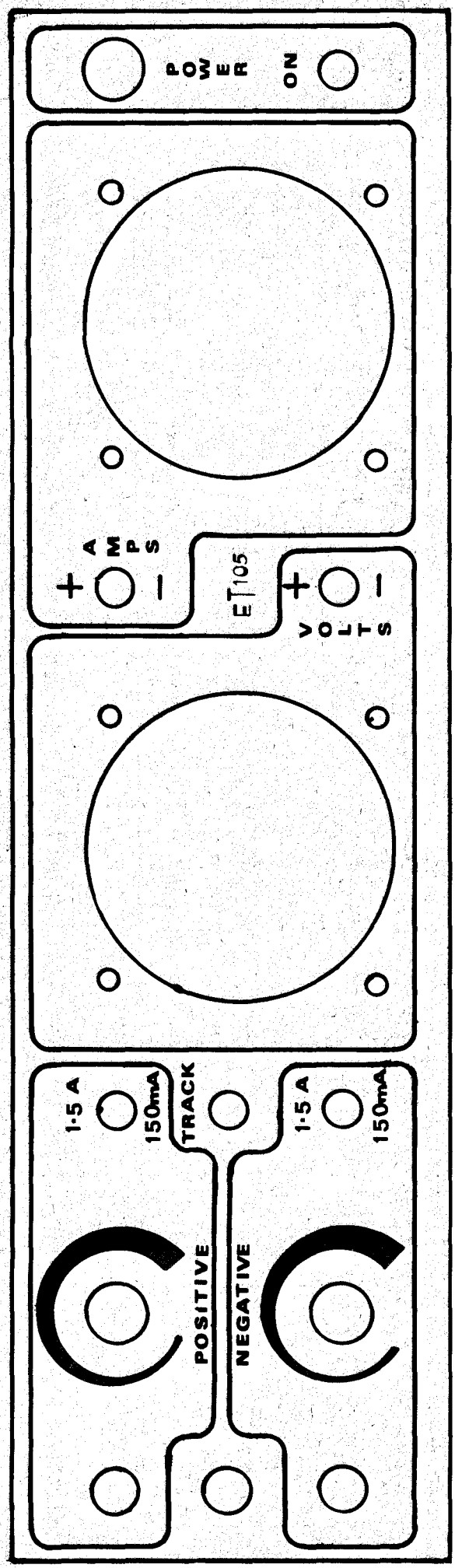

Front panel for power unit constructional project – pages 72-78.

BOOK REVIEWS

"BASIC ELECTRONIC PROBLEMS SOLVED". By Donald A. Smith. Published by TAB Books, first printing July, 1970. 190 pages 8½" x 5½". Soft Covers. Australian price $9.95 (hard back). $6.15 (soft cover). Available from Modern Books & Plans and other leading booksellers.

There are two main sections in this book, the first four chapters provide an extensive practical introduction to Ohm's law, delta star transformation and reactance, impedance and phase in ac circuits.

The second section gives brief theory and basic formulae on semi-conductors, power supplies and general receiver circuits, both valve and transistor. The final chapter provides a detailed discussion of the technique of using the slide rule.

Basic electronic problem solving takes up the first 111 pages of the book, and at first sight one would think that this would be of value to young people embarking on their first course in electronics, and so it would to a limited extent. The solving of Ohm's law problems is covered very well indeed with numerous examples being given and plenty of problems for the reader to practice. Answers to the problems are given in appendix 1 and further worked answers are provided in appendix 2. The same can be said for the treatment of inductance, impedance and all that.

But there the problem solving ends – no Kirchoff – no Thevenim. The text does not go far enough, yet there is a great deal of material included which is of little value. For example, there is a chapter devoted to the use of "powers of ten" which on reflection would seem to be pretty useless. These days, people who attain only the compulsory intermediate certificate standard of education will understand indices. This section would appear to be of benefit only to those older people who have forgotten their maths and need some revision.

The author states in his preface:

"For over 10 years my students have been after me to write this book, which they prefer to call a "cheat book". They claim it will help clarify the basics encountered in ANY electronics course, particularly for those without extensive mathematical background."

Well, electronics courses in the U.S. must be a lot simpler than they are in this country it would seem, but I doubt it.

The theory of semiconductors, power supplies and receiver circuits is covered in 40 pages and is therefore hardly exhaustive, although what is included is treated well, if somewhat briefly. The book would be far better and would achieve its purpose if this section had been replaced by more problems on circuit analysis.

Chapter 8, the last in the book, is devoted to the use of the slide rule, a tool with which every technician should be familiar. Here, however, in his efforts to be explicit, the author has gone slightly wacky. For example, take this explanation of how to find the number 15 on the rule:

"On most rules, there is so much space between the major divisions 1 and 2, that the next ten smaller divisions are actually marked with numbers as well as lines. Thus you will find a 5 marked on the rule half way between the major divisions of 1 and 2. Another way to understand the markings is to think of 5 in the previous example as 5. In this case, you can think of the next smaller divisions of ten on the D scale (between the major divisions of ten marked across the whole D scale) as being .1 each. In this case, the 5 is five tenths up the scale from the major division 1, between major divisions 1 and 2."

Did you follow that? I found it a little confusing, especially as pages 129 to 160 in my copy of the book were bound in upside down. – B.C.

BEGINNER'S GUIDE TO TV REPAIR by George Zwick. Published by TAB books March 1971, 171 pages 8½" x 5½" soft covers. Australian price $4.95 ($8.70 – hardbound), available from Grenville Publishing Co. Sydney.

In the preface to the book, the author states that it is not the purpose of the book to provide a complete course in TV servicing.

REVIEWER: Brian Chapman

Rather it attempts to provide a logical sequence for minor servicing (not including any soldering iron work) for those people who want to keep their TVs working at their best, by following a safe simple, preventative and corrective maintenance programme that requires no specialised tools or equipment.

In other words the book attempts to explain in simple unmathematical terms the operation of black and white and colour T.V. in a manner which is specifically designed for those having little or no previous electronic experience. In addition it delineates adjustments to compensate for ageing, degradation, image distortion, etc., and how to correct such defects as insufficient brightness, picture instability (rolling-tearing) and overloading. The servicing hints do not extend beyond the diagnosis and replacement of defective valves and, in fact, the author advises that any soldering iron work such as defective transistors, should be left to the professional.

From the point of view of the stated aim the book does a fairly creditable job and is quite well written. Diagnosis of faults down to a particular valve function is well done and makes good reading. However, the limited scope of the work makes it of little value to anyone seriously interested in T.V. servicing. The book, in fact, could almost be classified as general information and I doubt that there are too many people without electronic background in Australia who would firstly purchase a book of this nature and secondly, would be able to fully understand it particularly as "The T.V. System" is covered in 13 pages, and "How a T.V. receiver works" is covered in a further 20 pages. A case I would say of the expert overrating the assimulation powers of the novice. Nevertheless it is possible that a complete novice could use this book to diagnose valve replacements (without understanding what he is doing) and on this basis the cost of the book *could* be saved on one eliminated service call.

In general, however, experience teaches that tinkering with anything as complex as a T.V. receiver without any real understanding most often leads to further costly and unnecessary damage. As any T.V. technician will tell you, the number of calls that are made to T.V. sets which have suffered damage due to owners replacing valves in the wrong sockets, for example, are fairly common.

It is doubtful that this book will educate owners sufficiently to prevent them falling into the usual traps for young players. – B.C.

COMPUTER TECHNICIAN'S HANDBOOK by Brice Ward. Published 1971 by TAB Books, 475 pages 8½" x 5½" soft covers. Australian price $9.95 (or $13.60 – hardbound), available from Grenville Publishing Co. Sydney.

In the preface we are told that here is a book which will make a technician with *some* background in semiconductor technology, into a highly paid computer technician. This will be achieved, we are told, almost as quickly as a 1000 hour computer course and so, the sales blurb goes on: "Take advantage of your present electronics training and become a capable computer technician".

Let us make this very clear at the start. Computer technicians are not people with some knowledge of semiconductors who have read one book on computers. To become a *capable* computer technician definitely requires training by means of a course of lectures coupled with extensive practical sessions on a working computer. Yes, I agree any intelligent technician can grasp the theory of the basic computer building blocks, such as adders, registers, memories, etc., – but – the dynamic operation of a computer under programme control is something else. This is where the self study man comes unstuck. He is faced with a bewildering list of programme instructions and has no real understanding of what the heck is going on in the works – even though he fully understands the individual circuit blocks.

The book is divided into two main sections Part 1 and Part 2. Part 1 gives a general introduction, covers number and coding systems,

BOOK REVIEWS

the teletype, Boolean algebra and then has approximately 150 pages on basic computer circuitry. This section is quite well presented and does indeed give a fairly exhaustive treatment of all that any technician would require to know about the basic hardware.

Part 2 is an analysis of a typical small computer, namely the Computer Automation Incorporated PDC808. The description of the computer is very complete with a complete run down of programme instructions, commands, and peripheral options. The last half of Part 2 gives complete maintenance instructions for the same computer.

This is all good stuff and would be admirable for a text to be used in conjunction with a course on the PDC808. My complaint with it is that it reads like the company's operation and maintenance manual, with very little more amplification on the processes involved than could be expected in such a manual. In a general computer text, who would want to know, for example, how to set up R15 on the oscillator card. Obviously this kind of information in a general text is completely superfluous and does nothing to clarify the operation of the machine in any way whatsoever.

Nevertheless, the book is quite good in the presentation of the basics and any stout-hearted soul who waded through the second half would no doubt glean information about computers in general that is seldom covered in ordinary standard texts.

As said before, the book is ideal for anyone who is involved in any way with those machines manufactured by Computer Automation.

– B.C.

RADIO RECEIVER SERVICING GUIDE by Robert G. Middleton – copyright 1971 by Howard W. Sams & Co. Inc. U.S.A., published by W. Foulsham & Co. Ltd. England. 96 pages 11" x 8½", hard covers. Australian price $6.45, available from Modern Books & Plans, Sydney and other booksellers.

This book provides coverage of servicing techniques for both solid state and valve type receivers, and concentrates, in particular, on troubleshooting and repair of AM receivers.

The book opens with general troubleshooting and isolating procedures including the necessity for logical thinking. Each stage of the receiver is then discussed in a separate chapter that opens with a general discussion of the theory and waveforms associated with that particular stage. The chapter then proceeds to examine common circuitry, both valve and transistor, in detail before embarking on a complete coverage of faults and servicing hints.

Each chapter is well and clearly illustrated with circuit diagrams, explanatory diagrams and graphs which combine with the well written text to provide a simple, but lucid and complete coverage.

A description of field effect transistors is provided together with one on integrated circuit IF amplifiers, etc., so it may be seen that the text is quite up to date.

One of the most unusual features of the book is a section on the restoration of antique radio receivers. Most technicians these days will not touch an ancient set due to the difficulty of obtaining components and the hidden troubles such as corrosion of coils, etc., which make the proposition an apparently uneconomic one.

However, many people are prepared to pay as much to have their "old faithful" repaired as it would cost to buy a new and much superior replacement receiver. This is because of sentimental attachment rather than the logics of the situation, and we should always bear in mind that a customer is perfectly entitled to prefer his breadboard layout receiver with original Philips of Holland valves to a Japanese transistor if he so desires. These sets, in fact, are collector's items and are eagerly sought after, but no doubt at some stage in their earlier life they would have been classified as "not worth repairing" by some impatient serviceman.

Yet the techniques used, and the components, are not familiar to the modern serviceman and this section of the book, therefore, re-presents this forgotten theory and provides worthwhile hints on restoring such receivers to as near their original state as possible.

Well worth the money to those interested or engaged in radio servicing. – B.C.

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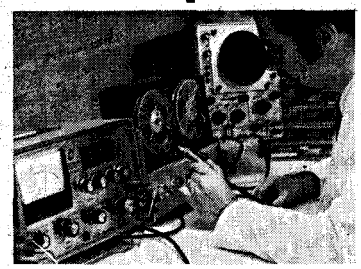

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OF UTMOST GRAVITY

(Continued from page 19)

meteorologist Alexander Friedman said that general relativity logically implies an expanding and contracting closed universe whose size is never constant: a universe that, in effect, breathes as the objects within it move apart and come together. Einstein admitted that he had made the "worst blunder of his life" in rejecting Friedman's predictions, after astronomer Edwin Hubble proved that the universe is expanding.

AN INFINITY OF FORMS

Further observations have confirmed that galaxies recede from each other at a decreasing rate because of their mutual gravitational attraction; eventually, they will reverse course and fall back together at an increasing rate. The present cycle of the universe will end when all galaxies reach the same point simultaneously, their complete gravitational collapse producing a singularity that will explode to begin another cycle; this indeterminable space curvature represents matters as it was and as it will be in an infinity of forms.

Quantum theory, the other giant of twentieth century physics, describes elementary particles as discrete quantities of energy, spin, charge and momentum occurring in multiples of basic units determined by probability waves. But quantum's laws do not allow for the destruction of most elementary particles — except by antiparticle annihilation — in relativistic black holes. The apparent contradictions of these pre-eminent theories may indicate that both are incomplete.

Many theoreticians have suggested that there is an elusive relationship between the worlds of the very large and the very small. The estimated radius of the universe at the phase of maximum extension exceeds the characteristic dimension of an elementary particle by a factor of 10^{40}; electric forces between two particles are 10^{40} times greater than gravitational forces; and the estimated number of particles in the universe is of the order of 10^{80}. There must be casual connections between these numbers, says Dr. Wheeler. Inside the black hole, quantum theory and general relativity may meet. A complete understanding of the extraordinary physics of these spacetime phenomena could lead to the quantization of relativity, or quantum geometrodynamics. Sought for more than 25 years, such a theory, with its comprehensive explanation of existence, would revolutionize the physical disciplines and perhaps challenge the precepts of western religion.

— Mort La Brecque

That's right. It's a pressure pack that helps you hear music better. It is the new handy antistatic record cleaner from Plessey. By cleaning your records thoroughly, it greatly improves the reproduction. You hear the music better – and you protect your records too. Every time you use the Plessey antistatic record cleaner you set up an antistatic barrier that repels dust, keeps your records cleaner, helps them last longer.

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AR44

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INPUT GATE

LETTERS FROM OUR READERS

NEW ZEALAND

I will shortly be moving to New Zealand, is it possible to send a copy of Electronics Today over to me each month? – GK. Exmouth, W.A.

• We can certainly arrange a subscription for you, but Electronics Today is available on the bookstands in all parts of New Zealand.

DEMONSTRATION RECORDS

Can you recommend any classical records that are suitable for demonstrating my audio equipment. I am seeking well balanced recordings that are free of gimmicks. – O.D. Wagga, NSW.

• Try these – Berlioz: Requiem, Philips 6700-019. Handel: Music for the Royal Fireworks, Vanguard S289, Orff: Carmina Burana, DGG 139362. Strauss: Thus Spake Zarathustra, London CS 6609, Verdi: Requiem, London OSA 1275.

STICKY PROBLEM

In your series of articles on reed switches you said that some reeds are liable to remain closed after the magnetizing force is removed. I would like to use these switches in burglar alarm installations – is it possible to overcome this problem? – FK. Cairns, Qld.

• Most reed switch manufacturers make a switch specifically for this application. The one most commonly used in Australia is the type XS7 from Plessey Ducon.

HEATHKIT

I enjoyed reading your article in the October issue of Electronics Today describing the construction of a Heathkit amplifier and speakers. Would you please tell me who are the Heathkit agents in Australia. – P.W.M. Ashfield, NSW.

• Surely – Schlumberger Instrumentation Australia Pty. Ltd., 112 High St., Kew, Victoria, Tel. 86-9535.

TRANSISTOR EQUIVALENTS

Transistors present a real problem to people like me, who have collected a stock of various types over the years. Every circuit appearing currently, seems to present new type numbers. This is all right for beginners who have to buy stock, but there are many experimenters who have plenty but are uncertain of whether any is an equivalent.

Would it be possible to publish lists of equivalents, alternative types or substitutes, base diagrams, etc? I feel that articles of this nature would attract widespread attention and convert a periodical into a reference library. – M.W.I., Preston, Vic.

• We are currently preparing a chart showing connections of the more commonly used diodes, transistors, silicon controlled rectifiers, triacs, etc. This will be published shortly.

It is not practicable to publish a list of equivalent transistors, for devices that can be interchanged in one circuit cannot in another. For example, practically any npn transistor can be used in a low-speed switching circuit designed for npn transistors – but in the case of a high-quality pre-amp, even slight differences in one parameter would preclude the use of an otherwise identical device.

As far as possible, we use similar types of components in all projects – for example, BC 108 and BC 178 transistors.

CHIPS WITH EVERYTHING

I have heard that an American company are manufacturing an integrated circuit containing all the functions necessary for a Dolby noise reduction system. Do you know anything about this? – RD. Auckland, NZ.

• Not very much. The company concerned is Signetics, and we understand that the chip will be on the market sometime next year. We will publish details as soon as possible.

HUNDRED DOLLAR HI-FI

Your hi-fi tests are very interesting but, with the exception of the Magnavox speakers, practically all the units described so far are way outside the price range of the average reader. There must be thousands of people like myself who can only afford a hundred dollars or so for a complete outfit. Why not come down to earth and test a few units in this price range. – DS. St. Marys, NSW.

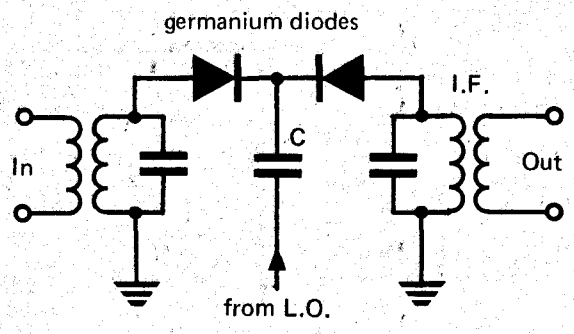
• One appreciates our reader's problem – but the simple fact is that it is just not possible to obtain high fidelity sound for a hundred dollars.

Nevertheless, remarkably good quality can be obtained from an outfit based say, on a Sansui AU 101 amplifier, and a couple of home-assembled Magnavox 8-30 speaker enclosures, these together would cost less than a couple of hundred dollars. And we have tested both.

But remember that hi-fi equipment lasts for years, and costs very little to maintain. If you really enjoy music, the cost of a good system, if spread over several years, is only a few cents a day.

TECH-TIPS

THE MISER'S MIXER

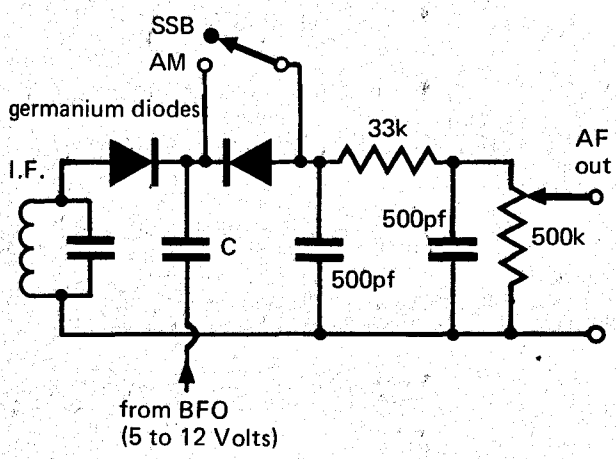


Here is a very simple mixer with good sensitivity and strong signal performance.

Diodes with low back resistance (preferably germanium) should be used as the circuit depends on this property for earth return. If silicon diodes are used, a 470k resistor should be across each.

The value of capacitor depends on the frequency used and the local oscillator coupling required. The local oscillator level should be adjusted for good strong-signal performance.

PRODUCT DETECTOR



The circuit above is very easily modified to act as a product detector for SSB and CW; and by simply adding a switch the circuit can be used as a conventional AM detector.

In this circuit, the IF input coil is replaced by a low pass filter and a BFO (switched off for AM) injects the local carrier.

Here again, diodes with a low back resistance should be used.

The local oscillator level should be adjusted for best strong-signal performance, and capacitor C chosen for the desired coupling.

CAREER OPPORTUNITIES

CUSTOMS & EXCISE

Applications are invited for two positions of Technical Officer (Science) Grade 1, with the Department's Sydney Laboratory.
Salary Scale – $4228-5419.
Duties – Perform microbiological examinations on a variety of foodstuffs including Salmonella in meat and egg pulp, within the limits of established methods. Assist professional staff.
Qualifications – An approved certificate from a technical college or institute of technology or its equivalent or such other qualifications as the Board considers appropriate together with appropriate experience. Applications will, however, be accepted from people who do not possess acceptable qualifications providing they have a minimum of 6 years relevant experience. If the selected applicant does not possess acceptable qualifications, he will be required to pass a test of knowledge and competence to establish his eligibility for nomination for the position.
Previous experience in bacteriology laboratory desirable.

Forward applications to the Inspector, Personnel, Box 8, G.P.O., SYDNEY, 2001 by 28-10-71.

ENGINEER CLASS 2

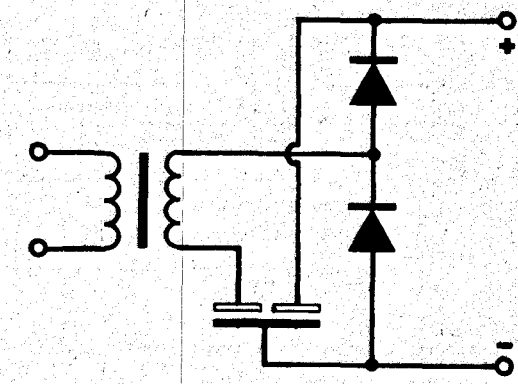
The Commonwealth Department of Works invites applications for a position of Engineer Class 2 in its Construction Section, located in the Tower Building, Australia Square.
Duties – Under general technical direction, responsible for the professional and technical control of electrical work performed by Metropolitan Day Labour organizations, including the installation and maintenance of underground and aerial reticulation and associated buildings, and the maintenance of air conditioning plants, automatic oil fired boilers and emergency generating equipment throughout the Sydney area.
Qualifications – Educational qualifications admitting to Grad. I.E. Aust.
Salary – Within the range of $7650-8570 according to qualifications and experience.
How to Apply – Standard application forms are obtainable from the Department of Works, Sydney (phone 2709.228). Completed forms should be forwarded to:

**Director of Works,
Department of Works,
P.O. Box H27,
Australia Square, SYDNEY, N.S.W. 2001
By: 29 Oct. 1971.**

For more information on the Careers Opportunity Columns of Electronics Today (Advertising rate 76c per line) contact:—Sydney, Howard Jenkins or Terry Marsden, 26 2296; Melbourne, Clarrie Levy, 51 9776.

TECH-TIPS

MODIFIED VOLTAGE DOUBLER

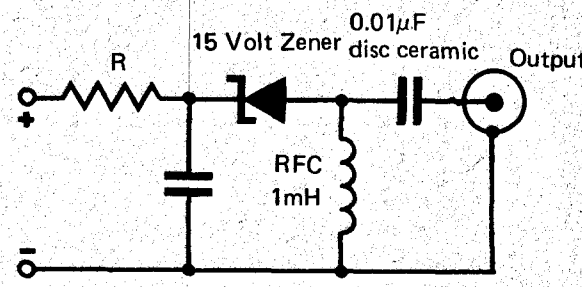


Twin electrolytic capacitors take up less space than two separate units but cannot normally be used in voltage doubler circuits.

However a slight modification to the circuit allows twin electrolytics to be used, with the can connected to chassis.

Alternatively, in low voltage circuits where high value electrolytic capacitors are used, two capacitors may be used without the necessity of insulating the case (generally the negative terminal) of one of them.

SIMPLE NOISE SOURCE



Zener diodes generate substantial amounts of internal noise. The level of this is typically 30 dB above thermal noise at frequencies up to 150 MHz.

Whilst the noise output is not sufficiently accurate to make noise figure measurements this circuit is very useful for adjusting VHF converters or receiver front ends, or as a noise source in antenna impedance bridges.

Resistor R should be adjusted to draw between six and eight mA from the power supply.

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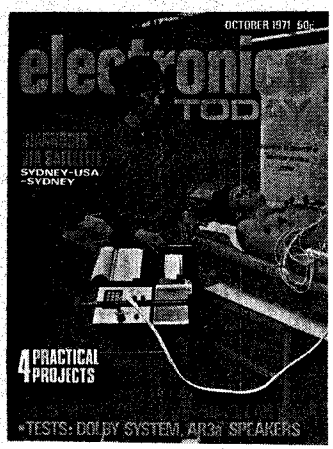

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The A-1230 stereo tape deck. It has all sorts of nice professional touches like record "pause control" and a bias control for high output low noise tapes. This switch will give you a wider frequency range and a very impressive signal to noise ratio of 55 dB. Tape recordings "off the air" and from discs will take on a new dimension of fidelity with TEAC's bias control.

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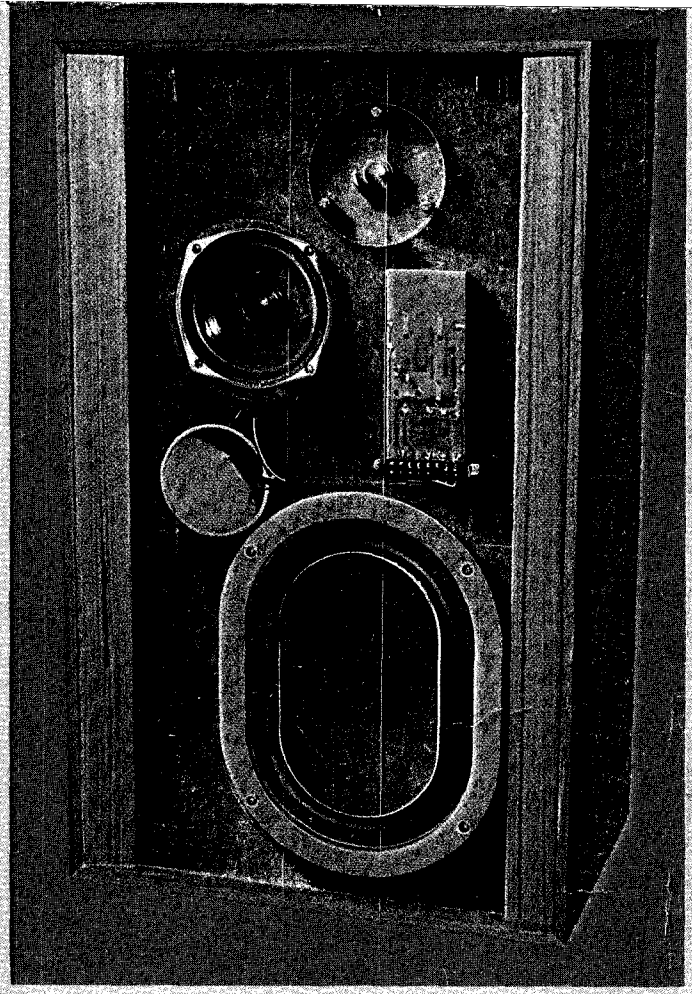
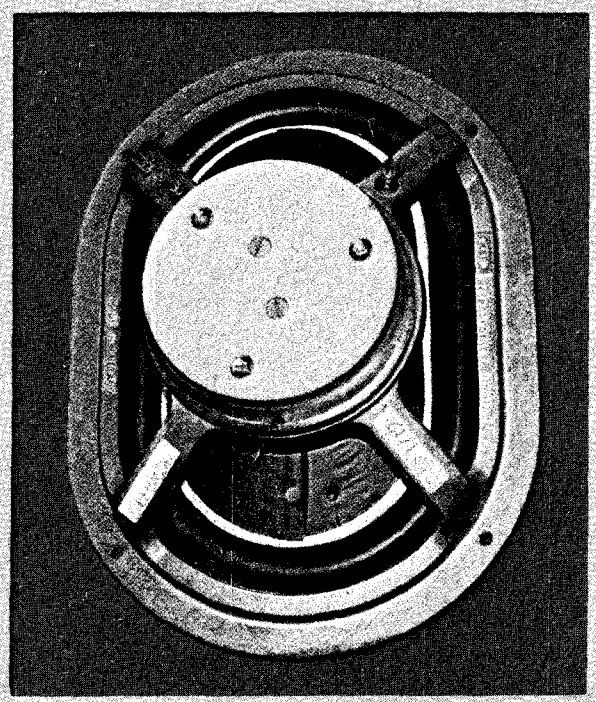
ALSO AVAILABLE IN KIT FORM

Pictured right is the KEF Concerto. The Concerto is more than a new KEF speaker system. Concerto offers you superb response over a very wide frequency range. The B139, B110 and T27 speakers are enclosed in a big 28" x 17" x 12" cabinet which reflects your good taste in design as well as music.





Illustrated above is the renowned B139 Bass Driver – SIZE: 13" x 9½" x 3"; WEIGHT: 10lb; POWER RATING: 30 W; IMPEDANCE: 8 ohms; FREQUENCY RANGE: 20-1,000 Hz; PRICE: Only $60.00.

CONCERTO – The KEF Concerto contains B139 bass unit, B110 mid range and T27 tweeter in cabinet 28" x 17" x 12". Frequency range 30-30,000 cps. Power handling capacity 25 watts. Price per unit only $220.00. Price for speaker kit only, is $140.00. Price for speaker kit and enclosure kit combined is $165.00.

CONCORD – The KEF Concord contains B139 bass unit and T15 tweeter in attractive teak cabinet. Frequency range 30-20,000 cps. Power handling capacity 25 watts. Price per unit only $149.00. Price for speaker kit only, is $89.00. Price for speaker kit and enclosure kit combined is $113.00.

CHORALE – The KEF Chorale contains B200 bass unit and T27 tweeter in cabinet 18½" x 11" x 8 5/8". Frequency range 35-30,000 cps. Power handling capacity 25 watts. Price per unit only $120.00. Price for speaker kit only, is $75.00. Speaker kit and enclosure kit combined is $90.00.

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