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AUGUST, 1965

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A PIONEER PASSES

It would be inappropriate to let this issue go to Press without making due reference to the passing of Sir Ernest Fisk, undoubtedly the most widely known of the pioneers of the Australian radio industry.

Arriving in Australia, in 1911, as a ship's radio operator, he played a major role in furthering “wireless” technology in this part of the world. In 1918 he personally received the first direct message from England by wireless telegraphy and repeated the feat in 1924 with the first direct reception of the human voice from England.

Ernest Fisk — his knighthood came in 1937 — was one of the founders of Amalgamated Wireless (A/asia) Ltd., a company which rose to a dominant position in the Australian radio scene, with interests ranging from local and international communication, through broadcasting and consumer products, to instrumentation and research.

He was the foundation President of what is now the Institution of Radio and Electronics Engineers but, well before that, had lent extensive and practical support to the then infant “Wireless Institute of Australia.

Recognition of his stature as an executive of world standing came with his appointment, in 1951, as Managing Director of the E.M.I empire. His passing severs yet another link with the history of radio in Australia.

So also did the passing, a few weeks ago, of another radio pioneer. John Briton, whose career substantially coincided with the radio industry in Australia and who later engineered the country's first television station, TCN9, in Sydney.

While they live, pioneers have many stories to tell of the old days but we, who remain, are apt to overlook the fact that their anecdotes and their reminiscences are, in fact, history, which will be documented and preserved.

With the calendar at 1965 time it is running out for those who still remember.

One can't help but wonder whether the industry is making sufficient provision for documenting its own absorbing history.

August, 1965

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ELECTRONICS Australia, August, 1965
DEFECTS IN CRYSTALS

About 400 scientists from all over the world will spend the week, August 16-21, at the Beaurepaire Centre, Melbourne University, discussing the twin subjects "Electron Diffraction" and "The Nature of Defects in Crystals." The first of these was discussed last month; in this issue, the author discusses the second subject and explains something of the internal structure of crystals, how the atoms are packed together, defects and their influence on crystal characteristics and the significance to everyday applications.

By C. K. Coogan M.Sc., Ph.D.


So far, we have only spoken as if crystals were perfectly regular, and so they are to a very large extent. It is this regularity of order of atoms in crystals which impressed the first workers with X-ray diffraction. But as more questions were asked, and the theoreticians had time to think about what the experimental results implied, people realised that there were snags.

Sir Charles Darwin, the grandson of the author of "The Origin Of Species," and Professor P. P. Ewald (who will be attending the Melbourne conference) saw that, in order to get the type of X-ray diffraction patterns that were being observed from a crystal, it would have to consist of a great many domains or regions about a micron (a millionth of a "true") in size, and tilted with respect to one another up to about half a degree. In other words, the crystal contained defects.

Soon the list of different kinds of defects which had been recognised in crystals grew as long as your arm and is still growing. Some have colourful names like deathniums, excitons, crows, point-objects. But there is growth in the size of these defects, and the microscope or a powerful magnifying-glass, individual grains of salt are seen to be little cubes.

The first of these defects is the vacancy, figure 1(a) which shows a missing chloride ion.

Figure 1(b) shows an interstitial ion, that is one which is fitted into the space between the normal ions: this is not very likely to occur in NaCl itself under normal conditions, but is much more probably in another crystal of the same basic cubic structure (called NaCl type) in silver chloride. Silver ions are small compared with chloride ions and this interstitial defect is, in fact, a big factor in the ordinary photographic process, in which silver bromide, chloride and iodide are used.

The third type, figure 1(c) is the substitutional impurity ion, in which, as the name suggests, an impurity takes the place of one of the normal ions. For example, NaCl may have a potassium ion, K+, sitting in a site normally occupied by an Na+ ion. These are but a few examples of what are called point defects.

In many crystals, the ideal ratios of the component atoms is not observed (e.g. 1 Na atom to 1 Cl atom in NaCl) and these are said to be non-stoichiometric. A good example is titanium hydride, within the ideal TiH2 composition is not retained and compounds in the range H6 to H34 have been observed.

Usually, these deviations are explained by the random presence of vacancies or interstitial atoms. But there is growing dissatisfaction with this point of view, at least in the case of many compounds, and there is now good evidence from X-ray diffraction work, that many grossly non-stoichiometric crystals are composed of "building blocks" of fairly simple crystal fragments joined together so that they form regular arrays of point, line or plane defects.

The simplest type of (hypothetical) example would be the case in which every second chloride ion, in the direction of the cube edges, was omitted which would lead to a combination of NaCl and Cl. One plane in such a crystal is represented in figure 2; try to visualise the same type of structure extending into the third dimension, down into the paper. But do not be misled by the apparent simplicity of this imaginary case. Look at figure 3, which shows a real example, W, Nb2O5, tungsten niobium oxide, the crystal structure of which was recently unravelled in Melbourne using X-ray diffraction as the "tool."

Then there are line defects and planar defects. Two of the most important of these are the edge dislocation and the stacking fault, representing line and plane defects respectively. The edge dislocation was predicted independently by Sir G. I. Taylor, Professor E. Orowan and Professor M. Polanyi, on theoretical grounds to explain the strength, or rather the weakness, of metals. Previous theories gave metals strengths about 1,000 times the values actually observed and the edge dislocations helped considerably to account for this anomaly.

The edge dislocation, which is shown in figure 4, can be likened to an "extra half-plane" of atoms slipped into the crystal which accommodates it as best it can, bending its planes around the edge of the extra half plane.

Dislocations were talked about for 15
to 20 years mainly in relation to plasticity in metals before their presence was detected using the conventional optical microscope. Much of the early theoretical work and the strength of metals was done in Bristol by Professor F. R. N. Nabarro, now of South Africa, who will be attending the conference.

Due to the distortions of the spacing between atoms around the edge of the extra half plane, impurity or interstitial atoms are best disposed of and form an atmosphere of impurities (or interstitials) around the dislocation. In certain circumstances these can coalesce to form blobs large enough to be visible under powerful optical microscopes, and hence to trace out the path of the dislocations like paper traces the path of the "haret" in a paper chase.

This was first discovered by Professor J. W. Mitchell at Bristol University in 1951, and the case he observed actually concerned blobs of silver chloride, as are formed in the photographic process. Just as everyone had predicted, the dislocations formed a kind of "three-dimensional chicken wire" with branches and junctions throughout the crystal, accounting for Darwin's domains.

Another basic type of defect is the stacking fault which is common in many types of crystal. Figure 5 shows how, in a rather diagrammatic way, the layers of atoms stack ideally in a face-centred cubic crystal. This type of crystal is quite common in metals, occuring in aluminium for instance.

We need not worry about the details of the stacking fault except that the layers can be labelled A, B and C and form a triangular net of atoms in each layer, all of which are identical except for their relative spacing laterally with respect to one another.

The normal sequence of layers is ABCABCAB. So it takes three layers before one atom is vertically below another. However, we occasionally observe that the sequence is ABBCABC which is called a stacking fault, so that atoms only two layers apart are vertically below one another. These "defects" are not just deplorable mistakes spoiling otherwise perfect crystals! We now understand that they are part of the natural order of things and that it is necessary for them to be there. It is very fortunate that they do occur, as without them most of modern industry would have to close down.

For example, nearly every crystal grows around another type of dislocation, called a screw dislocation, and its growth does not normally seem possible otherwise. But as late as 1949 the theory of dislocation growth of crystals was bitterly opposed by those with the old school view of crystal perfection.

The electron microscope, owing to a few of the useful side effects of electron diffraction, has been a very powerful tool in looking at dislocations in metal crystals particularly. Every electron micrograph is accompanied by some extent by diffraction effects and it has been possible to interpret some of these as arising from dislocations and to trace out the line of the dislocations in the micrographs.

Not only have static pictures been possible, but our knowledge of the inside story of dislocations in metals has been spectacularly supplemented by electron microscope "movies" which have shown how dislocations move in the crystal and multiply when a force is applied to it.

Scientists are no longer obsessed with the regularity of crystals; rather they are intrigued (and appalled) by the enormous amount to be learned about the mess of defects and complications which can exist in even the simplest crystals and the most perfect specimens obtainable in practice. Notwithstanding this, it is the overall regularity in crystals which gives the defects their properties and makes defects glaringly obvious.

It is this departure from regularity which makes defects such as dislocations visible under the electron microscope via diffraction effects. The actual photographs of such defective regions in crystals can be very beautiful in an abstract kind of way. So fascinating are some of these pictures that when they were discovered recently by a group of artists and potters in Melbourne they immediately began to form part of their collections.

It is hard to over-emphasise the practical significance of defects in crystals. All over the world, in the last decade, special laboratories have been springing up in industry, universities, and government sponsored institutes exclusively devoted to the study of solids. The name is usually something like Basic Materials Laboratory. There is

Figure 3. A schematic representation of the crystal (Diagram by courtesy Dr. A. D. Weddley, C.S.I.R.O. Division of Mineral Chemistry.)

Figure 4: A perspective view looking along the line of an edge dislocation in a simple cubic crystal (if there were such a thing as a simple cubic crystal). Actual spaces in metals for example are rather more complicated.

Figure 5: A stacking fault in a face-centred cubic crystal such as aluminium. The natural order of stacking of planes in this crystal is ABCABC . . . as in (a); with a stacking fault this becomes ABCBC . . . as in (b).
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metals and to harden them by hammering. Nowadays we have a good idea of what happens when a metal deforms, and the role dislocations take in this process.

How does the dislocation aid "slip" or plasticity to take place in a metal? Figure 7(a) shows what might have to happen were there no dislocations. One plane of the crystal would have to slide over its neighbour, which would cause a great upheaval in the neighbourhood of all the immense number of atoms in both upper and lower planes, and would require very large external forces.

On the other hand, when an edge dislocation moves, as is seen in the series of schematic "snapshots" in Figure 7(b), only a line of atoms, extending back into the paper, along the core of the dislocation, are seriously disturbed out of their normal type of environment at any one time, and a much smaller force is required to produce plasticity.

Some time ago the question began to be asked, "What happens in materials containing movable minute specks of metal, and is it possible to produce them?" Partial answers came when Bell Telephone scientists began investigating the tin whiskers, which grew spontaneously on solder joints over the years, and "tin whiskers" which grew spontaneously in metals like silver asparagus, and only a few millimetres long, were immensely strong whereas solder and tin are notoriously weak.

Later they found that each whisker contained only one dislocation, running down the core of the whisker, and about which the crystals grew, and which contributed no plasticity to the crystal because it cannot be moved easily. Whiskers have since been found to grow, given the right conditions, on all kinds of unlikely materials, such as graphite and sapphire. The commonest example is the "efflorescence" which one often sees growing out of brickwork, looking like white fungus, which is usually due to common salt in the mortar.

We are just entering an entirely new era in metallurgy due to the measurement of the strength of tin whiskers. The new wave of strong materials, some hundreds of times stronger than steel, consist of bundles of parallel whiskers or fibres, running along the direction in which strength is desired and "glued" together by a soft metal such as cadmium, silver or aluminium. They resemble spaghetti in a rather thick sauce!

These new materials pose their own problems, as they cannot be cut or drilled in the conventional way, but have to be formed by something like die casting. Imagine how the "spaghetti" would wind up around a drill! Typical examples are fibres of aluminium oxide in aluminium, or glass fibres in silver.

Another ubiquitous defect is the F-centre, which we have not mentioned up to now. It is so named after the German Farben, meaning colour. F-centres occur in ionic crystals, like NaCl, and colour them red, blue, green and orange. F-centres consist of negative ion vacancies, into which an electron has fallen and is trapped. They can commonly result from bombarding the crystal with X-rays or gamma rays. They can congregate, by diffusing through the crystal until they meet and join other F-centres, and form regions rich in metal ions and electrons.

Eventually this breaks down into a submicroscopic speck of metal, and the metal atoms pack together in the manner of the metal and not of the ionic

---

**Figure 6:** Diffusion in a crystal showing (a) the hypothetical case of atoms "squeezing" past atoms to exchange places, in the absence of vacancies, compared with (b) the much easier passage of an atom moving into a vacant site.

**Figure 7:** (a) How plasticity might occur in a crystal without dislocations. A whole plane of atoms would have to move over the plane below it, and while this was occurring all the atoms in both planes would be in grossly distorted crystal environments. (b) With an edge dislocation in the crystal (1), when a force is applied the dislocation begins to move through the crystal (2), until it passes out through a surface (3). Thus the shape of the crystal is changed permanently by applying force. As only a line of atoms, in the "core" of the dislocation, lie in grossly distorted sites, much smaller forces are needed to change the crystal shape permanently.

**Figure 8:** (a) A calcium (Ca) ion substituting for a sodium (Na) ion in NaCl, with a "compensating" vacant Na site bound to it in site 1; (b) When an electric field is applied the vacancy takes up one of the most advantageous bound positions, this being 1 or 4 in the case shown; (c) When the field is reversed, the most advantageous position is 2 or 3. The vacancy can perhaps "move" by cation A jumping into 1, and the cation at 2 jumping into the vacant site left by A. There are other possibilities in three dimensions.
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ELECTRONICS Australia, August, 1965
LONG-DISTANCE INSTANT COPY

The Xerox Corporation recently demonstrated a breakthrough in the art of graphic communications with its Long Distance Xerography system known as LDX. The system was shown in New York earlier this year, though it was actually foreshadowed in 1962.

LDX is a system for high-speed transmission of line copy that electronically sends a document across a corridor, or across a continent. In seconds, a scanner is able to send to a printer, anything written, typed, sketched or printed. The link between these two components is a broadband transmission line (microwave channel, coaxial cable or special telephone lines).

The original document remains with the sender while the device converts an image of the document into electrical impulses and transmits them thousands of miles away or across town to a receiver. The system even verifies that the printer is ready to receive an incoming signal before the scanner will transmit a document. The printer then stands by, ready to reproduce an exact copy on ordinary bond paper in a matter of seconds.

The implications of this unique facsimile system have yet to be felt in the business world. Here are some examples:

- A West Coast representative needs a particular engineering drawing this afternoon. Feed it into the office LDX and his copy arrives moments later.
- A trucking company can load perishable cargo and get it on the road without waiting for bills of lading. The forms can be typed up while the trucks are en route and will arrive safely at the destination before the trucks.
- Facsimiles of sales orders can be transmitted directly to a central office in minutes, cutting mail delays.

The system is a combination of optics, electronics and electrostatics. A cathode-ray tube in the scanning unit sweeps across the original document. A photo-multiplier converts the light from the scanned page into electrical signals that are then sent via the broadband link to the printer unit which can be thousands of miles away. The received signals are fed to another cathode-ray tube which "redraws" the image on a selenium coated drum. The LDX copy is then reproduced in the conventional Xerographic manner. It will send up to eight 8in x 11in copies per minute.
Right here, we can think of twenty good ways to use new nickel cadmium cells . . . there are hundreds more

Nickel Cadmium cells are opening completely new doors to designers of portable electrical equipment. They can be used in anything from transistor radios to portable electric typewriters. They can power toothbrushes or lawn mowers. They have an infinite number of applications because they offer characteristics not found in other batteries.

Nickel Cadmium cells are re-chargeable. They can be recharged either from AC mains or from a DC source such as a car accumulator. They need no maintenance, and no topping up. They can be used in any position, stored in any state, recharged hundreds of times. For the first time, a permanent source of portable electric power has been made available to designers and manufacturers. The uses to be found for this power source are bound only by imagination.

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A DIPOLE FOR 1000 cps

Inside a makeshift shelter on a 9,000-foot-high Antarctic plateau, three Boeing men huddled over a tape recorder playing Julie Andrews' recording "I've Grown Accustomed to Your Face.

Waves of music pulsed through the whiteout of the bitter Antarctic winter. Twelve miles away, the music came booming in to engineers in the scientific Stanford University field laboratory at Byrd Station.

By Wesley Robinson

ENTERTAINMENT? No. It was the first test of a 21-mile-long dipole antenna designed to collect scientific data at extremely low frequencies near one kilocycle. Other antennas using power transmission lines have dipped into the one-kilocycle region, but none of them was built specifically to study extremely low frequencies.

The Boeing men used no RF carrier equipment to transmit Miss Andrews' sentimental song. They fed the music directly from the tape recorder to the dipole antenna.

Music played no part in most of the antenna-experiment work. The bulk of the testing involved 8,000,000-watt narrow-band multiple pulses, mere microseconds long, which were directed to stations as far north as Great Whale River on Hudson Bay. A report of reception is being compiled.

Success of the whole venture hinged on careful installation of a dipole antenna excited from terminals at its centre, with two equal-length arms stretching in opposite directions on a straight line across the Antarctic plain from the makeshift central shack. For three months, Boeing engineers Robert Tighe, Ted Johnson and Art Guy had unraveled big spools of 1-inch polyethylene cable over the frozen surface in 1,000-foot segments, carefully surveying and aligning it as they went.

Their premonition was correct: the antenna performed better than expected. Considerable new data was gathered especially below 5KC.

BASIC RESEARCH

The big Antarctic antenna will continue to be a basic research tool for many years. "The door is now open to new ionospheric, propagation and geophysical research studies," said Johnson. "For example, we now can experiment with long-distance point-to-point radio communication outside the ionosphere via whistler modes. We can study ways of improving conventional modes of communication using propagation under the ionosphere. We can do research on solar flares and perhaps eventually give predictions of intense solar storms, that disrupt the earth's magnetic field. Also, we can study the electrical properties of materials deep under the Antarctic icecap."

The lower the frequency, the more stable the signal and the less likely it is to fade out during research and communication experiments. Big antenna systems reaching as low as 14 kilocycles are in operation in Maine and at Washington State's Jim Creek station, but the cost of building each of these stations was more than $50 million.

"For $12,000 worth of wire, we were able to build a bigger, more efficient research antenna which will operate at extremely low frequencies than any now in existence," said Art Guy. "It was a remarkably successful venture."

Antarctica was picked for the antenna installation because it has high, unpolluted transmission lines on which wire can be laid in straight lines for miles, and a frigid coating which prevents signal loss. Next to free space, ice is the best, most abundant insulating material naturally available on earth. Generally the colder the ice, the lower the signal loss.

MOUNTAIN BOUNDARY

The gigantic Antarctic Mountains divide the continent into East and West Antarctica. East Antarctica is generally explored by the Russians, West Antarctica by the United States. The boundary is entirely non-political, however, as Antarctica is a treaty area equally owned by all nations.

The antenna location was about 12 miles from Byrd Station, roughly 450 miles from the coast and 700 miles from the South Pole. The antenna was oriented along the magnetic meridian 30 degrees east of true north.

At the antenna site, summer temperatures fluctuated between 26 degrees above and 26 below zero. No sooner had the Boeing men located their campsite and erected their small shelter than a three-day blizzard hit, burying their equipment in 10 to 20 inches of snow. It proved to be the worst storm of the trip until just before time came to break camp and return home. At that critical moment, another fierce blizzard struck.

Much of the time the men worked either in bright sunshine or a calm whiteout, a condition under which there is no horizon, no perspective and no shadows. A whiteout is caused by a combination of the unbroken white landscape and a high-altitude fog, which completely diffuses sunlight reaching the icecap.

"Visibility is excellent in a whiteout," said Johnson. "Often you can see for miles. The trouble is, if you notice something you can't recognize, you simply cannot judge if it is a huge object several miles away, or a small object a few hundred yards away." Johnson, Tighe and Guy often worked all night long. As the sun never set there was no physical sensation of day and night.
Microminiature Circuits

"Microminiature Circuits," "Thin Film Circuits," "Integrated Circuits," and similar terms are appearing more and more frequently in technical literature. What are these devices and where do they fit into everyday electronics picture? This article, and the one to follow, explains what it is all about in simple everyday language.


MINIATURE comes from the Latin "miniatura," for something made on a small scale. The Greek "mikros" means "very small," such as microscopic. In science, the prefix micro denotes one millionth part of a unit, as in micro-farad.

Thus the mighty Greco-Roman double-deminisher "microminiaturisation" stands for the "shrinking of the shrunken." In the space age it has become a term for tiny semiconductor chips, or even molecular groups performing electronic operations. More often, miniaturisation is used for the size reduction, whereas microminiaturisation refers to the integrated circuits.

The need for smallness in electronics was first created by hearing aids, for which miniature and then subminiature valves were made. This trend was followed half-heartedly in portable radios, walkie-talkies and airborne equipment.

Miniaturisation proper was introduced during World War II. In 1943 a monolithic proximity fuse was developed in subminiature size, and mass produced by depositing conductive and resistive inks on a ceramic substrate. This then became the large-scale start of printed circuits.

The road to real miniaturisation was opened only by the invention of the transistor in 1948. Figure 1 depicts the time sequence of inventions, which led to the present state of microminiaturisation. Just how much equipment can be shrunk by various miniaturisation techniques is shown on Fig. 2.

It doesn't apply merely to show-piece shrinking. Since 1960, the production of micro-miniature devices is gradually shifting from the laboratories into the mass production departments labelled Micro Electronics, Micro Circuits, Micro Power Circuits, Monolithic Circuits. Thin Film Circuits, Monolithic Circuits, Integrated Circuits, Micrologic Circuits, Molecular Electronics and any combination of these terms.

In laboratories, the search goes on toward still tinier units, units which inspire such names as Ultra Micro-miniature Electronics, Pico Electronics, Micro-molecular, and Atomic Electronics. Perhaps the latter claimed its birth right here in Sydney when in February this year Dr Dan Haneman invented the high temperature (510° F.) germanium transistor in the Microscopic Circuits Laboratory at the University of N.S.W.

The fact is that, in 1965 micro-miniature electronic devices or microminiatures are produced in quantities from tens of thousands up to millions. Among the main suppliers are Texas Instruments.

In Australia, the micromins will be available from Mullard, Philips, Ducon, A.W.V, I.R.C., S.T.C. and Fairchild. Research on micro-miniature and thin film techniques is pursued at the University of New South Wales, C.S.I.R.O. and in the Application Laboratories of Philips Australia Ltd., A.W.V., Ducon, I.R.C. and Fairchild.

The demand for micromins, "at any cost" was first brought about by military and space age requirements. The space in missiles, deep space probes, satellites and airborne equipment is fantastically expensive, in some instances perhaps £5m. per cubic foot. But an awful lot of electronic functions were required and the answer was micro-miniaturisation. It had to be absolutely failure-free, at any cost. In consequence, the initial micromins were very expensive.

Automation has reduced the cost of micromins and for the first time this year they appear competitively on the consumer market. The bulk of the micromins goes into computers. However, in 1966, they will be on the wish lists of car radios, TV sets, Hi-Fi sound equipment, program-controlled home appliances, medical equipment such as hospital, telemetry, radar, and even the human brain, joined with 200,000,000,000,000 interconnected into a huge bionic computer. Although thousands of neurons die daily, the brain action never stops, since the functions of failing cells are taken over by others. But any such large redundancy will become prohibitively expensive even in survival equipment.

The cheapest way to extreme reliability is with solid state devices: transistors, diodes, composite thin films and molecular groups. All these are best produced by microminiature techniques and possess then a vastly superior reliability. A failure rate of one in 10,000,000 serves as a typical example for their reliability and a packaging density of 500 components in one cubic foot for smallness.

However, as the circuits are made smaller the leads and joints may occupy 95% of the volume and become useless.

For want of a missile, a city burned.
For want of a radar, a missile turned.
For want of a relay, a radar failed.
A failure in the electronic equipment means for a defence missile, an aircraft, a warning system, a naval or a land-based radar.

The probability that a component will fail during its life is given for every component and is always less than 1, which denotes absolute reliability.

According to the theory of statistics, the reliability of a device drops quickly with the increasing number of components. Even a small computer having a component reliability of 0.9999 per 1,000 hours is likely to break down hourly. It would be absolutely unsuitable for any vital purpose.

There remains then the expensive way to better reliability by duplicating or even triplicating everything, that is, by redundancy. This is nature's own way to reliability. There are about 10,000,000,000 nerve cells, neurons, in the human brain, joined with 200,000,000,000,000 inter-connections into a huge bionic computer. Although thousands of neurons die daily, the brain action never stops, since the functions of failing cells are taken over by others. But any such large redundancy will become prohibitively expensive even in survival equipment.

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Dr. Don Haneman who recently developed a high temperature transistor which represents a significant contribution to solid state physics.

A microminiature module containing four substrates, each 3cM x 2cM. It contains approximately 30 semiconductors and 70 other components. (Mullard-Australia Pty. Ltd.)

Dr. Haneman has developed a high temperature transistor which represents a significant contribution to solid state physics. The transistor uses thin film technology to create small, high-temperature devices. It contains 30 semiconductors and 70 other components, each measuring 3x2 centimeters. The transistor is one of several miniaturized components that have revolutionized the field of solid state physics over the last two decades.

**Figure 1 (above).** The era of miniaturisation commenced about 1943 with the development of printed wiring. Figure 2 (left). Current micro-miniature techniques are still far short of the ultimate in package density, the human brain.
KELLY SPEAKERS PROVIDE COMPLETE COVERAGE OF THE SOUND SPECTRUM

The Kelly speakers have been designed to provide complete coverage of the sound spectrum. They include tuners, tape recorders, dictating pick-ups and cartridges, turntables, amplifiers, etc. This list of components is comprehensive, covering all aspects of audio equipment.

Some of the features of these speakers include rumble and scratch filters, loudness control, separate bass and treble controls. They come in various models, such as the Mk III Bass Unit, which is transistorised and is said to be the best treble unit ever produced. The transient response is outstanding in this class.

AMPLIFIERS
- Leak, Pioneer, Trio, Lux, Encel, etc.
- Orpheus J.H., Lenco, Labcraft, Thorens, Garrard, etc.

TURNABLES
- Ortofon, A.D.C., Decca, S.M.A., J.H., B and O, Goldring, All Balance, Share, etc.

CARTRIDGES
- Ortofon, A.D.C., Decca, S.M.A., J.H., B and O, Goldring, All Balance, Share, etc.

TUNERS
- Chapman, Pioneer, Quad, etc.

The Kelly speakers command the respect of high fidelity enthusiasts and have gained a reputation as being high-quality products. Kelly Acoustics is a subsidiary of the Decca group and supplies are available everywhere.

MK III BASS UNIT
This bass unit is the product of many years of research by Kelly Acoustics. It is a transistorised system and is said to be the best treble unit ever produced. The transient response is excellent, and the Kelly price is only £19.10.

RIBBON TWEETER
Designed for use with the Mk. III Bass Unit, the Kelly Ribbon Tweeter is said to be the best treble unit ever produced. The transient response is excellent. The Kelly price is only £19.10.

CROSSOVER NETWORK
To match these speakers, the Kelly Crossover Network is priced at £4.10.

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Here we have listed some of the stock in our warehouse. Just ask for a quotation on any item you need — you'll be delighted. When ordering be sure to give us your name and address, so we can pack and despatch it anywhere. If you have difficulty finding an item, you can also write to us. If you cannot locate it, write to us as your last resort. We are always happy to help.

The Deluxe Model (CX2012) has a power handling capacity of 15 watts, using two metal-coated polyethylene speakers. It has a crossover frequency of 4 kc. The Deluxe Model (CX2012) has a power handling capacity of 15 watts, using two metal-coated polyethylene speakers. It has a crossover frequency of 4 kc.

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FRENCH ENGINEERS DESIGN NEW RADIOTELESCOPE

One of the most valuable astronomical tools devised in recent years is the radiotelescope; a unique instrument which is rapidly filling the gaps left by optical observations. The latest addition to the small group of giant instruments — Jodrell Bank; Green Bank; Parkes, Australia; — is at Nancay, in France, where engineers have adopted a novel approach to the many constructional problems in this field.

In the plain of the Sologne district, France, close to the small village of Nancay, south of Orleans, two gigantic metal panels rise above the pine and birchwoods. It is the site of the Radioastronomy Station, in existence for some 10 years now, where the astronomers of the Meudon Observatory have set up their instruments. The two panels are the reflectors of a new giant radiotelescope which has recently been completed to an already considerable amount of equipment; the Nancay station has long enjoyed world-wide renown owing to its solar interferometer, whose 32 antennae cover almost two kilometres.

The new radiotelescope, which is one of the largest and probably the most sensitive in existence today, enables French radio astronomers to tackle, with every chance of success, the study of distant galaxies and mysterious sources of radio waves. It is some years since radioastronomers, began to draw attention by building gigantic instruments. The first of these, completed in 1957 at Jodrell Bank in England, consisted of a large parabolic mirror 75M in diameter. A fairly similar instrument, although more accurate, has been built by Australian radioastronomers and another, which can be directed in a single plane, is at Green-Bank, in the U.S.A. Finally, other instruments based on a different principle were built last year, also deserving the term “giant.” The large 300M diameter fixed bowl at Arecibo in Puerto Rico is particularly worth mentioning. These instruments are indispensable if extragalactic radio wave radiation is to be studied, and France could not be left without one.

In 1958 the radioastronomy team of the Meudon Observatory, headed by J. F. Denisse, decided to build a large radiotelescope. The instrument of their choice differed somewhat from previous ones, combining the advantages of a very large surface and the possibility of taking prolonged shots of the astral bodies observed, with that of a considerably lower cost than for parabolae which could be pointed in all directions.

The simplest design of a radiotelescope consists of a large parabolic reflector concentrating the radio waves at its focus, where a small antenna picks them up and sends them to the receiver. To be able to aim at any astral body in the sky, this parabola must be completely mobile. However, when structures weighing several hundred tons have to be moved, and what is more, without the slightest distortion, the problem is by no means simple.

This is why the Nancay radiotelescope works on a different principle. The parabolic reflector is replaced by a fixed reflector forming part of a sphere. It is this reflector that causes the rays to converge on the focal antenna. However, as it cannot be aimed at will, a flat reflector which can swivel around a horizontal axis is added, sending onto it the rays from the radio source.

In addition, by suitably shifting the focal antenna, it is possible to track an astral body in the celestial sphere, i.e. to take shots of up to an hour’s duration, and hence to increase the sensitivity of the observations, in the same way as exposure time increases the ability of photographic plates to record light in the visible spectrum.

Two immense structures had to be built, one curved and stationary, 35M high and 30M long, the other flat, 40M high and 200M long, but inclined at an angle of 17°.

These dimensions may not seem large to builders of bridges, dams or steel frame buildings. However, the requirements of radioastronomers as regards the accuracy of the surfaces are such that it is becoming a very difficult task to construct a good radiotelescope.

In the case of the Nancay radiotelescope, it was required that at no point on the 18,500M² of surface was there to be a difference of over 1cm from the theoretical surface, regardless of temperature or wind pressure. This represented an entirely new problem for the builders of the metal frame.

The design and construction of the Nancay radiotelescope were entrusted to the Compagnie Francaise d’Entreprises, who successfully completed the project with a better accuracy than that called for.

The fixed reflector is a portion of a sphere with a radius of 560M. The (Continued on Page 19)

ELECTRONICS Australia, August, 1965
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In the same way AWV proudly use their mark to brand their products, a brand which has built up over the years a reputation for excellence and reliability.
DIRECT READOUT
DISPLAY USES STROBE LIGHT

The increasing popularity of direct readout displays has resulted in many designs for this form of presentation. One of the latest systems employs a rotating drum of figures and a high speed flash tube to "freeze" their movement at the appropriate instant.

THE stroboscope, or speedlight, can make whirling gears and turbine blades stand still for inspection. Now the Raytheon Co. is using the same techniques to generate flickerless displays.

Fewer components, low operating power and high reliability are the result of coupling the stroboscopic principle with time-sharing of electronic circuits in the Datastrobe, a new readout device. The dual drum system has many advantages, including simplicity and versatility over other projection techniques to generate flickerless displays.

The Datastrobe inherently lends itself to customising, so prices will vary a good deal. A basic unit, without accessories or special features, is expected to sell for 50 or 60 dollars per character.

Applications are being explored in radar range readout, industrial process control, flight control displays, and navigation system readouts. Datastrobe is considered specially attractive for on-the-bridge displays aboard automated ships. Only four bits per digit are required for input and this significantly reduces the number of wires needed from remotes.

Telescope—cont.

The time-sharing principle permits low voltage, low current operation. A six-column readout has a maximum of four bits energised at any one time. This time-sharing of a single tube and single decoding logic circuit over all six characters-columns provides great advantages in reliability and economics over systems which require a separate decoding matrix per column or a separate stroboscope tube per column.

The rotating drums, Datastrobe's only mechanical moving parts, require no close speed control, the logic being self-sustaining. No brushes or rubbing contacts are used, and no gears. The six-digit display is expandable to 12 by putting in drums on a single shaft.

The optics permits printout, including microfilming.

Datastrobe uses rotating drums, a xenon flash lamp; all-solid-state circuits; and an optical projection system, to produce a high-contrast, white-on-black multiplex display from binary-coded decimal (BCD) input signals.

The flash tube is surrounded by a continuously rotating cylinder, which has transparent characters on it. The tube replaces as many as 66 incandescent bulbs in conventional project displays.

The readout operates directly from the four-bit BCD input, using a one-volt signal and four milliamps per bit.

Datastrobe's time-shared, all-solid-state logic reduces the number of components. This means increased reliability at lower cost, according to Raytheon's engineers. The drum columns are so close together that the correct readout is given or the device fails. "Erroneous readouts are virtually impossible," says a Raytheon designer.

In the first production model, two drums are used, one with coding and the other with six columns of characters etched on it. Both drums are mounted on the same shaft, and rotate at 2,500 rpm.

The basic Datastrobe accepts up to six columns of parallel, four-bit BCD information directly from the user's output. This information is serialised by the input decoding system, and signals from its drum column pickup. As each column comes to the proper position, the corresponding four bits or signals are supplied to a four-bit, one-volt, one-milliamp per bit panel. The four-bit input signals are converted into a single four-bit input panel. When the desired number is in the viewing area, a trigger pulse from this circuit fires the flash tube.

Because of the high scanning rate, the six-digit presentation appears on the screen in parallel as a sharp, high-contrast image. The hatching pattern in the first model uses a reluctance type pickup of voltages in an 8-4-2-1 code.

ELECTRONICS Australia, August, 1965
These products of Hivac Limited are among today's miniature works of art... the care and precision moulded into their manufacture, backed by extensive R. & D., ensure products of the highest standard of reliability.

Informative technical literature on all Hivac products including miniature and filamentary indicator lamps is available from Ducon Industries Limited.

Hivac dry reed relay inserts offer you some remarkable characteristics. For example, being sealed against any environment, their gold-plated contacts have a life generally better than 100 million operations. They offer high speed operation—better than 1 millisecond. Their contact resistance is very low—less than 50 milliohms. Types are available handling up to 1 Amp. Electromagnetic, magnetic and change-over operation make dry reed relay inserts the most reliable and versatile contacts available.

Hivac's many years experience in development and high-volume production means components of consistent high quality.

It will pay you to think of cold cathode tubes for a very wide range of applications. Look at what they offer: versatile switching, reliability, simplicity and (often a most valuable quality) self indication of operation. Add to this low cost and delivery from stock in any reasonable quantity; this is why more and more designers are turning to cold cathode tubes for automatic control, computing, data handling, telephone switching, and numerous other applications.
Precision Synchrons

Synchrons in International frame size 08 have been added to the comprehensive range of precision servo components designed and manufactured by Vactric Control Equipment Ltd. Control transmitters, control transformers and control differential transmitters are included in the new range.

The synchrons are designed to meet the British Specification DEF.148 and the American Specification MIL-S-20708A which, as applicable, require an endurance test of 1,200 hours in the ambient temperature range -55 degrees C to +85 degrees C, an altitude test of up to 100,000 ft and a full electrical test of -55 degrees C to -125 degrees C. Following Vactric's normal practice, some of the specification requirements are exceeded due to advanced techniques used in the design and construction of the components.

For these synchrons, the maximum electrical error is seven minutes of arc in the operating frequency of 400 c/s. For the control transformer and control differential transmitter, the nominal primary voltage (static line to line) is 11.8 volts, while for the control transmitter it is 26 volts. Full electrical data and performance details are available on request.


Battery Tester

Litton Industries' Atherton division, Minneapolis, has introduced a "Battery Analyst" battery tester which has three major design advances enabling it to test batteries more rapidly and accurately than other testers. The new Litton 313 "Battery Analyst" tester can instantly test all run-down batteries (including the new solid-top batteries) without first charging the battery, can accurately test batteries at any temperature from zero to 125 degrees without complicated temperature calculations, and tests all batteries more accurately because it compensates for various ampere hour sizes.

Litton describes the "Battery Analyst" tester as a "complete, portable battery laboratory" because it indicates condition of the battery, percentage of charge, remaining ampere hour capacity, and checks for shorts and for the condition of the vehicle's alternator and generator voltage regulator.

(Litton Industries, Atherton division, 2530 North Second Street, Minneapolis, Minn., U.S.A.)

Sticky Tape CLEARS FLOORS

Floor rollers faced with adhesive plastic tape are said to pick up dust, lint, crumbs and even broken glass. The "Floor-care" roller is made by Helmac Products Corporation, of Box 73, Flint 1, Michigan. It is sold with a 30-foot roll of tape which can be torn off and applied when the old tape has lost its stickiness.

Rubber Blades

Rubber cutting blades for rotary lawn mowers are the latest in a series of innovations seeking to make the mowing safer to use. The rubber blade, made by the Safety Research Corporation of College Park, Georgia, is said to cut grass adequately. At the same time, it bends when it strikes rock or glass.

Detecting Cable Faults

Development of a device for the automatic and continuous detection of faults in the imulating sheath of a cable as it emerges from the extrusion machine producing it is claimed by Tremetrona, 28 Rue de Madrid, Paris. Metal brushes, in contact with the sheath, rotate as the cable emerges from the extrusion die and follow a helical path along it. The current carried by the brushes rises immediately a fault is traversed and is shown by an ammeter.

Protecting Metal

Clear self-adhesive plastics film has been found to have a very useful application in the aircraft industry. It is being used to protect both the surfaces of metal components and the exterior of complete aircraft from damage which could be caused by tools and equipment during construction.

The film is also used to protect expensive metal billets from flying swirl while machining is taking place and for covering wing sections so that they can be walked over without any damage being caused. One of the main uses of the material is the D2 Haviland Division of Hawker Siddeley Aviation. Made by the Fablon Division of Commercial Plastics, Berkeley Square House, Berkeley Square, London, W.1, the film is supplied in 3-foot wide rolls.

Tiny Hearing Aid

A tiny solid state circuit originally designed for use in satellites forms the basis for a new British hearing aid which weighs only a quarter of an ounce. The unit, which can be clipped to the earring of a pair of spectacles or simply hooked behind an ear, has controls to suppress background noise and vary the volume level.

(Richern Ltd, Lancaster Road, High Wycombe, Buckinghamshire, England. Australia Agent: O.P.S.M. Hearing Aids Pty. Ltd., 174 King Street, Sydney.)

Radar Interrogator System

An entirely new secondary radar system, Secar, developed jointly by The Marconi Company and Compagnie Francaise Thomson Houston (C.T.H.H.), was demonstrated recently under full operating conditions at Marconi's Riverhall Establishment in Essex, England. Secar provides a comprehensive data link between an air-traffic controller and any aircraft fitted with a secondary radar transponder. Vital information concerning position and movement can be extracted automatically from the aircraft by this system, without attention from the aircrew.

This extremely versatile equipment, the most advanced of its type in the world, can interrogate on all civil and military
Another assignment completed—thanks to the compact versatility of the Fi-Cord 202! The Fi-Cord 202 caters for the most exacting professional and the enthusiastic amateur — whether you are in the studio or out on a job the Fi-Cord 202 places high fidelity recording at your fingertips. And with this wonderful precision machine you enjoy all the advantages of a full size recorder in a compact unit weighing only 6 3/4 lbs.

The Fi-Cord 202 offers you absolute reliability — around 300 of these feature packed Fi-Cord recorders are in daily use by the Australian broadcasting and television industry!

The Fi-Cord 202 may also be operated from standard torch cells if necessary — so that no matter where you are you have 100% security in your power supply. Main features of the 202 include:— * 2 speeds — 7 1/2 and 3 1/2 i.p.s. * Standard 4" spools * Vu-meter * Fast forward wind * Fast rewind * Resettable counter * Manual volume control * Built-in loudspeaker * Sockets for microphone, extension speaker and remote control * Safety record switch * Easy-load battery cassettes * Battery warning lamp * Mains input optional * Accessories available: Carrying case, a wide choice of Beyer microphones, power packs for the mains and the car.

Contact any office or representative of Simon Gray Pty. Ltd. for details and technical data on this remarkable professional recorder. Sales and service facilities are available in all states. Whatever your assignment — take the Fi-Cord 202!

**Australian National Distributors:**

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modes and ensures that transponders are only triggered over the narrow man interrogation beam. The complete system is fully transistorised, with the exception of the high-power output stage of the interrogator transmitter. It meets all foreseeable requirements and exceeds the existing ICAO recommendations.

Secar works simply by transmitting interrogation signals to the aircraft from a ground station. These signals are received by a special airborne equipment (a transponder), which will then automatically transmit coded replies to such questions as "Who are you?", "What is your height?", etc. (The Marconi Company Ltd., Chalfont, Essen, England. Australian Agent: A.W.A. Ltd., Engineering Products Division, 47 York Street, Sydney, N.S.W.)

High-powered Fans

Completely new concepts in fan-driven ventilation are announced by Colt Ventilation and Heating, Surbiton, Surrey, England. With them the company believes it can cut the cost of powered ventilation by as much as 50 per cent. In other words, at the same revolutions per minute the fans can move twice the volume of air, with a considerable drop in noise.

There are, in general, two types, called Hurricane and Typhoon. They are manufactured in several sizes and in one of two materials - aluminium or glass fibre. The Hurricane is described as a "low-silhouette" unit. Fitted into a wall, there is an outside cowl for weather protection and shutters that seal a building when the fans are not running.

The Typhoon is to be used upward - in a roof or ceiling, for example. In this unit there are four specially designed blades which shut down on openings when not in use.

With the Typhoon upward type, the flow of air being extracted from a building prevents even heavy rain from interfering when the fan is running. All fan motors of both types are guaranteed for 10 years.

Aircraft Fault Detection

Lockheed recently outlined plans for giving aircraft "instant physicals" - in-flight - thereby saving thousands of hours of down time, and increasing airlift productivity for a fleet of transport aircraft. Relayed to the flight engineer's station through an automatic printer and oscilloscope, pulse readings from more than 1,000 test points throughout the aircraft structure can provide an immediate "physical examination." They pinpoint, and in some cases anticipate, malfunctions in engines, landing gear and brakes, and in the electrical, environmental, flight control, avionics, and instrument systems. It presents graphically to the flight engineer such information as the errant unit's name, location, and part number; the time and special tools (if any) needed for replacement. And it even reports if the aeroplane carries a spare board for in-flight replacement. Thus, the crew can either make repairs in-flight or alert ground crews to have specific parts ready.

Flexible Laminate

A significant achievement in the world of plastics is the introduction of a flexible grade of copper-clad laminate, based on polyester film, which has many uses in the electrical and electronics industries, and in automobile wiring.

Printed circuits produced from this grade of laminate may be coiled and folded, and need not, therefore, be limited to a single plane in the same manner as circuits produced from rigid copper-clad laminated sheet. This feature allows the size of the assembly to be considerably reduced, and has applications in computer wiring and memory units, telephone and switchboard wiring and as car dashboard panels, as well as radio and domestic appliances. (Bakelite Ltd., 12-18 Grosvenor Gardens, London, S.W.1. Australian Agents: O. H. O'Brien Pty. Ltd., 116-176 Parramatta Road, Burwood, N.S.W.)

Solders At High Speed

Automatic equipment has been introduced in Canada for soldering armature windings to commutator segments. Armatures travel at a continuous speed through the system, being rotated as they pass the flux and soldering waves. Coated, soldered armatures are released automatically and pass on to a varnishing operation. A machine 30 feet by 5 feet by 6 feet high made especially for a major car manufacturer handles an average of 600 armatures per hour.

The new machine developed by Electrovert Manufacturing Co., P.O. Box 1200 N.D.G., Montreal 28, Quebec, Canada, can be used to solder many other products where a combination of forward and rotational movements is of advantage.

Welding Light Metals

A spool-welding process for light metals, like magnesium and aluminum, has been patented in Britain. Pieces to be welded together are subjected to a momentary external load sufficient to form very fine cracks in the oxide films that always cover these metals. A welding current is then applied. Shin-Mitsubishi Jukogy K.K., Tokyo, 10. 2-chome, Marunouchi, Chiyoda-ku, Tokyo, has taken out the patent in which it is claimed that the usual pickling operation (immersion in acid) before welding is no longer required.

Colour TV Display

Development of a cathode ray tube system with a full colour display capability has been announced by the Guidance and Control Systems division of Litton Industries, Woodland Hills, California. This system differs from others in that it is designed to...
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AUSTRALIA'S LEADING MANUFACTURER OF ELECTRICAL INSTRUMENTS (A UNIT OF INSTROL)
withstand military environments and will remain completely operational without colour degradation caused by changing magnetic fields, according to Fred W. O'Green, president of the division. Thus, for the first time, full-range colour can be utilised in the display of sensor and computer information in aircraft, ships, submarines, and tanks.

Additional features of the Litton dynamic colour display, called Chromoscope, include image storage, true three-dimensional capability in full colour or monochrome, and the capacity for the simultaneous presentation of data from different sources on a single viewing surface.

New Oximeter

Earpiece cells, sensitive to both red and infra-red light, actuate the latest oximeter for measuring the percentage of oxygen saturation in the blood. This model employs modern electronic design to produce the most accurate measurements possible and eliminate the machine’s operation from the possible sources of error inherent in oximetry.

Measurements of red light—absorbed in varying degree by fully or partially oxygenated blood—and of infra-red light—which is unaffected by it—can be read as electrical outputs on a meter. The two figures are used to set two sliding cursors on a calculator provided with the unit. A pivoted cursor, adjusted to their point of intersection, then gives an instant reading on a curved scale of percentage oxygen saturation.

The whole process is said to take less than three minutes and to need no mental calculation. (Stanley Cox Ltd., Ellis House, Aintree Road, Perivale, Greenford, Middlesex, England.)

Solar Flares

Prediction of solar flares, which are a radiation hazard to spacecraft and personnel and thus a key to long-duration manned space flight, is a step nearer, according to the Lockheed-California Company. A two-year study conducted by the company—the most intensive ever undertaken of the sun’s magnetic fields—has detected patterns of action in solar events such as sun-spots, flares and filaments.

This evidence of an order or system governing solar behaviour is essential to prediction and constitutes a major advance in knowledge. The new evidence, now incorporated in a report, “Research on Solar Magnetic Fields,” by Dr. Donald S. Beach, head of Lockheed’s astronomical sciences laboratory, can be expected to lead to other indicators allowing longer-range warnings.

Moisture in Wool

To provide a rapid method for determining the moisture content of wool, a Direct Reading Regain Tester was designed in the C.S.I.R.O. Division of Textile Physics, Ryde, N.S.W., Australia. It is a robust instrument suitable for use by textile mill employees and gives results accurate to within 1 per cent.

Manufacture by National Instrument Company Pty. Ltd., Essendon, Victoria, began in 1962, and about 140 Regain Testers have been produced thus far. The Dryer unit of the Regain Tester was originally designed for intermittent use. Many mills have found it so convenient and accurate that their usage has increased to the point where a continuous-duty dryer has become necessary.

A new unit, known as Type 22, designed in the Division of Textile Physics, is now being manufactured by National Instrument Company.

Screw Thread Conferences

Australian industry should rationalise on the ISO inch (unified) and the ISO metric screw thread systems and should declare its existing common thread systems—BSW, RSW and BA—obsolete. This appears to be the consensus of opinion in discussion at the two recent conferences called by the Standards Association of Australia to review screw thread standards for Australian industry.

One conference was held in Sydney and the other in Melbourne. They were attended by a total of more than 350 representatives of manufacturers and suppliers of threaded fasteners and associated equipment, Commonwealth and State Government departments, nearly all branches of industry concerned with usage of fasteners and threaded components, and research and professional organisations.

At the conferences, the first paper was presented by Mr L. W. Nichols of the U.K. National Physical Laboratory, who dealt with the development of international screw thread standards, and discussed tolerances and gauging systems and differences between the American and British versions of the Unified screw thread. The second paper was presented by Mr C. A. Gladman of the Australian National Standards Laboratory, who gave a critical review of the S.A.A. publication MP16, “Report on Triangular Screw Threads in Australia,” and commented on the effects of a change in screw thread practices.

The proceedings at each conference were summarised by Mr J. G. Ritchie, vice-chairman of the Council of the Standards Association. Among points made by Mr Ritchie were that the discussion at the conferences had clearly indicated that the Standards Association should provide a suitable range of standards for the ISO thread systems, including thread form, gauges and tools; and for the common types of fastener, that every encouragement should be given by industry and Government to users to shift to ISO inch or ISO metric thread forms; that those industries which are at present major BSW users should urgently consider a shift to ISO inch threads; and that manufacturers of fasteners and fastener tooling should ensure that ISO inch fasteners, particularly UNC, are readily available to users from stock.

Pictured above is the new £1,000 Direct Accounting Computer, designed for maximum speed and efficiency in relation to regular accounting procedures. Typical applications include payrolls, job cost and labour distribution, tax and utility billing, inventory control, mortgage, savings and insurance accounting. (Burroughs Ltd., 40 Miller St., North Sydney.)
Designed for use with TV receivers the TR-0809 is a compact, light and portable unit which provides test and measurement facilities for every stage and function of a TV receiver. This instrument, which is of high accuracy, is suitable for use in fixed locations—laboratory and service sections—also in the field. It can also be used for servicing radio receivers. Among the many facilities provided is an inbuilt valve voltmeter which is, itself, an extremely useful instrument apart from its application to TV receiver service. This VTVM has 20 ranges covering DC and AC volts, also resistance. The TR-0809 is housed in a metal case fitted with a leather carrying handle and finished in hammer tone lacquer. A leather carrying case with shoulder strap is also supplied as standard equipment.

**SECTIONS INCORPORATED IN THE TR-0809**

- HF Signal Generator (5.2Mc/s-220Mc/s)
- Pattern Generator with sync pulses
- FM Inter-carrier Generator (5.5, 6.5Mc/s)
- RF Signal Generator (200Kc/s-6Mc/s)
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- Audio Generator (1000c/s)

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- Ground Clamp
- Mains Connector, 6 spare fuses
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LAUNCESTON (2-5322)
Rayon Strength

The Yokohama Rubber Company, of 9 Shiba-Tamuracho, 5-chome, Minato-ku, Tokyo, says it has found a way of raising the strength of spun rayon so that it can be used with greater effectiveness for reinforcing rubber tyres and conveyor belts. Its bond-strength with rubber is also said to be improved.

Treatment is effected at the spinning stage or afterwards by spraying the rayon with one of a number of orangefin solutions.

Under Locks — And Key

Daimler-Benz AG, Stuttgart, Unterurfturheim, Germany, has patented an all-round improved locking device for cars. The driver, on locking his own door, a several vacuum servo motors connected to the locking device for cars.

A machine that enables one man to pull loads of up to 18 tons was one of the smaller exhibits among the huge variety on view at the International Engineering Exhibition held recently in London which Denis Desouter, editor of "Engineering News," picked out for mention in one of his regular industrial reports in the BBC World Service "Science and Industry" program.

Its makers, M.L. Aviation Limited, call it the Mini-horse," said Desoutet, "and it is simply a three-wheeler tractor, powered by a diesel engine and controlled by a man who leads it like a horse. It has a sort of tiller to steer it by, and on the tiller arm is a squeeze throttle control. The brakes go on automatically if the conductor should let go. The first use of these Mini-horses is to pull large servicing vehicles to and from airliners at airports, but they will have obvious uses in factories and on farms.

Nitrogen Source

To meet the increasing demand for dependable, low-cost supplies of high-purity nitrogen for numerous chemical, petro-chemical, electronic and metallurgical applications, Union Carbide Corporation has developed a new air separation plant cycle for unattended on-site gaseous nitrogen production. Designed to deliver as little as 10,000 and as much as 100,000 cubic feet per hour, the new units yield a continuous supply of high-purity product (99.999 per cent nitrogen plus inert, with less than 10 ppm of oxygen).

Aluminium Protects Zinc

Zinc prints which give cathodic protection to metal for longer than usual are claimed by A. G. Marx, of 6 Taxach, Hallein, Austria. The improvement results, it is said, from combining pure aluminium powder with the zinc in amounts up to 30 per cent or less depending on the quantity of binder used. Tendency for the paint to blister in hot climates is claimed to be reduced.

Hat, Built-in Radio

Hats with a pocket for a transistor radio receiver permits sports fans to hear one game while they are watching another.

ELECTRONICS Australia, August, 1965

or just to hear the fate of the home team while walking down the street.

The hat, a product of Hat Corporation of America, 530 Fifth Avenue, New York 36, is made of imitation black Persian lamb in "Russian" style. A pocket in the side carries the small radio with a thin wire going to a receiver in the car. The 20-dollar price includes the radio.

Mechanical Horse

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Hat, Built-in Radio

Hats with a pocket for a transistor radio receiver permits sports fans to hear one game while they are watching another.
No more dark secrets when you install a

VOLTOMETER

in your family car

Two prototype voltmeters supplied for our preliminary tests by Messrs University Graham and Ferrier Electrical Instruments. Both firms plan to make available instruments styled for use as auto voltmeters.

Back in the early thirties there was some question among car manufacturers as to whether a voltmeter, an ammeter or a simple generator warning light was the most suitable monitor for a car's electrical system. For a time at least one manufacturer fitted voltmeters to his vehicles but the majority settled for an ammeter or a warning light.

By Keith Jeffcoat

SINCE this time the argument has been between the ammeter and the warning light with the idea of an auto-voltmeter almost totally forgotten; forgotten, that is, until recently when a number of auto-voltmeters have begun to find their way on to the American "auto accessory" market.

This renewal of interest overseas caused us to look closely at the value of such a meter and eventually led us to persuade at least two local manufacturers to produce a special unit to be made available for readers of "ELECTRONICS Australia."

At this stage our readers may be wondering why they should need a meter to tell them the voltage of a battery, which is nominally fixed at 12 or 6 volts, whichever the case may be.

The fact is that a vehicle's battery voltage will vary quite widely over a range centred around 12 (or 6) volts and an instrument which can show these fluctuations at a glance will reveal quite a lot about the state of the battery and the rest of the electrical system.

To be of any real value, an auto voltmeter must be accurate to within a small fraction of a volt and easily readable — requirements which immediately prejudice its chances of being selected as an item of standard equipment in production cars.

A voltmeter needs to be a much more refined — and costly — instrument than the average auto ammeter, in which the pointer does little more than deviate from centre, one way or the other, along a sparsely calibrated scale. Yet even the ammeter has been displaced in most vehicles by a simple "no charge" warning light.

Bound up with the question, of course, is the matter of comprehension by the driver. A light which should go out calls for a minimum of mental effort; an ammeter which should read this way or that is rather more mysterious; a voltmeter which calls for definite interpretation presents much larger problem for the uninstructed.

However, readers of this journal are not "uninitiated" and are well able to take advantage of the information which a permanently installed meter can give them about the car's electrical system.

To appreciate how effective an auto voltmeter can be as a monitor, let's review some fundamentals of auto-type lead-acid storage batteries.

The batteries are constituted from a number of "cells," each of which consists, in turn, of a number of "plates" made from a porous lead composition. The cells are filled with a mixture of sulphuric acid and distilled water which is known as the "electrolyte." The specific gravity of water is 1.0 and of sulphuric acid 1.84 and the two are mixed in the proportions of approximately 21 parts water to 1 part sulphuric acid to produce a normal specific gravity of 1.260 at 77 deg. F.

In a fully charged battery the positive plate consists predominantly of lead peroxide, a chocolate-brown coloured substance. The negative plate is of porous lead and light grey in appearance. At this stage the acid is of normal strength, with a specific gravity of 1.26, as previously quoted.

As the battery is discharged, decomposition of the electrolyte takes place until, when fully discharged, each of the plates acquires a liberal coating of lead sulphate. During this process the concentration of the acid electrolyte decreases and the specific gravity is a fairly accurate measure of the state of charge. The specific gravity of the electrolyte in a discharged battery is approximately 1.170.

Although sulphate formation is a perfectly normal part of the discharge cycle, its presence always constitutes a risk. Sulphate has a tendency to harden over a period of time, making it difficult or even impossible for it to return to the electrolyte when we reverse the cycle (charge the battery). Thus, the further the battery is discharged, the greater is the risk that some of the sulphate will harden if the battery is not immediately recharged. Also, for purely chemical reasons, there is a pronounced tendency for the sulphate to crystallize when the specific gravity falls below a certain figure, representing excessive discharge. Ideally, therefore, a battery should be kept in a fully charged condition as far as possible, fully recharged immediately after discharge, and never excessively discharged.

One method of keeping "tab" on the condition of a battery is to use a device known as a hydrometer, which directly measures the specific gravity of the electrolyte. Unfortunately, how to use a hydrometer is a messy thing to use and its readings are subject to some interpretation, because specific gravity will vary with temperature and different design parameters used by individual battery manufacturers.

We would venture to say that, of those motorists who actually possess hydrometers, very few would make regular use of them to check the condition of the battery.

Quite apart from the specific gravity of the electrolyte, it can be shown that the open circuit voltage is a measure of the state of charge; a fully charged cell measuring about 2.1 volts and a discharged one about 1.75 volts. In fact, it is possible to establish a relationship between open circuit voltage and the specific gravity of the electrolyte.

Thus, an accurate voltmeter may be used as a means of charging and, in fact, a device known as an "electric hydrometer" is now standard equipment in most well-equipped service stations.

This device is nothing more than an expanded scale voltmeter which is designed to be connected across a single battery cell, reading directly the cell voltage and, on an adjacent scale, the equivalent specific gravity figure. (R.T.V. and H. March-April, 1963.)

It is just possible that the existence of some readers may light up with the
recollection of a high quality DC voltmeter which has been lying, discarded, in their spare parts box. By all means get it out and check it; it could serve you well, even though its lack of expanded scale will make it harder to read while driving.

For those who lack a spare parts box so accommodating, or who want a unit expressly designed for the purpose, we have arranged for the supply of meters to the trade with a suitably expanded scale, marked both with voltage and ampères. In addition, the movements have shock-resistant bearings to withstand vibration, as in a car.

Our voltmeter is not intended to be as pretentious as a commercial electric hydrometer but it will give a quite accurate indication of battery terminal voltage and is therefore most useful in determining the battery charge state. Its major advantage, in this respect, is that it is permanently connected to the battery and its reading is therefore available at a glance. (The drain this meter imposes on the battery is insignificant.)

A fully charged 12-volt battery should show a reading of 12.6 to 12.8 volts and when discharged would read 10.5 volts. Since this range represents approximately 25 per cent of our suggested meter scale, it can be seen that a useful indication of batteries state is readily possible.

UNDER LOAD

Incidentally, the figure of 10.5 volts is the figure beyond which further discharge of the battery is likely to cause damage to the plates. Our meter has a red line at the 10.5 volt mark as a warning against over-discharging the battery.

So far we have shown how a meter can determine the condition of a battery under open circuit conditions, i.e., without any form of load connected to the battery. It is also possible to predict an imminent failure of the battery by observing its voltage under operating conditions, particularly when it is being used by the starting motor.

As a battery ages, its effective plate area may be decreased by sulphating and by loss of active material which separates from the plate surface and falls to the bottom of the cell container. Both effects tend to increase the internal resistance of the unit. When the battery is then placed under conditions of heavy discharge, as in starting the motor, the internal resistance of the salt solution causes the cells and hastens their further deterioration.

Unier heavy load conditions, this rising internal resistance causes a reduced voltage at the terminals of the battery, which can be easily seen on a voltmeter.

The scale on our instrument has a yellow shaded portion marked "start" and the needle can be expected to drop to somewhere within this range whenever the starter motor is used with the battery in a normally charged condition, as indicated by its no-load voltage.

Once a normal no-load value within this range has been established it can be used as a guide to any progressive deterioration of the battery, due to increasing internal resistance.

If, for instance, the battery continues to show an open circuit voltage of 12.6 but the voltage on "start" begins to drop progressively lower each time the starter is used, then it can be taken as a sign of deterioration and the wise motorist would take steps to replace the battery before it strands him on a lonely road some wet night.

The need for a reliable battery is even greater in many modern cars employing automatic transmission, since certain types of automatic transmission will not operate until the engine is running to drive the oil pressure pump. Thus the car cannot be started by towing or coasting; in fact, in no way other than by means of the battery and starter motor.

In use, the voltmeter must be connected directly to the battery posts bypassing, in the process, the normal connections. There is good purpose in this, because it enables one to distinguish between the internal resistance of the battery and any excessive resistance which may exist in the external wiring cables due to poor terminal connections, loose or corroded joints, or broken strands in the conductors.

Excessive resistance in the cables or terminals would probably be attributed to a flat battery when, in fact, the battery may be perfectly O.K.

It will be noted that the portion of our meter scale between 12.8 and 15 volts is divided off, considerably below and marked "charge". Whenever the motor is running at an r.p.m. figure sufficient to operate the generator cut-off, the pointer shows a figure somewhere within this portion of the scale.

HIGH READING

If the car has just completed a run the meter may read within this portion of the scale for a while, even though the motor is not running; this will be due to a "surface charge" on the plates of the battery. Normally the meter will only read within this portion of the scale when the generator is actually charging the battery and, here again, the reading obtained can be an excellent indication of generator performance.

When a motor is first started, and for the first few minutes of driving, it would be normal for the meter to read towards the top end of this "charge" scale. During this period the generator and its regulator will be improving the battery voltage and therefore an increased current "charge" into the battery, in order to replace the energy used in starting the vehicle.

As the battery approaches full charge, however, the reading should gradually drop and finally stabilise at somewhere around 14 volts. This latter figure being

<table>
<thead>
<tr>
<th>METER READING</th>
<th>MOTOR STOPPED OR IDLING</th>
<th>MOTOR TURNING OVER ON STARTER</th>
<th>MOTOR NORMAL RUNNING (At least twice idling speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-volt system</td>
<td>12-volt system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 4.5 volts</td>
<td>Below 9.0 volts</td>
<td>Meter defective, disconnected or improperly wired. If the engine will start and/or run, the battery voltage could scarcely be this low.</td>
<td>Generator not working or voltage regulator set too low.</td>
</tr>
<tr>
<td>4.5 to 5.9 volts</td>
<td>9.0 to 11.8 volts</td>
<td>Normal range for winter to summer starting.</td>
<td></td>
</tr>
<tr>
<td>5.9 to 6.4 volts</td>
<td>11.8 to 12.8 volts</td>
<td>Meter defective; voltage not be this high, if starter is actually turning motor over.</td>
<td></td>
</tr>
<tr>
<td>6.4 to 7.5 volts</td>
<td>12.8 to 15.0 volts</td>
<td>This high reading is normal for a short after driving, due to battery &quot;surge charge.&quot; If motor has been stopped for some time, however, the meter is defective and reading high.</td>
<td>Meter defective for surface charge.</td>
</tr>
<tr>
<td>Above 7.5 volts</td>
<td>Above 15.0 volts</td>
<td>Meter is probably defective. As above.</td>
<td>Voltage regulator set too high or contacts sticking, Battery fluid level excessively low.</td>
</tr>
</tbody>
</table>

Set out above are typical voltmeter readings related to normal driving situations. The markings on the meter face, as suggested, summarise this information. Experience will enable the individual to interpret his own readings.
BOYS... obtain expert training in electronics AT NO COST WHATEVER!

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Selected apprentices may be given Technical College Diploma or University Degree courses and appointed as commissioned officers in the Technical Branch of the Air Force.

QUALIFICATIONS:
An applicant must be a British subject, permanently resident in Australia, aged 15 but not 17 years on January 1, 1966, and be medically fit. He must have completed Intermediate or Junior year (in Tasmania, the third year of the Schools' Board Course) and have studied English, Physics or a Science subject and Mathematics.

APPLICATION FORMS FROM:
RAAF Recruiting Officer, Combined Services Recruiting Centre, G.P.O., Box XYZ, in the capital city nearest to your address.

APPLICATIONS CLOSE 20th AUGUST, 1965

ENGINEERING APPRENTICESHIPS, TOO!
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ELECTRONICS Australia, August, 1965
dependent on the type of regulator used, that were involved and the temperature. Most regulators contain temperature-sensitive elements intended to compensate for the differing charge requirements created by differing battery temperatures.

The actual figure at which the generator voltage should stabilise should be available in the manual for a particular vehicle and this same section of the manual should also list the high and low limits of generator voltage. It is these latter figures that are of most interest to us because a reading outside these limits is an indication of malfunction in the generator/regulator system.

If, for instance, the meter shows a constant "charge" reading toward the high end of the scale, it could mean that the regulator is adjusted for too high a charging rate or, alternatively, that the regulator contacts are stuck together. In either case, the fault must be corrected if damage to the battery and/or the generator is to be avoided.

With very few exceptions, a reading beyond 15.2 volts would be a sure sign of a fault in the regulator and steps should be taken immediately to rectify the same.

On the other hand, readings which are on the low side could mean that the regulator contacts are dirty and need cleaning or that the generator itself has a dirty armature or may even have short-circuited in one of its windings. A low reading could also be caused by a high internal resistance in the wiring between the generator and the battery.

By careful interpretation, an ammeter can reveal some of the troubles encountered, but a generator warning light, or "idiot light," as it is sometimes called, tells only that the generator is working. The actual current output of the generator is not shown.

In the case of the meters mentioned, the generator outputs some of the troubles encountered, but a generator warning light, or "idiot light," as it is sometimes called, only tells that the generator is working. The actual current output of the generator is not shown.

SPECIAL MOVEMENT

The majority of auto voltmeters currently available on the American accessory market are of the moving iron type. The scale is calibrated to read from 0 to 16 volts at full scale. These meters have the advantage of being cheap and fairly robust in construction and, in addition, their movement is linear, so that particularly the bottom portion of the scale is cramped, with the centre section well spread out. For the present requirement, this is an advantage, because most of the measurements involve the centre portion of the scale.

Unfortunately, these meters do not have the order of accuracy we felt was really desirable—approximately 2% to 3% at full-scale deflection—and we accordingly turned to the idea of using a moving coil meter, preferably with some form of expanded scale, either mechanical or electrical.

Another requirement for any meter intended for mounting in a car is that it be sufficiently robust to withstand the vibration which is normal to this environment. This generally means that the meter should be specially made for the job.

The idea of using an electrically expanded scale meter occupied our thoughts for some time, but this type of instrument has the disadvantage in being difficult to calibrate, unless a known accurate source of voltage is available.

There is the further disadvantage that an electrically expanded type of meter costs rather more and is scarcely warranted unless expansion of 30% or less of the normal scale is required. For the present purpose, it was felt sufficient to expand 50% of the normal scale and we found that the cheapest and most satisfactory way of doing this was to use a type of expanded scale meter which local manufacturers could supply as a standard line.

To further simplify matters for the user, this gives a sample "log" as prepared by averaging the readings taken on two vehicles.

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To further simplify matters for the user, this gives a sample "log" as prepared by averaging the readings taken on two vehicles.

**Preliminary reading (cold battery)**
- Ignition switched on: 11.9 volts
- Press starter button: 11.7 volts
- Drive for 5 miles: 14.1 volts
- Stop vehicle (battery "surface" charged): 12.9 volts
- Ignition switched on: 12.4 volts
- Press starter button: 10.5 volts
- Drive 40 mins: 14.1 dropping to 13.8 volts
- Stop vehicle (surface charge): 13.0 volts
- Vehicle standing (overnight): 12.1 volts

From "winding on" the meters, the manufacturer actually halves the normal sensitivity of his movement or, in other words, doubles the amount of current required to achieve full-scale deflection.

In a typical case a 0.1 milliamp movement which has been made zero suppressed would now require 1 milliamp of current flow to overcome the pre-tensioning of the springs and move the pointer from the stop up to the zero mark on the scale. The next 1 milliamp of current flow would move the pointer from the zero to the full-scale mark.

Of the two local meters which have been made available for this project, one is a 2-milliamp full-scale deflection movement with a sensitivity of 500 ohms per volt. The other meter requires 10 milliamps for full-scale deflection and its sensitivity is 100 ohms per volt. The extra current drawn by the second movement is of no consequence despite the fact that it will be permanently connected across the car battery. If the vehicle were left in the garage and never used, the meter would take almost 12 months to flatten the battery.

Multiplier resistors for either movement can be calculated in the normal manner although, of course, the meters will not begin to read until half the full scale deflection voltage is reached.

In the case of the meters mentioned, the scales are calibrated to read from 4 to 8 volts for a 6-volt vehicle and from 8 to 16 volts for a 12-volt vehicle. In both of the meters supplied by local manufacturers the appropriate value of multiplier resistance will be included but the user must specify whether the

(Continued on Page 75.)
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Fully manufactured in Australia and directly interchangeable with their imported equivalents.

Specially designed for use in miniature transistor portables and as extension speakers in applications where space is extremely limited, as in TV remote control units. The speakers feature totally enclosed ALNICO magnets providing negligible flux leakage and permit ferrite rod aerials to be mounted near the speaker without saturation of the aerial.

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SPECIFICATION
RESONANCE: 350 cycles
RESPONSE: 300-4,000
VOICE COIL IMPEDANCE: 8 ohm
POWER HANDLING ABILITY (PEAK): 250 mw
TOTAL GAP FLUX: 9,000
AIR GAP FLUX DENSITY: 6,000
RAFFLE OPENING: 2" round
MOUNTING HOLE CENTRES: -
MAXIMUM DEPTH: 2"
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for
fine products

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Agents all other States.
In this article, we describe the construction of a 3-inch oscilloscope, designed primarily for audio and other limited frequency applications and for general use around the "Ham" shack. Avoiding the complications and cost of our earlier 3-inch wide-band oscilloscope, it should also make an excellent tuitional project for construction and use by radio club members.

By Keith Woodward

The gentleman who coined the phrase "seeing is believing" could not have coined one more appropriate to the cathode-ray oscilloscope—or "CRO." Frequently, in connection with electronic circuits, observation suggests the presence of signals or other voltage phenomena, though their exact nature may not be too clear. In most cases, an oscilloscope can exhibit the signal visually, allowing it to be examined and evaluated with a minimum of ambiguity. Seeing is, indeed, believing!

The uses which a CRO can be put to vary from relatively simple designs, with restricted frequency range, to instruments with bandwidths from DC to 10MC or more. While extensive facilities are extremely useful in laboratories and other specialized fields, the simpler forms of cathode-ray oscilloscope can perform most of the tasks required in the classroom, the home workshop and the "Ham" shack.

In connection with audio amplifiers, oscilloscopes are commonly used to evaluate frequency response, observe overload distortion and any tendency to supersonic oscillation, and to display the ripple on the HT line or the presence of hum in the output. Other "audio" applications include the use of Lissajous figures for frequency comparison and use of the instrument as a high impedance AC voltmeter. A CRO will also very usefully display the amplitude and waveform of the high frequency bias signal in tape recorders. The use of a modest oscilloscope is not limited to audio amplifiers but extends to many other applications. In using a wheatstone bridge, a cathode-ray oscilloscope can make a very sensitive null indicator. In TV receivers it may be used in alignment procedures, as well as checking the audio section.

If provision is made for access to the oscilloscope deflection plates, further applications are possible in the field of transmitting monitoring. Thus, while most of us would like to own an oscilloscope with elaborate features and specifications, a much simpler—and cheaper—instrument is not to be despised. This is the very reason why the present one has been featured, taking the place of older designs which, in most cases, depend on components no longer available or necessary.

When building an oscilloscope the classic question crops up as to whether a cathode-ray tube of the "surplus" variety should be used. Due consideration was given to this point and for various reasons, including availability, age and size, it was decided that the best approach was to use a new cathode-
"Better than ever." That's really saying something for the New C8MX because its predecessor, the 8MX, easily met the requirements for hi-fi reproduction.

Nevertheless it's true. Now fitted with a powerful Ferrite magnet the New C8MX has even better transient response, is acoustically more efficient and can handle more power than the 8MX.

The use of the Ferrite magnet, coupled with refinements to the diaphragm unit, have given the New C8MX even better Transient Response, Acoustic Efficiency and Power-handling Capacity — it is now rated at 16 Watts Peak — than the 8MX.

With these features and a frequency response of 40-12,000 c.p.s. at 6db, the C8MX represents the best possible approach to high-fidelity reproduction.
We have endeavoured to keep the above circuit simple without prejudicing the performance. The typical voltage readings shown were made with a VTVM and would vary if taken with a multimeter of lower sensitivity.

**PARTS LIST**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESISTORS</strong></td>
<td>1/5-watt unless otherwise specified</td>
</tr>
<tr>
<td>1. 1K</td>
<td>3</td>
</tr>
<tr>
<td>2. 1.5K</td>
<td>2</td>
</tr>
<tr>
<td>3. 4.7K</td>
<td>1</td>
</tr>
<tr>
<td>4. 100K (see text)</td>
<td>1</td>
</tr>
<tr>
<td>5. 10K (see test)</td>
<td>1</td>
</tr>
<tr>
<td><strong>CAPACITORS</strong></td>
<td>220pF ceramic NPO 400VW.</td>
</tr>
<tr>
<td>1. 68pF 200V plastic</td>
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</tr>
<tr>
<td>2. 82uF 350VW pigtail electrolytics</td>
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</tr>
<tr>
<td>3. 16uF 500VW pigtail electrolytics</td>
<td>1</td>
</tr>
<tr>
<td>4. 22uF 400VW plastic</td>
<td>2</td>
</tr>
<tr>
<td><strong>RESISTORS</strong></td>
<td>1200 ohm (see text)</td>
</tr>
<tr>
<td>1. 220 ohm 1W</td>
<td>2</td>
</tr>
<tr>
<td>2. 470 ohm</td>
<td>1</td>
</tr>
<tr>
<td>3. 100K</td>
<td>1</td>
</tr>
<tr>
<td><strong>CAPACITORS</strong></td>
<td>500 linear potentiometers</td>
</tr>
<tr>
<td>1. 100K linear potentiometer</td>
<td>1</td>
</tr>
<tr>
<td>2. 1M linear potentiometer</td>
<td>1</td>
</tr>
<tr>
<td><strong>MISCELLANEOUS</strong></td>
<td>Screws, nuts, solder lugs, hook-up wire, tinned copper wire, shielded wire, solder, etc.</td>
</tr>
</tbody>
</table>

**VALVES AND DIODES**

1. 26BY6 valves
2. DG7-32/01 cathode-ray tube
3. DG7-32/01 cathode-ray tube complete with socket
4. IN3194 diodes or equivalents
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TRANSCRIPTION
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- Calibrated Harmonics 120-390 Mc
- R.F. Output 0-100,000 uV, adjustable (120 Kc-38 Mc)
- Modulation Frequencies 400 and 1,000 cps, A.F. Output adjustable.
- Crystal Oscillator 1 Mc to 15 Mc.
- Tube Complement 1-12BH7 1-6AR5.
- Accessory 1-75 ohm Cable
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tured, cleared all trace of interference from the screen.

For an oscilloscope of this nature it is generally considered desirable that the vertical amplifier have a frequency response flat to at least 100KC. To achieve this figure with simple circuitry there are several design points which must be carefully watched and these are outlined later in the text. In fact we did rather better than the target figure.

In the circuit chosen both the vertical and horizontal amplifiers incorporate a "long-tailed pair" phase inverter to provide push-pull deflection of the cathode-ray beam. The use of push-pull rather than single-ended deflection results in improved linearity.

The timebase oscillator uses a 6BX6 valve in a transitron oscillator configuration. To keep the types of valves used to a minimum, a 6BX6 valve was also utilised in the vertical pre-amplifier stage. Thus we have a total of four valves, two type 6BX6 and two type 12AU7A, plus the DG7-32/01 CRT.

By using a system of terminals and links on the front panel of the oscilloscope a number of facilities become available. The horizontal amplifier may be fed from an external source or linked to the output of the timebase. This also means that the timebase output is available for use in external circuits. Provision is also made to feed an external sync pulse to the timebase and a terminal is provided for this purpose. Normally this terminal is linked to the internal sync output terminal adjacent to it.

As the flyback trace on an oscilloscope is normally only a nuisance, steps are taken to suppress it. In this circuit a negative-going voltage, on the flyback period, is taken from the oscillator and applied to the grid of the CRT. This signal lowers the brightness of the CRT, effectively blanking out the flyback trace. The flyback blanking circuit is also routed via two linked terminals on the front panel. Removing the link allows an external signal to be applied for modulating the brightness of the trace.

This facility is normally referred to as the "Z axis." While on this point, the horizontal deflection of a CRT is referred to as the "X axis" and the vertical deflection as the "Y axis." Being able to modulate the grid of the CRT is a handy feature when used in conjunction with a sweep oscillator. If an alternating voltage is applied to the CRT grid during each half cycle of the control voltage, the high tension filter choke is located in the top left hand corner in this view while immediately below it is the CRT filament transformer. The silicon rectifiers are mounted on two tagstrips adjacent to the filter choke. The NE-2 neon used in the calibrate circuit is mounted adjacent to the filament transformer.

This diagram shows most of the detail necessary for wiring the power supply and "calibrate" components. Also shown are the connections to the sync terminals. The tagstrip shown in conjunction with the 16uF 500VW capacitor is the one associated with the sweep oscillator.
PRESENTING A COMPLETELY REVISED RANGE OF MEDIUM FIDELITY OUTPUT TRANSFORMERS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>NOM. WATTS</th>
<th>PRIMARY IMPEDANCE OHMS.</th>
<th>CIRCUIT APPLICATION</th>
<th>SECONDARY IMPEDANCE OHMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPM1A</td>
<td>5</td>
<td>7000,5000</td>
<td>S.E.</td>
<td>15,8,3,7,2</td>
</tr>
<tr>
<td>OPM19A</td>
<td>5</td>
<td>7000,5000</td>
<td>S.E.</td>
<td>500,250,166,100</td>
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<tr>
<td>OPM20A</td>
<td>5</td>
<td>10000,8000</td>
<td>S.E.</td>
<td>15,8,3,7,2</td>
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<tr>
<td>OPM2A</td>
<td>7</td>
<td>10000</td>
<td>P.P. or S.E.</td>
<td>15,8,3,7,2</td>
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<tr>
<td>OPM15A</td>
<td>10</td>
<td>10000,7000,5000</td>
<td>P.P. or S.E.</td>
<td>15,8,3,7,2</td>
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<tr>
<td>OPM3A</td>
<td>10</td>
<td>4000,2500</td>
<td>S.E.</td>
<td>15,8,3,7,2</td>
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<tr>
<td>OPM4A</td>
<td>10</td>
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<td>S.E.</td>
<td>500,250,166,100</td>
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<td>OPM5A</td>
<td>15</td>
<td>5000,3000</td>
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<tr>
<td>OPM6A</td>
<td>15</td>
<td>5000,3000</td>
<td>P.P.</td>
<td>500,250,166,100</td>
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<tr>
<td>OPM7A</td>
<td>15</td>
<td>(10000),8000,7000</td>
<td>P.P.</td>
<td>15,8,3,7,2</td>
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<tr>
<td>OPM8A</td>
<td>15</td>
<td>(10000),8000,7000</td>
<td>P.P.</td>
<td>500,250,166,100</td>
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<tr>
<td>OPM17A</td>
<td>15</td>
<td>500</td>
<td></td>
<td>15,8,3,7,2</td>
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<tr>
<td>OPM10A</td>
<td>25</td>
<td>8000,6600</td>
<td>P.P.</td>
<td>15,8,3,7,2</td>
</tr>
<tr>
<td>OPM9A</td>
<td>25</td>
<td>8000,6600</td>
<td>P.P.</td>
<td>500,250,166,100</td>
</tr>
<tr>
<td>OPM18A</td>
<td>25</td>
<td>500</td>
<td></td>
<td>15,8,3,7,2</td>
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<tr>
<td>OPM14A</td>
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<td>8000,6600</td>
<td>P.P.</td>
<td>15,8,3,7,2</td>
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<td>OPM11A</td>
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<td>8000,6600</td>
<td>P.P.</td>
<td>500,250,166,100</td>
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<td>OPM13A</td>
<td>55</td>
<td>3500</td>
<td>P.P.</td>
<td>15,8,3,7,2</td>
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<td>OPM12A</td>
<td>55</td>
<td>3500</td>
<td>P.P.</td>
<td>500,250,166,100</td>
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<tr>
<td>OPM21A</td>
<td>100</td>
<td>(4500)</td>
<td>P.P.</td>
<td>500,279,124,21</td>
</tr>
</tbody>
</table>

( ) Impedances in brackets indicate screen taps available.

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ELECTRONICS Australia, August, 1965
Above is a partial wiring diagram of the sweep oscillator vertical pre-amplifier, vertical amplifier and horizontal amplifier. Only the more important components and wiring runs are shown for clarity. The filament wiring, not shown, should be run in twisted lead.

The spot will be made brighter or fainter, as the case may be. Used in this way the brightness modulation can indicate a time sense or difference and may operate to suppress an unnecessary or confusing portion of the trace.

When constructing any oscilloscope one trouble which is likely to be encountered is the horizontal timebase signal radiating into the vertical amplifier. With the layout used in this oscilloscope two distinct precautions were required to prevent this happening. One, which will be apparent in the accompanying photographs, is the provision of a shield around the Vertical Gain control and associated components. The other precaution is the use of two 0.01 disc ceramics at the 6BX6 vertical pre-amplifier socket bypassing each filament pin to chassis.

The shield can be folded from tinplate in the form of a 2-inch cube, but minus one side. The potentiometer can be mounted inside it and the components installed and pre-wired, including two lengths of shielded lead. The assembly can then be attached to the front panel by a second nut on the pot shaft.

To secure maximum frequency response from the vertical amplifier, care must be taken with the layout of the associated components. The wiring diagrams supplied show most of the relevant details. The wires to the CRT socket should be kept short as possible to minimise any high frequency losses, due to capacitance to chassis. By suspending components on tagstrips underneath the cathode ray tube we were able to make use of space which normally would be wasted.

The wiring of the two shift controls is shown above. The wires to pins 6, 7, 9 and 10 of the CRT socket should be kept short as possible to minimise any high frequency losses, due to capacitance to chassis. By suspending components on tagstrips underneath the cathode ray tube we were able to make use of space which normally would be wasted.

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Yamabishi volt sliders

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       single phase
       1 to 30 amps
       three phase

standard (surface) and panel mounting types

nominal  240 V (single phase input or per phase)
nominal 0-260 V (single phase output or per phase)

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MELBOURNE BRISBANE PERTH

ELECTRONICS Australia, August, 1965
checked. Should the generator have low impedance output, generally the case, a series resistor of approximately 47K should be inserted between the generator output and the grid for this test, to simulate the source impedance from which it will ultimately be fed. In our prototype the input (the lowest frequency we could measure) was 3dB down at 175KC.

Passing to the vertical pre-amplifier circuit, 0.1μF is inserted in the input during the tests for frequency responses. Similarly the cathode is heavily bypassed by a 100μF capacitor. Lower values of capacitance should not be used, otherwise the low frequency response will suffer.

The relatively low value plate load specified for the 6B86 serves to ensure a sustained high frequency response, though at the expense of gain at lower frequencies. This is the normal compromise that must be made in such circumstances.

FREQUENCY RESPONSE

At this stage, with the vertical gain control fully on, the audio generator may be used to check the vertical input and the frequency response again checked over the complete system. The response should again read 3dB down at approximately 175KC.

Without the trimmer shown in the circuit, it will be found that, as the gain control is turned down, the high frequency response will be adversely affected.

The function of the trimmer is to compensate for this deficiency. To set the performance in this region, the vertical gain control should be set at its electrical mid-scale. As this is a linear potentiometer this should coincide with the mechanical mid-scale. Now try various settings of the trimmer and for each setting sweep the audio generator up to 50KC. The setting which gives a flat response to this frequency is the correct one. In our prototype we ended up with approximately 22pF in the trimmer.

While conducting these frequency response measurements we removed the link on the TB Output/Hor. Input terminals. This leaves a vertical line on the oscilloscope screen which is easier to check than a swept pattern.

The time-base oscillator has five switched positions giving a frequency range from a few cycles per second to approximately 50KC. It has been indicated both in the circuit and the wiring diagram for this particular scope to be wired in low-capacitance shielded cable. This precaution is necessary to stop radiation into the vertical amplifiers. We found that synchronism was obtained with good signal available from the 12A7UA plate.

An earlier attempt to take the synchronism by connecting the pre-amplifier to the oscillator failed, as the time-base frequency was fed into the vertical amplifier in sufficient quantity to be quite noticeable in vertical deflection on the screen. However, this quantity of time-base signal has no effect when connected directly into the deflection plate circuits. This time-base signal could no doubt be improved by the use of a cathode follower feedback system, the linearity of our oscillator was quite good enough for the applications envisaged. The time-base oscillator feeds into a long-tailed pair phase inverter which replaces the plate load, and the horizontal deflection plates. As the frequency response is not quite so critical, at least for the sweep frequencies most used, we were able to use shielded lead on the 12A7UA plates to reduce the possibility of radiation into the vertical amplifiers.

To provide suitable operating voltages for the cathode-ray tube, two rectifying systems are used from the power transformer. The first is a standard voltage doubler system, producing a positive high tension voltage for the amplifiers and time-base, as well as for the deflector plates and screen of the CRT. The second voltage doubler rectifier, capacitance coupled to the secondary of the power transformer, has a negative output and is used to feed the cathode control grid and plates one and three of the CRT.

Spot focusing will tend to vary over the cathode-ray tube screen if the final accelerating electrode or "anode" is not at a potential equal to the average of the high tension applied to the anode. This effect is termed "astigmatism," as the defocusing effect resembles that experienced by people with astigmatic vision. To minimize this effect, the final anode voltage is supplied by a pre-set potentiometer connected between the positive high tension line and the chassis. This potentiometer is located on the rear apron of the chassis. The setting will depend somewhat on the normal operating point of the brightness and focus controls. For normal operation, once the control has been set, it need not be altered.

The maximum heater-to-cathode voltage for the 6A7 is quoted at 62.5 volts. This meant that we could not use the same heater supply as used for the amplifiers and time-base, since this heater supply is returned to ground. To overcome this problem, a separate heater supply is used and the cathode is connected to one side of this supply. When fitting the cathode bypass capacitor for the vertical amplifier input, take care to insulate it from the front panel. We found that this arrangement gave the least trouble from ground loops in the input circuits.

A pattern for the CRT shield is given on our chassis blueprint but the general shape is as sketched. Made of tin-plate, the shield is reasonably easy to manufacture. After the cone is cut out, it may be formed by working it around a smooth piece of pipe held firmly in a vice. By gradually breaking the grain of the metal a crinkle-free cone may be formed. Tin the sections of the overlap joint before clamping it together with a small G-clamp. A hot soldering iron may then be applied to run the solder through the joint.

The cylindrical section of the shield is similarly fashioned and butt-jointed to the conical section. The completed shield should be a snug fit over the CRT, leaving a portion of about 5/16 inch from the face of the CRT free from shielding. A coat of enamel will help protect the shield from rust.

If it is preferred, the manufacturer of the CRT (Mullard) is able to supply a mu-metal shield for this particular tube. However, while far more effective as a shield, the commercial unit is not cheap.

MOUNTING CRT

When mounting the CRT on the chassis, a length of foam plastic packing should be wrapped around the face end to hold it securely in the mounting plate. A "U" shaped clamp on the neck of the CRT holds it firmly in place against the front mounting plate. Before tightening the "U" clamp the cathode-ray tube should be orientated correctly using the horizontal sweep trace.

While metalwork for this project will probably be available from some of our advertisers blueprints (2) will be available through our query service for those who like to "roll their own." The "Calibrate" terminal used on the oscilloscope supplies a clipped square wave of 1 volt peak-to-peak. It is necessary to vary the value of the resistance from the "Calibrate" terminal to ground to achieve the correct output. This may be done by checking the output with an oscilloscope of known calibration. If an oscilloscope is not available it can be checked with a VTVM. The VFVM should give a reading close to 0.29 volts RMS, corresponding to 447 P.P. for the waveform concerned.

We found on the prototype that a parallel combination of 10K and 68K gave the correct output, but this may vary from oscilloscope to oscilloscope.
TRUMPETS

H 210

- Low frequency cut-off: 350 Hz
- Sound distribution: 90°
- Air column length: 510 mms.
- Maximum diameter: 225 mms.
- Maximum length: 275 mms.
- Weight: 1,100 kgs.
- Power rating: 12 watts
- Watts peak: 25 watts
- Voice coil impedance: 16 ohms
- Frequency response: 150-6,500 Hz
- Maximum diameter: 82 mms.
- Maximum height: 60 mms.
- Weight: 790 grs.

Complete with accessories for application of line transformer.

H 300

- Low frequency cut-off: 220 Hz
- Sound distribution: 90°
- Air column length: ... 550 mms.
- Maximum diameter: 315 mms.
- Maximum length: 365 mms.
- Weight: 1,500 kgs.
- Power rating: 18 watts
- Watts peak: 35 watts
- Voice coil impedance: 16 ohms
- Frequency response: 120-7,000 Hz
- Maximum diameter: 82 mms.
- Maximum height: 60 mms.
- Weight: 1,020 grs.

Complete with accessories for application for line transformer.

H 800/s

- Low frequency cut-off: 85 Hz
- Sound distribution: 65°
- Air column length: 1740 mms.
- Maximum diameter: 825 mms.
- Maximum length: 920 mms.
- Weight: 16 kgs.
- Power rating: 25 watts
- Watts peak: 45 watts
- Voice coil impedance: 16 ohms
- Frequency response: 80-12,000 Hz
- Equalized compression system
- Maximum diameter: 88 mms.
- Maximum height: 70 mms.
- Weight: 1,200 grs.

Complete with accessories for application of line transformer.

Price on application.
THE CUSTOMER IS ALWAYS RIGHT

This well-born business slogan has served as a basis for dealer/customer relations ever since man first began to sell produce in a market place, and there is undoubtedly something to be said for it. Nevertheless, there are times when not only is the customer wrong, but he must be shown he is wrong if the serviceman is to retain his reputation.

Such a situation calls for diplomacy of the highest order.

THE story I am about to relate is a typical one; one where the customer was convinced he had been "done in" and was determined to make the point, or even worse, to vindicate himself at all costs. The serviceman should indulge, without much of self-effacement, in a number of other transactions, since the present discussion - over five years ago, had serviced it ever since, and had benefited from a number of other transactions from the same household. And, although he had been on a strictly business basis, it was inevitable that I had to know them pretty well. Certainly, I valued their respect of my ability and integrity just as much.

SUSPICIOUS TYPE

On the other hand, I had always had the feeling that the man of the family never really trusted me or, at least, that he was a typical service man in general. Perhaps I couldn't blame him for that, but I did feel that he should treat me, or any other servicemen, with respect.

The circumstances which led to the final showdown started in October of last year - the date is important when he complained that the TV picture was getting weaker. Apparently it had reached a stage where it could no longer be used during the day and only in a dimly lit room at night. I packed a suitable replacement picture tube and went out to have a look at the set that evening.

"What?" he replied, with obvious incredulity. "How long." I asked. "Have you been running the set without an aerial?" "What?" he replied, with obvious incredulity.

"I pointed to the floor behind the set, where the feeder lay unconnected on the carpet. Both he and his wife stared at it in obvious surprise, looked at each other, then back at me. "Is that all that's wrong with it?" the husband asked at last, probably because I was still talking. "No," I replied. "It may not be all, but it is one very good reason. Any idea how it happened?"

"The husband looked sheepish. "We sometimes pull the set out from the wall to make for more convenient seating," he said. I realized that I must have pulled it too far. "While we had been talking I had stripped the ends of the feeder and replaced them under the chassis terminals. After resetting the brightness and contrast controls, the set gave a near perfect picture. The only snag was the windscreen wiper bar which was still evident. This was obviously due to channel 10,
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Aux 5MV.
(8 ohm load).
VR Max. 25 MV,
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Frequency response
Harmonic distortion
Hum and noise
Output impedance
Tube complement
Ac input
30-20KC ± 2 DB.
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Distortion
Input sensitivity
Hum and noise
Output impedance
Tube complement
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which had caused a lot of similar problems in this area.

The husband picked this point immediately, probably to cover up his embarrassment over the aerial.

"It's that bar that really bothers me," he explained. "And that's been there since you put the new tube in."

"Since last October?" I asked.

"Yes," he replied, and his wife backed him up.

"Are you sure it hasn't been only since last April?" I asked. But both were adamant that it had been there since last October.

"In that case," I replied, half jokingly, "I'm afraid there is nothing I can do about it."

Naturally, they both expressed surprise and wanted to know why.

"Well," I explained in mock seriousness, "the only cause that I know of for that complaint is interference from channel 10. But if it started last October it can't be channel 10 because they didn't start transmissions before April. Therefore it must be a completely new fault that I know nothing about."

Perhaps it was a brutal way to prove nothing, but I had tried in other circumstances, but I had judged their reaction pretty accurately. The husband looked a bit sheepish and then grinned.

"Well, perhaps you're right," he said, "It's hard to keep track of when these things happen. It just seems that we've been playing up for a long time."

I agreed that it was difficult to be sure about these things, and went on to explain that other customers were often confused in this manner. This last was aimed at taking some of the sting out of my victory.

After all, the problem of the windscreen wiper bars was something of an anti-climax. Some adjustment of the AGC control, plus a small pad in the aerial feeder cured it completely. For the first time in many months the set was delivering a first-class picture.

We parted on the most cordial terms, and I am quite certain that I lost nothing by standing my ground and refusing to be browbeaten into taking the blame for something I hadn't done. In fact, I suspect that I may actually have boosted his confidence in my integrity.

Be it as it may, the story itself provides a clear example of how consumer confusion combined with natural suspicion, can lead to a serviceman being falsely accused of incompetence or malpractice.

The truth is, people DO lose track of when things happen, and it DOES seem to (them) that the set has been playing up for a long time. It needs only one more step in their imagination to link the present fault with the last service call to assume that one is the cause of the other. Unfortunately, not all cases are as clear cut or as easy to prove as the one I have just described.

While on the subject of public relations, here is another story which involved personalities as well as technicalities. Fortunately, it wasn't quite the serious situation portrayed in the previous story.

Most servicemen, I suppose, have encountered the job which has seriously embarrassed them, and to them an old phrase, "endangered a beautiful friendship."

In fact, this did involve a rather attractive member of the fair sex, a family acquaintance, who rang to inquire whether I could attend to a fault in the household radio. I couldn't, as it happened, because I was in the very act of packing for a few days' holiday, beginning on the following morning. However, the next morning, I suggested that she ring a serviceman acquaintance who lived not far from her address.

There the matter was forgotten until a few weeks later, when I received a phone call beginning "You know that set..."

It seemed that the friend had been duly rung, had made whatever repair was necessary at the time, since when, "It has never gone properly. It whistles and squeals... no, not all the time... but often."

Would I please pick it up sometime and fix it? She had not the slightest intention of giving it back to "that chap you recommended!"

Well, I picked the set up, as requested, with the intention of running it in the shop to give any intermittent troubles time to show up. In fact, nothing very definite did show up. The octal valve socket pins seemed a bit sloppy and were tightened; a slightly noisy 6K8 was replaced but it just played and played and played!

Hopefully, I took it back, only to learn, later, that it was still as bad as ever. She had put me in the same boat as my conferee.

Again I picked the set up and again I let it run and run in the shop until one thinking it over, it failed to produce the anticipated sound. Turning up the volume control, and tuning, produced a series of heterodynes; the set was...

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A new record changer called the DISCOMATIC was unveiled recently which may well make it possible for every home to have its own "jack" box. Developed in Switzerland by Engineer Jean Foufounis, President of Grammezt, S.A., the Discomatic excited the attention of the U.S. phonograph industry when it was demonstrated in New York. The Discomatic record changer makes it possible to load 40 seven-inch records into a portable rack, press up to 80 buttons for the selection desired, and sit back and relax while listening to from four to eight hours of uninterrupted music.

The secret is an ingenious record handling mechanism, precision-made, that is operated entirely by one small electric motor which runs at a constant speed all the time the machine is on. This mechanism, as opposed to electrical system activates the record selector controls, record pick-up and return, and supplies the power for spinning the records at either 33 1/3 or 45 r.p.m. The pick-up is coupled to a transistor amplifier and speaker, enclosed in an admirably designed case, and covered by a plexiglass dome that fits over the entire system for protection and carrying security.

The Discomatic has been available for some months in Europe and is now on the U.S. market. The inventor, Mr Foufounis, designed the record changer for seven-inch records only, because of his belief in the need for a 'freedom of choice' in recorded music.

SMOKING CRystal

And to finish off, here is an interesting letter from a reader, Mr P.H.R., of Lower Hutt, New Zealand. After saying some nice things about the Service-man stories, he goes on to describe a record player with a most unusual symptom. He suggests other readers might find it interesting. Here is the story:

"A record player was brought in for servicing with the rather nondescript symptom—it doesn't go. It was one of the more common types which uses a solid state power supply and a single triode/pentode valve (6CL52 8BM8) as both preamp and amplifier.

"It seemed a simple enough job and the player was plugged into the mains and the volume control turned full on in case the fault could be a weak cartridge or something similar.

"Imagine the surprise when, as the valves warmed up, the cartridge began to emit smoke. Nonsense, you will say. Who ever heard of a piece of crystal cartridge smoking? But he assured it really did smoke.

"After switching off in a hurry, a quick check with a meter solved the mystery. The culprit was a short between plate and grid in the triode section. The fact that the volume control was full on only helped accelerate the damage.

"A new valve and a new cartridge to replace the rather 'cooked' one soon put the player back into order.

"But it never pays to think you've won everything."

Well, thanks Mr P.H.R., for an interesting and amusing little story. I agree that there are probably few servicemen who have experienced anything quite like it.

However, I feel that there is one minor point which should be clarified. Which of the two plates, pentode or triode, was involved in the short to the triode grid?

Mr P.H.R.'s letter suggests that it was the triode, and this would be a natural assumption on the basis of probability.

On the other hand, a rough sketch which accompanied the letter suggests it was the pentode plate, and further consideration tends to support this idea. The main reason is that the triode plate circuit would consist of a fairly high value resistor, typically 100K or 220K, which would severely limit the current flow possible from this source. In view of the violent reaction within the cartridge, it seems unlikely that such a high resistance source could be responsible.

But the pentode plate could deliver quite a wallop, and seems a much more likely culprit. True, a short between the triode grid and pentode plate is less likely, but it is not impossible if a scrap of conducting material was floating around inside the envelope.

Which only makes the whole story more remarkable.
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ELECTRONICS Australia, August, 1965
POWER SUPPLY FOR EXPERIMENTERS

From Mr B. Currie, c/- B.S.L., Carrum Downs, Victoria, comes the following article describing a variable power supply. The supply is intended for experimental use and will deliver up to 80mA at a voltage variable between about 30 and 250V. It uses easily obtainable components, many of which may be in the traditional "junk-box." Mr Currie writes:

"This article describes a fully variable power supply for powering experimental projects, etc. It uses an ordinary full-wave valve rectifier and filter system, which is followed by a power triode valve (an 809 transmitting type, available from disposals) in series with the HT line.

"The bias on this valve can be varied, by means of the potentiometer connected between its plate and earth. The potentiometer acts as an output voltage control, since it varies the conductance of the valve and thereby the voltage drop across it. The action of the control is quite linear as the valve is virtually connected as a cathode follower. The output voltage can be reduced to about 30 volts for no output current, or increased to 250 volts with a 10 mA output current. It would be in order to use any pre-calibrated voltmeter available, or any meter up to say 5mA together with a suitable multiplier.

"I had considered using some source of negative voltage at the 'earthly' end of the voltage control to reduce the minimum voltage to zero, but decided that this was not worth the trouble. For the applications envisaged for the supply such low voltages would rarely be required.

"The 2-pole 3-position switch allows the HT to be switched off while leaving the valve filaments still running. Thus minor adjustments can be performed without having to wait for the filaments to warm up each time the supply is turned on.

"The 1181K 3W resistor was fitted from 809 filament winding. A 1181K 3W resistor was fitted from 809 cathode to earth to avoid contact potential from the 809 giving a voltage reading in the HT on position of the switch. The switching was arranged to short the HT through a 1K 3W resistor in the off position.

"Since both valves are directly heated, warm-up time is only a few seconds.

"In the original, the output was taken across the valve and thereby the voltage drop is quite flexible; almost any transformer, rectifier, filter, power valve and metering circuit could be used, provided current and voltage ratings for the various components are not exceeded.

"The bias on this valve can be varied, by means of the potentiometer connected between its plate and earth. The potentiometer acts as an output voltage control, since it varies the conductance of the valve and thereby the voltage drop across it. The action of the control is quite linear as the valve is virtually connected as a cathode follower. The output voltage can be reduced to about 30 volts for no output current, or increased to 250 volts with a 10 mA output current. It would be in order to use any pre-calibrated voltmeter available, or any meter up to say 5mA together with a suitable multiplier.

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"The 2-pole 3-position switch allows the HT to be switched off while leaving the valve filaments still running. Thus minor adjustments can be performed without having to wait for the filaments to warm up each time the supply is turned on.

"The 1181K 3W resistor was fitted from 809 filament winding. A 1181K 3W resistor was fitted from 809 cathode to earth to avoid contact potential from the 809 giving a voltage reading in the HT on position of the switch. The switching was arranged to short the HT through a 1K 3W resistor in the off position.

"Since both valves are directly heated, warm-up time is only a few seconds.

"In the original, the output was taken across the valve and thereby the voltage drop is quite flexible; almost any transformer, rectifier, filter, power valve and metering circuit could be used, provided current and voltage ratings for the various components are not exceeded.

"The bias on this valve can be varied, by means of the potentiometer connected between its plate and earth. The potentiometer acts as an output voltage control, since it varies the conductance of the valve and thereby the voltage drop across it. The action of the control is quite linear as the valve is virtually connected as a cathode follower. The output voltage can be reduced to about 30 volts for no output current, or increased to 250 volts with a 10 mA output current. It would be in order to use any pre-calibrated voltmeter available, or any meter up to say 5mA together with a suitable multiplier.

"It should be noted that the design
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Mounting screw 5/16 inch,
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Material zinc diecast,
Cord 6m,
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What are DRY REED SWITCHES?

One of the most intriguing pieces of electronic hardware to appear on the market in recent years is the dry reed switch or relay insert. Originally designed for telephone exchange switching, it has quickly established itself as an extremely useful device in a wide range of industrial electronic applications.

INTEREST in the magnetic reed switch was first aroused by the telephone industry's constant search for an inexpensive, reliable crosspoint for telephone switching networks. However, it was soon apparent that it had a much wider field of application and is now finding acceptance in the engineering world on a very wide scale.

Electrically, the dry reed relay offers nothing new; it is simply a pair of contacts which can be opened or closed in response to a magnetic field or, in this respect, would appear to be little different from the conventional mechanical relay which has been standard since the early days of telegraphy.

Mechanically, however, it has many unique features.

One of the most attractive is its complete simplicity. Two slender cantilevers of magnetically soft material are fused into the ends of a glass tube. The extreme ends of the reeds align and overlap separated by an airgap of about 0.1 in.

When the assembly is placed in a magnetic field, the ferromagnetic reeds become part of the magnetic circuit and the overlapping ends of the reeds assume opposite polarities. If there is sufficient flux, the stiffness of the reeds is overcome and they flex and touch. The reed tips are plated with precious metal contact material and a switch action is obtained.

The sizes of the units vary, but one of the larger ones has a glass tube diameter of .217 in and a length of 2 in. Overall length, including leads, is 2.75 in. By comparison, one of the smaller units is only .15 in diameter, .8 in long (glass) and 1.45 in overall.

To minimise the adverse effects of arc formation caused by oxidation, the tube is either evacuated or filled with an inert gas. The choice between these two, and the type of gas if one is used, depends on the intended application, particularly where extreme conditions are envisaged.

The result is a sensitive, magnetically operable pair of contacts, which are completely sealed against contamination: the oxygen of the atmosphere, dust, magnetic particles, industrial fumes, salt atmosphere, etc. The magnetic field to operate them may be provided by either an electromagnet (a coil wound around the glass tube) or a permanent magnet brought into close proximity.

When correctly used, the reed switch has a very long life. The actual life is primarily dependent on the load to be carried and interrupted. As load currents are increased, the reeds are subject to the erosion of materials experienced with conventional contacts. This causes loose particles of material to build up in the air-gap until a complete bridge is formed.

Variations in the characteristics of the reeds become apparent before complete bridging occurs. The narrowing air gap decreases the reluctance of the magnetic circuit, tending to bring the operate and release levels closer together and the contact resistance becomes unstable.

The frequency of operation also has a bearing on the life of the switch, since it has rather poor thermal conducting ability. Some switches contain several atmospheres of hydrogen to improve heat dissipation.

Typical life expectancy is of the order of 10^9 (100,000,000) operations when the current is limited to the "Long LifeRating" issued by the manufacturer.

This would range from 100 mA for the smaller sizes to 250mA, for the larger ones. However, the larger ones can be operated at up to 1 amp with some reduction in life expectancy which, however, would be perfectly acceptable in many applications.

On the other hand, the dry reed switch is finding particular application in circuits where currents and voltages are very low, too low to break down non-conducting films which may exist on normal relay contacts. The gold-plated reed switch is the most practicable answer to this problem. Gold-plated contacts, sealed against the ingress of moisture, oxygen and other film-producing agents, enable completely reliable switching to be achieved over a life of several hundred million operations.

The contact rating of reed switches is limited to some extent by the low contact pressures available compared with conventional switches. Reed spacing, the type of gas and the gas pressure determine the maximum voltage, which is usually of the order of 250 volts. The maximum load rating is normally about 15 watts. Higher ratings are achieved in some cases by using special contact materials and by increasing the air gap.

Another feature of reed switches is their high switching speeds. Closure times of less than 0.5 milliseconds are possible, with 2 milliseconds typical. Release times are normally from 0.5 milliseconds to 2 milliseconds. Closure times can be decreased by increasing the magnetomotive force: however, contact...
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bounciness proportional to the actuating force for the level with which it is saturated. The operating ampere-turns are recommended in manufacturers' data sheets are usually a compromise between operating and bounce duration. The bounce time is normally included when stating the operating time.

The sensitivity of reed switches is build-up during operation and is, therefore, dependent upon reed overlap and air-gap ratio, while release levels are determined by the stiffness of the reeds. Typical release levels are 70 to 100 ampere-turns and release levels 30 to 60 ampere-turns.

The basic reed configuration forms a normally open switch (A). A normally closed contact (B) can be produced by including a bias magnet in the magnetic circuit. Change-over contacts (C) are achieved by the addition of a second reed switch and magnetic or mechanical biasing.

Alternatively, there is now available a changeover type reed assembly (illustrated). This has two short contacts at one end and a long contact at the other. The long contact is mechanically biased against one of the short contacts, moving to the other contact under the influence of a magnetic field.

Another attractive feature of reed switches is relatively low cost. Types such as the XS2, even when bought in small quantities, cost about 10/ on the Australian market, which is a very reasonable figure for a component with such unique properties. Naturally, distribution costs are less for larger quantities.

The reed switch is finding a variety of applications in many industries. The basic reeds are suitable for almost every low level switching application and functional combinations of reeds may be used as relays, logic elements, switching networks such as crossbar matrices, selectors and commutators or computing elements such as flip-flops, counters, adders and shift registers.

A number of broad suggestions are illustrated in the accompanying diagrams. Those employing electromagnetic fields are, in general, similar to those already possible with conventionally operated relays, though possibly more satisfactory in regard to cost, size, reliability, etc.

Permanent magnet operation, on the other hand, would seem to offer more scope for completely new applications, or high orders of improvement over conventional methods. A typical example is its use in place of conventional mechanical door and window contacts in burglar alarm systems. Mechanical contacts have several disadvantages; they are not always as reliable as they need to be, leading to alarm failures or false alarms; they are not easy to conceal, and they are often relatively expensive if a high order of reliability is sought.

The reed switch overcomes all these objections. It is small enough to be housed in a simple recess cut in a door or window frame and becomes virtually invisible when covered with putty and paint. Similarly, a small permanent magnet may be mounted in the door or window in such a position as to close the reed contacts when the door or window is closed. The system has near perfect reliability, is virtually invisible, and is relatively inexpensive.

A completely different application is found in the medical sphere. People with certain heart defects can be given a much longer expectation of life by means of an implanted pacemaker; a simple electronic pulse generator which delivers regular stimuli to the heart muscles.

However, such a pacemaker, once implanted, cannot be turned off or its speed altered without recourse to surgery, and there are times when both of these requirements may need to be met.

In some cases, for example, natural heart stimulation may recur spontaneously and, if it does, there is a risk that it may conflict with the pacemaker pulses in a manner which leads to ventricular fibrillation, a condition which is invariably fatal if not treated immediately—usually involving surgery. If the pacemaker can be turned off when normal rhythm recurs, this can be avoided.

Again, it is often necessary to change the speed of the pacemaker, particularly during the post-operative period after implanting.

Until the advent of the reed switch there was no way of performing either function in the conventional pacemaker.

In 1964, J. Weinman, of the Rogoff Laboratory for Medical Electronics, Jerusalem, described the use of a reed switch in an implanted pacemaker, actuated by a permanent magnet outside the patient's body, to switch the pacemaker on or off as required.

At the present time, an Australian manufacturer is marketing a highly successful pacemaker which may, according to the type, be switched off or switched on to a different speed by means of an external permanent magnet.
The Revox G36 is a two-speed, three-motor, semi-professional, high-quality tape recorder featuring separate recording, playback and erase heads.

All forms of duoplay or multisplay without accessories or bridging cables are possible and remote control and/or pre-selected operating modes can be selected by push-buttons.

Each channel has an individual VU-meter to control the record level while cathode follower outputs provide for amplifier, headphones, or pulse coder for an automatic slide projector. A built-in 6-watt monitor amplifier can be switched to each channel or used with a high-quality speaker system.

The capstan is driven by a hysteresis-synchronous type motor with pole-switching to provide the two speeds. Spool sizes from three inches to 10½ inches can be used and an end-of-tape cut-off is incorporated. It will rewind 2,400 feet of tape in less than 80 seconds.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>TAPE SPEEDS:</th>
<th>7/1, 3½ ips</th>
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<tr>
<td>SPEED ACCURACY:</td>
<td>0.3% from nominal</td>
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<tr>
<td>WOW AND FLUTTER:</td>
<td>0.1% peak reading weighted (DIX45507)</td>
</tr>
<tr>
<td>FREQUENCY RESPONSE:</td>
<td>40 - 18,000 cps at 7½ ips</td>
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<tr>
<td></td>
<td>2 db — 3 db</td>
</tr>
<tr>
<td></td>
<td>40 - 12,000 cps at 3½ ips</td>
</tr>
<tr>
<td></td>
<td>2 db — 3 db</td>
</tr>
<tr>
<td>INPUTS PER CHANNEL:</td>
<td>0.5 microvolts, Max 600 mV</td>
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<tr>
<td></td>
<td>2 radial input at 1 Mohm, Max 10V</td>
</tr>
<tr>
<td></td>
<td>3. Aux. 3-500mV at 47 kohm</td>
</tr>
<tr>
<td>LINE VOLTAGES:</td>
<td>110, 125, 145, 220 and 240 Volts, 50 cycle</td>
</tr>
<tr>
<td>WEIGHT:</td>
<td>Approx. 45 lbs.</td>
</tr>
<tr>
<td>CASE DIMENSIONS:</td>
<td>19 in. x 13½ in. x 12 in</td>
</tr>
<tr>
<td>HARMONIC DISTORTION:</td>
<td>2 track recorder: 55 db</td>
</tr>
<tr>
<td></td>
<td>4 track recorder: 52 db at peak record level with 5% harmonic distortion.</td>
</tr>
</tbody>
</table>

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ELECTRONICS Australia, August, 1965
ternal magnet and an internal reed switch.

Yet another use is by model railway enthusiasts, to detect the movement of a train into or out of a section. The reed switch is buried in the track and a suitable magnet suspended beneath a unit of rolling stock. As the train passes over it, the reed switch closes momentarily and may be used to pull in a locking relay which indicates that the section of the track is now occupied.

These are but a few typical applications, in quite different fields, which give some indication of the versatility of these units. The possibilities are almost unlimited and any electronics engineer faced with an industrial control problem might well stop and consider whether the reed switch may solve it.

MAGNETS

Quite simple permanent magnets will operate the reeds in most applications. What are known as "stick-cast" magnets (they are cast in "sticks" which are subsequently broken up into individual magnets) and which are commonly used for magnetic door catches and similar functions are quite suitable for many jobs. A typical unit, measuring 2in x 3/8in x 7/32in, and capable of lifting a 7oz steel block, will pull in a typical large reed switch at 5/8in and release it at 5/8in.

Reverting to electromagnetic applications, a lot of interest centres on the power or amper-turns needed to operate various types and combinations of reeds, and the coil designs necessary to achieve this.

Combinations of reeds, within a single coil, are used to simulate the conventional multi-contact relay. By using both single-contact and changeover types, quite a wide range of functions can be achieved, with the added advantage that the individual can make up any combination to suit his requirements.

At the same time, it should be emphasised that the dry reed relay is not an automatic replacement for the conventional relay. While it will do a better job and provides greater design flexibility in many applications, there are still a great number of jobs best performed by the conventional relay. This applies particularly where large numbers of contacts are required on a single relay and/or heavy currents are involved.

Australian manufacturers are currently producing a range of reed relay bobbins and coils which are suitable for most of the reed switches currently available. The bobbins are designed to cater for a variety of component mounting techniques, including printed circuit, metal chassis and post-office 2,000-type mounting practice.

Coil design is based on amper-turns data. Data sheets normally specify either the power, in milliwatts, or the amper-turns necessary to close the contacts. Most coil design is based on amper-turns data. Data sheets normally specify the "Just Operate Amper-turns" and most coil design includes a safety factor (say 1.5) to ensure positive operation.

The following information is presented for the use of engineers or experimenters who wish to design their own coils for operating dry reed inserts. Simple coils suitable for operating one or two inserts are discussed, but the design principles may be extended to more complex coil assemblies. For example, two coils wound on a common bobbin may be designed to produce a latching relay, an AND gate, or an OR gate.

The operate parameters given in dry reed insert data sheets are based on the use of the insert in a standard test coil. The length of the test coil is approximately the same as the glass length of the insert. Shorter coils can increase the efficiency of the relay by reducing the number of amper-turns required to operate the insert, but the relative positions of the coil and insert become more critical as the coil length is reduced and a small displacement of the insert can have a large effect on the operate sensitivity of the relay. The operate and release times of the relay are largely dependent upon the coil parameters, coils with higher Q giving faster operation.

For normal use, it is recommended that the coil length be similar to that of the test coil for the appropriate type of insert. This will enable the operate parameters given in the data sheet to be used without modification.

In order to achieve fast operate time without excessive contact bounce, single insert coils should be designed to operate at 1.5 times the operate amper-turns of the insert, and two insert coils at 1.75 times the operate amper-turns of the insert.

LONGITUDINAL OR PERPENDICULAR MAGNET TRAVEL FOR PROXIMITY SWITCHING

TACHOMETRY OR ROTARY MAGNET MOVEMENT

Typical applications using permanent magnets to actuate the reeds. Many variations on this theme are also possible.
<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Input Volts</th>
<th>Output Volts</th>
<th>Magrath Price</th>
<th>Notes</th>
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<tr>
<td>BPS</td>
<td>2.5 Amps</td>
<td>240</td>
<td>0.260</td>
<td>£8/7/6</td>
<td>Plus 12½ p.c. Sales Tax</td>
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<tr>
<td>SB5</td>
<td>5.0 Amps</td>
<td>240</td>
<td>0.260</td>
<td>£11/12/6</td>
<td>Plus 12½ p.c. Sales Tax</td>
</tr>
<tr>
<td>PI</td>
<td>0.5 Amps</td>
<td>240</td>
<td>0.260</td>
<td>£4/5/-</td>
<td>Plus 12½ p.c. Sales Tax</td>
</tr>
<tr>
<td>SB10</td>
<td>10 Amps</td>
<td>240</td>
<td>0.260</td>
<td>£14/5/-</td>
<td>Plus 12½ p.c. Sales Tax</td>
</tr>
</tbody>
</table>

Also available... 3 phase unit built in current ratings from 2.5A up to 25A.
The basic expressions necessary for the calculation of one and two insert coils are given below:

(a) Physical Characteristics.

Depth of winding, \( B = \frac{N}{n} \) in.
Length of average turn (single insert coil), \( P = \pi (d + B) \) in.
Length of average turn (two insert coil), \( P = \pi (d + B) + 2s \) in.
Total length of wire, \( L = \frac{PN}{36} \) yd.
Overall winding dia., \( D = d + 2B \) in.

(b) Electrical Characteristics.

Resistance of winding, \( R = \frac{Lr}{1000} \) ohms.
Current through coil, \( I = \frac{X}{N} \) amps.
Coil supply voltage, \( V = IR \) volts.
\( N = \) Total number of turns.
\( n = \) Number of turns per square inch for a given gauge of wire.
\( a = \) Length of winding.
\( d = \) External diameter of central core.
\( r = \) Resistance of wire per 1000 yd.
\( X = \) Design ampere turns.

The following examples illustrate methods of coil design:

(1) Information known:
Design ampere turns (= 1.5 times operate ampere turns of insert).
Coil current.
Bobbin dimensions.

Information required:
Wire gauge.
Coil supply voltage.

Method:
We have, \( B = \frac{N}{na} \)
and \( D = d + 2B \)

(2) Information known:
Design ampere turns (= 1.5 times operate ampere turns of insert).
Gauge of wire to be used.
Number of turns.
Length of bobbin.
External diameter of central core of bobbin.

Information required:
Overall diameter of winding.
Coil current.
Coil supply voltage.

Method:
We have, \( B = \frac{N}{na} \)
and \( D = d + 2B \)

Typical coil bobbins for use with reeds. In the top row are four, two and one reed bobbins for the larger (X52) type reeds. At lower right are one and two road bobbins for the smaller (X56) type. At lower left is a four reed bobbin with a 10000 ohm winding. Bobbin dimensions quoted in the formulas are given on page 61.
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ELECTRONICS Australia, August, 1965
Method:

Since it is possible to use a number of different combinations of turns and wire gauge to obtain the same operating conditions, it is necessary to stipulate either the wire gauge or the number of turns before the other coil parameters can be calculated.

If the number of turns are specified, the problem becomes similar to example (I).

If the wire gauge is specified, the number of turns is calculated from

$$N = B n$$

This figure can be rounded off to a convenient value below that calculated and the other coil parameters are obtained as in example (I).

N.B.: the values calculated from the equations given above are theoretical, and may differ slightly in practice due to the variation in coil winding efficiency, etc.

We wish to acknowledge the very valuable assistance, technical data and diagrams, given us by the following firms:

Ducon Condensers Pty. Ltd., P.O. Box 2, Villawood, N.S.W. Australian agents for "Hivac" Dry Reed Relay Inserts.

Telephones and Electrical Industries Pty. Ltd., Faraday Park, Meadowbank, N.S.W., manufacturers of reed relay bobbins and coils.

Rola Company (Aust.) Pty. Ltd., Prince’s Highway, Noble Park, Victoria, and 167-187 Kent Street, Sydney, N.S.W., manufacturers of a wide range of industrial magnets.

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<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
<th>Description</th>
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<tr>
<td>TV AERIALS SPIRAL TYPE</td>
<td>19/6 ea.</td>
<td></td>
</tr>
<tr>
<td>ARMORED PLATED GLASS</td>
<td></td>
<td>Suitable for Bench Top Work 3/6 ea.</td>
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<tr>
<td>24 HOUR TIME CLOCKS</td>
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<td>240 volts 10—15amp.</td>
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<tr>
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<td>10/-</td>
<td>each</td>
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<tr>
<td>Lapel Microphones</td>
<td>10/-</td>
<td>each</td>
</tr>
<tr>
<td>Panel Meters 0-300V AC</td>
<td>39/6</td>
<td>each</td>
</tr>
<tr>
<td>POWER TRANSFORMERS</td>
<td></td>
<td>Prim. 220-240-255V Sec. 218V 270 M/A Filament 6.4V 8 AMPS 25/- each</td>
</tr>
<tr>
<td>NEW Carrying Handles</td>
<td>1/6</td>
<td>each</td>
</tr>
<tr>
<td>VIBRATORS 6V 12V Synchronous</td>
<td>5/-</td>
<td>each</td>
</tr>
<tr>
<td>500 K. C. DOUBLE POTENTIOMETERS</td>
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<tr>
<td>WALL EXTENSION SPEAKER</td>
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<td>Small ........ 47/- Large ........ 56/-</td>
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<tr>
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<td>5/-</td>
<td>coil</td>
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<tr>
<td>9V RADIO BATTERIES</td>
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<td>each</td>
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<td>1 amp ...... 1/- ea. 2 &amp; 3 amp ...... 1/3 ea. 5 amp ...... 1/6 ea.</td>
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<td>240V 50 Cycle 15/- each</td>
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<tr>
<td>CAR AERIALS Locking Type Invisible Aerials</td>
<td>3£</td>
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- DC Current: 0.5 to 500 mA.
- Resistance: 0.6 to 0.1 M Ohms.
- Capacitance: 0.001 to 10 Mf.
- Decibels: -20 to +30 db.
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ELECTRONICS Australia, August, 1965
PLATING at home...

Every so often we are asked for information about home electroplating — what sort of anode to use, the composition of the electrolyte, the current density, and so on. This article is intended as a guide to the home plater, and gives the essential information concerning copper, nickel, gold, silver and rhodium plating. It also describes electrolytic cleaning and aluminium anodising.

HOME plating normally does not require expensive or highly elaborated equipment. One can plate small objects such as keys, cutlery, small radio components and jewellery using nothing more than a pint or two of electrolyte in a glass jar, a piece of metal for an anode, some copper wire and a 3V cycle battery. With the addition of a thermometer and using a variable voltage supply to replace the battery it is possible to carry out many of the operations performed in a commercial plating shop.

The photograph shows one variable supply which may be used for plating the "Transistor Regulated Power Supply" of April 1962. However if this supply is used it would be wise to fit it with a series resistor to protect it against accidental shorting of the output. A 3-5 ohm resistor would be suitable in most cases.

A number of small imported variable supplies are currently available which would also be suitable. These are usually capable of delivering 200 milliamps or so, and would be quite suitable for plating small objects and jewellery.

It is an advantage to have an ammeter to monitor the plating current, although such a meter is by no means essential; similarly a voltmeter is a worthwhile but not essential addition.

Most home plating can be done with no more than a quart of electrolyte in a glass or plastic container, together with a similar container for the cleaning bath. Gold, silver and rhodium plating solutions should be used in glass jars so that they can be fitted with airtight screw caps when not being used. This is desirable to prevent decomposition of the electrolytes, and also to prevent contamination with dust, etc.

In the case of gold and rhodium plating solutions, the use of a glass jar also allows the plating bath to be safely heated to the correct working temperature. This is done by placing the jar in a dish or tin of hot water—not by directly heating the jar.

With the exception of rhodium plating, the financial outlay will usually be quite modest. Chemicals for making up a gallon or so of copper or nickel plating electrolyte will typically cost about 10/-, while a piece of copper or nickel for the anode will be 5/- at most.

Commercial salts to make a quart of silver or gold plating electrolyte typically cost 20/- and 26/- plus tax, respectively, and, if stainless steel is used for the anode, this will cost only a few shillings. Fine silver or gold anodes, if used, will be more expensive—about 25/- for a typical silver anode for jewellery work, and about 70/- to 90/- for a fine gold anode of similar size (both plus tax).

Rhodium plating is somewhat more expensive, with a bottle of salts to make up one litre of electrolyte costing 108/- plus tax. For serious plating in a home plating bath it is recommended that these should be ordered through the local pharmacy. Nickel foil for an anode may be obtained from the same suppliers.

Gold, silver and rhodium plating salts, electrolytic cleaning salts and precious metal anode material may be obtained from precious metal refiners. One such firm is Matthews Garrett Pty. Ltd., has offices in Sydney, Brisbane and Richmond, Victoria, and will supply materials by mail if payment is made in advance. The Sydney address is 824 George Street.

The first requirement in plating is that the work must be thoroughly cleaned and if a polished finish is required, the work must be polished before plating. Plating will not cover up a rough surface, but will it adhere to a dirty surface.

The amount and type of cleaning required will depend upon the work itself. It is greasy, it must be degreased by bathing in an organic solvent such as petrol or trichlorethylene. If clean but dull and oxidised, it is should be pickled in a bath of strong acid—a mixture of concentrated nitric and sulphuric acid is often used, called "bright dip".

Small objects such as jewellery and small radio parts can often be cleaned...what you need to know

WARNING!

PLATING and electrolytic cleaning solutions are highly dangerous. Most are extremely corrosive, containing either acid or strong alkali. Gold and silver plating electrolyte and electrolytic cleaning compounds contain deadly cyanide compounds.

Parents are therefore strongly warned against allowing children to experiment with electroplating. This article is not presented for the youthful experimenter, but for the responsible hobbyist and amateur jeweller.

Those who engage in plating are warned that they should employ all possible care. After plating, wash the equipment, the plated work and your hands very thoroughly to make sure that no trace of plating compound will adhere to a dirty surface.

Electroplating is a field of serious occupation and these warnings are made with this in mind.

It is also recommended that the use of a glass jar should always be used. A glass jar prevents any possibility of electric shocks, and the use of a glass jar will also make it easier to monitor the plating current, although an ammeter is not essential. A voltmeter is also a worthwhile addition.

Commercial salts to make a quart of silver or gold plating electrolyte typically cost 20/- and 26/- plus tax, respectively, and, if stainless steel is used for the anode, this will cost only a few shillings. Fine silver or gold anodes, if used, will be more expensive—about 25/- for a typical silver anode for jewellery work, and about 70/- to 90/- for a fine gold anode of similar size (both plus tax).

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Small objects such as jewellery and small radio parts can often be cleaned...
sufficiently by boiling them for ten minutes or so in a fairly strong solution of household detergent.

In general, however, it is very desirable to clean the work finally in an electrolytic cleaning bath. Such baths are best made up from commercial salts, which are quite inexpensive—a jar of the best made up from commercial salts. Electrolytic cleaning with such salts uses the work as cathode (negative) and plating of the various metals has been incorporated into a table, to allow easy access. Current density values and times required are only approximate and should be regarded as a guide rather than rigid prescriptions. The following comments may also be found useful.

Before plating, make sure that all trace of the cleaning solutions, polish, etc., is removed from the work. Rinse thoroughly, preferably in distilled water. Before rhodium plating a rinse in distilled water is virtually essential.

For copper and nickel plating the electrolyte is made up from common chemicals including those shown here—copper sulphate, nickel sulphate and sulphuric acid. Commercially prepared plating salts are recommended for precious metal plating, however, as the chemicals required are rather dangerous. The photo on page 64 shows a typical set-up for copper plating.

In all plating work the work connects to the NEGATIVE terminal of the battery or power supply. Support the work in the plating bath by a hanger of copper wire—clean and untinned, to ensure good contact and prevent bath contamination. Tie the wire to the work loosely, at a place where it will not prevent plating at an important part of the surface.

The current density is simply a mea-

---

**HOME PLATING INFORMATION**

<table>
<thead>
<tr>
<th>PLATING METAL</th>
<th>SUGGESTED ANODE (+)</th>
<th>SUGGESTED ELECTROLYTE</th>
<th>CURRENT DENSITY ma/sq. in.</th>
<th>TEMPERATURE degrees F.</th>
<th>APPROX. TIME</th>
<th>SURFACE METAL OR PRIOR METAL PLATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPPER</td>
<td>Copper</td>
<td>2 pints Dist. Water 7oz Copper Sulphate 1oz (16mL) Sul. Acid (ADD ACID TO WATER)</td>
<td>70-250 (1-4V)</td>
<td>Room temp.</td>
<td>1-5min</td>
<td>Nickel plating required before plating copper on iron or steel.</td>
</tr>
<tr>
<td>NICKEL</td>
<td>Nickel (foil)</td>
<td>2 pints Dist. Water 4oz Nickel Sulphate 1oz Ammon. Chloride 1oz Boric Acid</td>
<td>70-150 (1-2V)</td>
<td>Room temp.</td>
<td>10-20min</td>
<td>Direct on brass, copper, steel, iron, etc.</td>
</tr>
<tr>
<td>GOLD</td>
<td>High qual. stainless steel</td>
<td>MAKE UP FROM COMMERCIAL SALTS (see text)</td>
<td>10-20 (approx 3V)</td>
<td>110-140</td>
<td>10-60sec</td>
<td>Initial plating of nickel req. for thin gold plating. Otherwise plate on silver.</td>
</tr>
<tr>
<td>SILVER</td>
<td>High qual. stainless steel Fine Silver</td>
<td>MAKE UP FROM COMMERCIAL SALTS (see text)</td>
<td>20-30 (approx 1V)</td>
<td>Room temp. (60 deg. or higher)</td>
<td>5-40sec</td>
<td>Copper plating req. first over soft solder.</td>
</tr>
<tr>
<td>RHODIUM</td>
<td>Platinum, or high-quality stainless</td>
<td>MAKE UP FROM COMMERCIAL SALTS (see text)</td>
<td>50-80</td>
<td>100-110</td>
<td>10-60sec</td>
<td>Plates on silver, gold, platinum, copper, nickel, etc., BUT NOT iron, steel, zinc, lead or aluminium.</td>
</tr>
</tbody>
</table>

**ELECTROLYTIC CLEANING**

Make up electrolyte from commercial salts. Maintain the bath at 180 degrees F. or maximum allowed by work. Use a nickel anode (+) and approximately 6V for about 10-15 seconds. Rinse the work well before immersing in plating bath, preferably in distilled water.

**ALUMINIUM ANODISING**

Use a lead or mild steel cathode (—); work is anode (+). Use 12V or more, for 20-30 minutes. The electrolyte is 4oz (70mL) of Sulphuric Acid in 2 pints water. Use aluminium hangers for work. (ADD ACID TO WATER, slowly.)
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ST. PETERS, S.A.

**ELECTRONICS Australia, August, 1965**
or steel. To copper plate these metals even plate.

to ensure that electrolyte. In the case of gold plating.

that to shake or vibrate the work and hanger poorly adhesive coating.

in "burning" - a spongy. uneven and Too great a current density will
density which gives value shown of surface area by the current density.

surface area - don't try to measure it face sure of the current per unit of total sur-

Before nickel. Acid pickling may be required it

ing silver may tend to diffuse through should he used.

visable. To be plated, a nickel undercoat is

Estimate S"Nrersion. When a very thin coating of gold is

a most attractive finish. as witnessed by aluminium work.

plating is anodising, which is commonly used to impart an even matte finish to aluminium work. Anodised aluminium can be dyed with organic dyes to produce a most attractive finish, as witnessed by many domestic drinking tumblers and saucepan lids.

Anodising the surface of the alum-

imium is converted into a thin and even layer of aluminium oxide. This may be produced by immersing the aluminium object in a weak caustic solution such as sodium or potassium hydroxide, or alternatively by the electrolytic process shown in the table.

In contrast with plating, the work is connected to the positive terminal of the supply and becomes the anode. A lead or mild steel cathode is used, and the electrolyte is dilute sulphuric acid—some 70mL of concentrated acid per quart of water. (Other electrolytes are sometimes used, such as chromic or oxalic acid, but sulphuric acid is usually easiest to obtain.)

Fairly high voltages are employed from 12-20V. The current may be quite high, and an accumulator is best used as the supply. The process takes some 30 minutes. Make sure that only aluminium is in contact with the solution at the positive electrode—use an aluminium strip hanger, or leave part of the work out of the solution.

If an aluminium hanger is used, it should be firmly attached to the job, the anodised aluminium surfaces are very poor conductors.

When anodising is complete, the work should be thoroughly washed. It may be dyed by immersing it in cloth dyes (the colourfast variety is preferable). To make the dyeing fast the work can either be neutralized with water or boiled in water—the latter removes some of the colour, but "fixes" the rest.

And with that necessarily rather brief discussion of anodising we must bring this article to close. In closing the author would like to gratefully acknowledge the assistance provided by the firm of Matthey Garrett Pty. Ltd., who were most courteous and helpful in providing plating information and details of material availability. Without their assistance the article could hardly have been written.

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As so often happens with these columns, after the tumult and shouting of major arguments have passed, we are left with a collection of "bits and pieces"—observations which came in too late for the mainstream discussion, items that have been passed over, and so on. This is one of those months.

By W. N. Williams

The interests of continuity, however, we can begin with the matter of component prices in Australia, which has been the subject of running comment in the past two or three issues. A point which has been brought to our notice is the relevance to the situation of modern mechanised (or should we say computerised?) methods of accounting and stock control. I don't profess to be an expert in these matters but the broad story, as put to me, is clear enough.

Stock control and accounting has always been a tremendous headache to any manufacturer concerned with large numbers of small, low-cost items, made to a variety of specifications and supplied in a variety of quantities to a variety of purchasers. Resistors, capacitors and other small items common in the electronics industry provide classic examples of such products.

Tight stock control by the old book- and-pencil methods could become costly beyond reason.

"Loose" stock control led to inefficiency through wrong production planning, unwise purchase of raw materials, and such like, with plenty of opportunity for pilfering or other unprofitable "leakage" of stock.

A course which is currently being adopted by industry is to install a computerised accounting system and channel the day-to-day activities through it, so that it becomes a "Big Brother" who hears all, sees all and knows all.

It knows the stock position at any point in time and is fed with information in a strictly standardised form and this keeps quite a lot of people busy—so many, in fact, that the "economies" of computerised operation are currently the subject of much argument in the business world.

But that is another story.

Be that as it may, for big clients and big orders, the system works well and the cost of injecting information to the computer system is small compared with the profits from the transaction.

But here's the rub.

Unless special provisions are made, exactly the same system has to be used and the same process costs are involved for small orders as for large. The system goes through the same motions to handle the sale of 0,000,001 resistor for £1000.00.00 as it does for 1,000,000 resistors for £2500.00.00.

What's more, it makes no effort to conceal the average cost of handling each individual transaction. That is one reason why executives, these days, are not too inflexible on matters of individual stock.

In talking to us during the month, one such executive rick-some thing like the foregoing and finished with the refrain: "We've got 'em by the million! But we can't sell you one!"

He then went on to speculate about the possibility of some individual wholesaler acting as a distribution agent for small quantities but ended with the grumble that wholesalers won't think this way and won't spend money individually on reasonable stock.

Which brings us right back to the observations in earlier issues.

What bothers me is why computer systems or other automated stock-handling procedures have to be so inflexible.

Surely a manufacturer should be able to set up a small subsidiary stock of his own lines which could be fed in bulk to the computer system but sold in small quantities by the most economical possible means.

Every office has a petty-cash system which is there to cover small but necessary expenditure on items which are individually too trivial to warrant separate detailed accounting.

Surely it should be possible for manufacturers to operate this in reverse, to handle sales which are individually unimportant but significant in total—and significant in more ways than one.

On the subject of kits, G.B. of Townsville, Qld., says that he was interested in acquiring tape equipment along the line of our Playmaster 110. He had thought to build it but found that he could buy it ready assembled for only £6 more than the cost of the kit.

To quote: "What would be the sense of my fiddling around with a soldering iron, smoking myself silly in the wee small hours, only to make a killing of six quid? And that's assuming the whole thing worked when I'd finished!"

He goes on to say that he subscribes to an English journal and indications there are that considerable savings can be effected by buying a kit or buying it ready built.

He goes on: "One of the clues appears to be the kit price. Here, everything carries a pretty high level of tax whereas, in Britain, the purchase tax varies and, in some cases, does not apply. The situation is such that it is possible to buy, in Britain, the 'works and box' much cheaper than the case where the works already inside.

'Incidentally, one of your advertisers says 'quality assembled test equipment at Kit Price.' Very soon it will be cheaper to buy a completely assembled and tested piece of equipment, simply to tear it apart for the pleasure of building it ourselves'."

A number of readers are obviously intrigued by this latter situation—ready-built kits competitive with kit prices. On the surface it appears plain ludicrous.

Here again I (or we, the magazine) have no first-hand knowledge of exact costs, because we have no connection with any electronic business house. We originate and publish designs for the benefit of our readers, and it is of no special significance to us whether readers build them up for the pleasure and instruction of so doing or buy them ready made.

However, we do hear comment regarding both activities which tend to explain the situation.

As we have already said, the costs of marketing small quantities of components are very real and multiply as the buyer—

(1) Spreads his purchases over more occasions;

(2) Delays the man behind the counter while he makes up his mind or talks about his problems;

(3) Expects every item to be well packaged and complete with lead connection data.

All these things are very much a feature of over-the-counter selling and

Electronics Australia, August, 1965

69
for quality, select
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70
Dear Sir,

The following matter appears of sufficient interest that you may wish to give it early and appropriate publicity in your journal. It appears that, by a recent decision of the Minister for Customs, Mr Ken Anderson, the traditional high duties imposed on important items of radio equipment imported into Australia from foreign sources may be remitted in certain circumstances.

The Minister was requested to review the following incident: In April, 1965, I sent a 500-cycle bandwidth 455KC mechanical filter to Mr H. N. Bowman, VK5FM, of Bridgewater, S.A.; purchased at his request in connection with experiments planned with two respective amateur stations in the VHF bands. The filter was estimated for Customs duties at £14/9/0, or about 80 per cent of its wholesale price.

Representations were made to the Minister by me and others, indicating the impossibility of obtaining such equipment now or in the immediate future, and its vital importance in a serious research project. It was further emphasised that Australian radio amateurs had traditionally expended much of their limited personal resources to ensure that their equipment was equal to the world's best, exercising great ingenuity in the face of limited availability of appropriate industrial components.

In a letter from the Minister of Customs, dated June 1, 1965, I am advised that it has been decided to admit the filter duty free. I understand that the Minister has expressed to Mr Bowman his appreciation of the "excellent technical description" accompanying the request for removal of duties.

This enlightened and historic legal precedent hopefully opens a new door to the future of the Australian experimenter. As always in such matters, continuance of this attitude by the authorities will depend on respect for the legal intent: It would appear to cover items intended for experiment and not available in Australia, and not the abuse of this privilege by the irresponsible may well wreck the operation for the many. Let us hope that commonsense will prevail.

As a former Australian now engaged in brain research with many commitments in the area of biomedical engineering, I am ever mindful of the almost incalculable importance of a body of sophisticated technological knowledge in the Australian community. It may well rank with seemingly more specific commitments in the country's development, and particularly in its defence. For this reason, the opportunity to take full advantage of overseas technological developments should be available to the Australian experimenter.

Sincerely yours,

W. Ross Adey, M.D. W8DFF/M
(Professor of Anatomy and Physiology, University of California, Los Angeles, Director, Space Biology Laboratory, Brain Research Institute, University of California, Los Angeles.)

--

The reference to dictionary sounds like a sly dig at our habit of quoting references when challenged on technical points. If so, there'll probably be opportunity for plenty more digs, because, it's a very natural and reasonable thing to do.

But in this case I propose to raise no further defence. Our correspondent has made a very good point and one well worth watching in future. I quote from his last part: "As you do not often stray over the grammatical no-man's-land, I can only take a pot-shot very rarely. Still it's nice to have you wonder what your structure might be to which I can only reply . . . ."

When I, or we, start taking offence at construction, it will be time to step down for someone else.

ELECTRONICS Australia, August, 1965
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TV Aerials and TV Sound

Our Answer Man, this month, has been called upon to discuss a couple of matters to do with television reception — the idea of stacking television aerials for distant reception and the problem of receiving hum-free TV sound signals on a wide-range FM broadcast tuner.

I have a book about television made easy. It mentions that better signals can be received by stacking two aerials, with half a wavelength between them, and joining them with ribbon. How long is half a wavelength?

We don't know whether your phrase 'television made easy' is the actual title of the book or a description. Frankly, we are not at all happy about some of the books we have seen, which might qualify for such a description. In hypotathing to one of the 'not so hard' aspects, they can all too easily end up with half-truths, particularly if the author is more gifted as a writer than as an engineer.

In these circumstances, the term 'half a wavelength' is quite meaningless in terms of aerial spacing.

Nor does the problem end there. If it isn't right just to connect two aerials together with a piece of aerial ribbon and expect them to work efficiently in union.

The practice of mounting aerials a fraction of a wavelength apart is commonly advocated in handbooks on VHF aerials but a wavelength is not a fixed unit of distance, as you appear to imagine.

Radio signals travel through space at a speed of about 300,000,000 metres per second.

If a signal has a frequency of, say, 100 megacycles per second, it can be suggested that 300,000,000 complete wave cycles will pass a given point in one second.

From these two figures, it follows that the length of each wave in space must be 3 metres.

For a signal having a frequency of 200 megacycles per second, the wavelength would be 1.5 metres, and so on.

In short, the wavelength of a radio signal varies inversely with frequency.

Assuming that wavelength is expressed in metres and frequency in cycles per second, either one can be found by dividing the other into 300,000,000.

With wavelength in metres and frequency in kilocycles per second (KC) either can be found by dividing the other into 300,000.

For metres and megacycles per second (MC) use 300.

Where an aerial has to operate over a narrow and specific band of frequencies — say a single TV channel or the 144-148MC amateur band — no special difficulty arises, because the equivalent wavelength can be calculated, as also the spacing of the aerials.

But general purpose television aerials are commonly designed and required to operate over a wide range of frequencies from 50MC or below to over 200MC. The incoming signals may therefore have a wavelength ranging from more than 6 metres to less than 1.5 metres.

In these circumstances, the term 'half a wavelength' is quite meaningless in terms of aerial spacing.

As far as the end result is concerned, the exact nature and length of the interconnecting conductors is significant, as also the phasing that is whether the elements one above the other are connected or those on opposite sides of the two aerials and the point of connection for the down-lead.

The instruction you quote doesn't take any of this into consideration and the results you might get by simply mounting two aerials one above the other and interconnecting them would be very much a matter of luck.

If you are in a weak signal area and have a need to use something more than a simple high performance aerial, you would be well advised to take the matter up with a TV aerial manufacturer or his local representative. They have worked out the right ways to stack various types of aerial and can provide the requisite hardware to interconnect them to best advantage.

Is the FM sound radiated by television stations the same kind of FM as used for overseas hi-fi broadcasting? On an FM tuner, the sound seems to suffer from hum even though I don't notice the same hum in my television receiver. Why?

This question really breaks up into two parts, so let's begin by considering the first sentence.

The frequency modulated (FM) sound signal radiated by Australian television stations differs only in detail from the kind of signal radiated by overseas FM broadcast stations — and by the experimental stations which once used to operate in this country.

The FM sound signal pertaining to a television station is handled by a fairly ordinary FM transmitter quite distinct from the picture transmitter but, for convenience, radiated from the same aerial.

In terms of frequency, television stations are distributed in 'channels' from below 50 to above 200MC and most of the signals, picture and sound, fall outside the normal pass-band of conventional FM broadcast tuners, as fitted to some imported hi-fi equipment.

In Australia, channels 3, 4 and 5 are inside the sector originally envisaged for FM broadcasting, but other channels may sometimes be received as an 'image' or other spurious effect in tuners having limited RF selectivity.

Another point about the FM signals as transmitted from television stations, is that their frequency deviation is somewhat less than usual for FM broadcast stations, this being dictated by the technical standards under which TV stations operate.

This does not have any essential effect upon the quality of sound audible but does mean that the detector in a tuner designed for wider signal deviation, recovers a somewhat lower level of audio signal, requiring the audio gain to be advanced a little more.

However, while the sound signal transmitted by a television station is a fairly normal FM transmission, the method of
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reception adopted in modern television receivers is quite different from a conventional FM broadcast tuner.

In the latter, a normal dial is used, as in a medium-wave broadcast receiver, driven by a ganged variable capacitor or a set of slugs in the coils. The tuning must be adjusted so that the local oscillator, beating with the inhomogeneity of frequency, will cause the local oscillator to be in the range of the IF channel, which usually operates at about 10.7MC.

To ensure a distortion-free reception, the resultant IF signal must coincide exactly with the band of frequencies over which the FM detector is set to operate. Mis-tuning can result in severe audio distortion.

This being the case, a conventional FM tuner calls for careful tuning in the first instance, added to which it must be designed to be as free from drift as possible. In some units, visual aids are provided to simplify tuning, or electrical circuits to compensate automatically for inaccurate tuning or subsequent frequency drift.

INTERCARRIER SYSTEM

In television receivers this problem is effectively disposed of by using what is called the "intercarrier" system of reception for the FM sound signal.

It is possible, in the first instance, by insisting that all TV stations maintain an exact frequency spacing between their picture and sound carriers. In Australia, the figure is 5.5MC, the sound carrier being set exactly 5.5MC higher in frequency than the picture carrier.

The input circuits of the receiver are kept wide enough in their pass-band to handle both signals simultaneously. Both are heterodyned to lower frequencies by the receiver's local oscillator and both passed through the IF channel to the video detector, still 5.5MC apart.

At the video detector, the IF signal relating to the picture is taken on for further amplification so that it can modulate the picture-tube grid circuit.

The IF signal relating to the sound gets no further than the video detector.

In fact, the second IF resultant, heterodyned at the video detector to produce a heterodyned or "beat" frequency at 5.5MC—the difference frequency between the two signals as originally transmitted and, later, as passed through the receiver's IF channel.

The 5.5MC resultant contains a mixture of the picture and sound modulation, as on the original carriers, though it is usual to control the amplitude of the two resultants at the video detector, such that the 5.5MC beat contains a predominance of sound modulation.

5.5MC IF SYSTEM

The 5.5MC signal is then passed through a video IF amplifier, pretuned to 5.5MC, to an FM sound detector, which recovers the original audio modulation and substantially rejects the amplitude-modulated picture component. One point behind all this is that the 5.5MC difference frequency, from which the FM component is ultimately resolved, is predetermined by the television transmitter and is the same for all channels. It is not affected by any tuning—or mistuning—at the receiver and therefore makes no demands upon the user of the television receiver.

At the receiver, the one vital requirement is that the discriminator coil for the FM detector be accurately pre-aligned to 5.5MC and that it be free from frequency drift from any cause.

Summing up then, the answer to the first part of the question is: Yes, the FM signal radiated by television stations is a normal kind of FM transmission but television receivers employ a principle of reception different from ordinary FM broadcast tuners."

Now for the second part of the question regarding hum content.

On an FM tuner, the sound seems to suffer from hum, even though I don't notice the same hum in my television receiver. Why?

Assuming no malfunction at the transmitting end, the FM signal radiated by a television station should be comparable to that from a high fidelity FM broadcast station—given good program material, of course. There is no fundamental reason why the signal should contain any higher order of distortion, noise or hum.

More than likely, any hum you have heard is caused by a vestige of the 50-cycle field frequency on the adjacent picture carrier penetrating the FM tuner. It indicates some lack of selectivity on the part of the FM tuner and incomplete rejection of AM components. In all fairness, however, it must be admitted that the tuner is being asked to do something for which it was not originally intended—to resolve an FM signal cleanly, with a more powerful and deeply modulated AM signal sitting on 5.5MC away.

POSSIBLE CURES

It becomes a matter of chance whether or not a given FM tuner will meet the requirement. If it won't, it might be difficult to make it do so except by expert attention to its design and alignment.

On the other hand, it may be possible to improve matters by installing a TV-type attenuator in the aerial lead or a number of TV-type traps tuned to the offending sound carrier(s).

The FM sound system in television receivers has the advantage of being designed with this problem in mind but it would be wrong to assume that the problem doesn't exist in such receivers.

In many cases, the 50-cycle hum is caused by the relatively poor bass response of ordinary loudspeaker systems, added to which is the tolerance that most viewers extend to hum or buzz that isn't too obvious.

It would be very much more obvious in a high-quality loudspeaker system and to a quality-conscious listener. Your own TV receiver may be good in this respect—or you just never have listened to its audio through the same loudspeaker as your FM tuner.

AUTO TYPE VOLTMETER

(in Page 31)

Instruments is to used on a 6- or a 12-volt vehicle.

All that an intending user will need to do is mount the meter in a suitable place inside the vehicle and then run two leads through the bulkhead and onto the terminals of the battery, care being taken to maintain the correct polarity.

To mount these leads on the battery, we suggest drilling a small hole, say 1/8in in diameter, in the top of each battery post so that the two terminals can be connected directly to the battery posts with two suitable self-tapping screws. For reasons explained earlier, readings may not be valid if meter leads are attached to the battery or any cable connectors or elsewhere in the electrical system.

Because the meter has its multiplier resistor inbuilt, there is no possibility of accidental shorts in the wiring doing damage to the meter itself.

It is a good idea, however, to include a simple "line" type auto fuseholder with, say, a 100 millamp fuse between the active post of the battery and the lead to the meter. This fuse should, for preference, be as near as possible to the battery terminal so that if it gives some protection against any shorts which may occur in the "hot" lead to the meter.

Included in this article is a voltage chart which shows typical normal and abnormal voltages that could be indicated on the meter under varying conditions of motor speed, etc. It must be remembered that these voltages are only approximate and intended as a rough guide. With experience, however, you will soon learn what is "normal" for your vehicle and deviations from the norm will stick out like the proverbial sore thumb.

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<td>24 16 2</td>
</tr>
<tr>
<td>AY6104 PNP</td>
<td>T01B</td>
<td>Metal</td>
<td>6V</td>
<td>60</td>
<td>10mA, 10V</td>
<td>20V</td>
<td>700Mc</td>
<td>27 18 2</td>
</tr>
</tbody>
</table>

*Planar a patented Fairchild process  Add 25% Sales Tax if applicable

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ELECTRONICS Australia, August, 1965
Silicon Transistors in Audio Circuits

With silicon transistors now available at low cost for home construction, it is natural for audio enthusiasts to be curious as to whether they can offer worthwhile advantages over the well-established germanium variety in preamps, output stages and other "difficult" applications in audio. Adapted from an application report published by Fairchild Australia, this article shows some of the advantages of the silicon transistor in designing a high-power high-fidelity amplifier for record reproduction. A practical circuit and parts list are included.

TRANSISTOR audio amplifiers suitable for high quality gramophone reproduction were not a very attractive proposition until quite recently. Compared with high quality valve amplifiers they tended to be more costly, less versatile and less tolerant of adverse conditions. To arrive at a practical amplifier design, the designer was virtually forced to compromise in terms of either quality or economy.

The recent release of silicon transistors for use in consumer products and for home construction has caused this situation to change. Using silicon transistors, it is possible to design a gramophone amplifier which is both economical to construct and capable of excellent performance.

The discussion and design details which follow should serve to illustrate the advantages which accompany the use of suitable silicon transistors in audio. The discussion starts with a consideration of the input circuitry.

Because of the low cost and highly acceptable performance of the crystal-ceramic type pickup cartridge, this type of cartridge is naturally the popular choice among designers who are conscious grams. With valve amplifiers, it is possible to design a gramophone amplifier which is both economical to construct and capable of excellent performance.

The input impedance of a transistor is naturally the popular choice among designers who are conscious grams. With valve amplifiers, the input impedance is almost ideally compatible. It has a high amplitude output, requiring little if any preamplification: it has a virtually "flat" frequency characteristic, obviating the need for special equalisation, and its requirement of a high loading resistance is easily met by a valve input circuit.

When one tries to use the crystal or ceramic cartridge with transistor amplifiers, however, problems arise. The normal junction transistor is a current-operated device, and thus has inherently low input impedance.

If we attempt to feed the pickup cartridge into a low impedance input and equalise to compensate for the gain loss and frequency unbalance produced by the mismatch, noise becomes a problem. And if we use feedback circuitry to increase the input impedance of the amplifier, to produce correct matching, noise and temperature stability both become a problem.

At least, the latter is the case with germanium transistors; the silicon variety are much more helpful, as will be explained shortly.

It would be ideal to use an FET or MOS field-effect device in the input circuit, as such devices have an extremely high input impedance and very low noise. However, although these devices are now available locally for higher-priced industrial use, they are far from economical milliamps.

Operation at low emitter current levels is thus an advantage, providing the current gain Beta can be maintained at low currents. This is not the case with most germanium or silicon transistors, but special silicon types such as the Fairchild SF-4010 have very high Beta at currents of only 1mA, while some industrial types have Betas of more than 100 at only 1mA (2N317).

A feature which makes silicon transistors such as these particularly attractive is their very low collector-base leakage current, 10^-13A. Due to their relatively high leakage, germanium transistors generally cannot be operated satisfactorily below about 300ua, even if the current gain could be maintained below this level.

In addition to the transistors, the input biasing resistors must be considered. Although with suitable feedback design these resistors can be "bootstraped" so that their input shunting effect is considerably reduced, with germanium transistors the resistors must be moderately low in value.

Silicon transistors again score here because of their very low beta and their ability to operate with high gain at low current levels. Using a silicon transistor the biasing resistors can be of a very high value, and with a bootstrap circuit their effect can be made negligible.

As mentioned above, a high input impedance can be achieved with many transistor types by using local or extended feedback. Many circuits using common collector configuration or variations of this configuration have in fact been in use for some time, but this is not the best solution where optimum noise performance is considered.

There are many low noise transistors available. However, few are available which give low noise when used with a high source impedance. In general, noise increases with source impedance, so that a transistor must be operated at a very low source impedance. A feature which makes silicon transistors such as these particularly attractive is their very low collector-base leakage current, 10^-13A. Due to their relatively high leakage, germanium transistors generally cannot be operated satisfactorily below about 300ua, even if the current gain could be maintained below this level.

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ELECTRONICS Australia, August, 1965
The circuit for the amplifier shown on page 77, an example of the application of silicon transistors to audio circuitry

low emitter current to give acceptable noise performance when fed from a high impedance source. Only a silicon transistor like the SE4010 is capable of meeting this requirement.

One component of transistor noise is due to collector-emitter leakage, which is a function of a collector voltage Vce. With the older germanium transistors, leakage is high and thus the transistor must be operated with low applied Vce if this component of noise is to be kept to a minimum. This is not a problem with silicon transistors due to their very low leakage.

While the use of a common collector ("emitter follower") input stage with its large unbypassed emitter resistor improves the input resistance of the stage at the expense of noise figure, external feedback to a small emitter resistor does not degrade the noise performance. Yet it increases input impedance considerably.

As far as the input stage is concerned, then, the best solution at present would seem to involve a low noise silicon transistor like the SE4010 in a low current bootstrapped circuit to which overall negative feedback is applied via a small emitter resistor. This approach provides high input resistance with low noise, at quite reasonable cost.

These requirements can be met quite neatly by a feedback common emitter complementary pair. The basic circuit is shown in figure 1.

If we neglect the effects of R1 and

---

**PARTS LIST**

**TRANSISTORS AND DIODES**

<table>
<thead>
<tr>
<th>Part</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SE4010</td>
<td>or equivalent.</td>
</tr>
<tr>
<td>1 AY1108</td>
<td>or equivalent.</td>
</tr>
<tr>
<td>1 AY1103</td>
<td>or equivalent.</td>
</tr>
<tr>
<td>1 AY1104</td>
<td>or equivalent.</td>
</tr>
<tr>
<td>2 2N3567</td>
<td>or equivalent.</td>
</tr>
<tr>
<td>3 AN1102</td>
<td>or equivalent.</td>
</tr>
</tbody>
</table>

**CAPACITORS**

Ceramic: 10pF, 0.47uF, 0.1uF, 0.22uF, 220K.

Electrolytic: 50uF 18VW, 100uF 25VW, 500uF, 18VW.

**RESISTORS**

Half-watt, 5%: 2 x 220K, 470K.

One-watt, 10%: 2 x 1 ohm.

**SUNDRIES**

Wiring board or chassis, heat sink material, power supply components if required.

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<table>
<thead>
<tr>
<th>Performance Data</th>
<th>Power Output mW</th>
<th>Input Sensitivity mV</th>
<th>Input Impedance Ohms</th>
<th>Load Resistance Ohms</th>
<th>Supply Voltage Volt</th>
<th>Total Distortion %</th>
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<td>PC1</td>
<td>150</td>
<td>10</td>
<td>1.5K</td>
<td>20</td>
<td>9</td>
<td>6.5</td>
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<tr>
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<td>400</td>
<td>2</td>
<td>1.5K</td>
<td>200</td>
<td>9</td>
<td>6.5</td>
</tr>
<tr>
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<td>6.5</td>
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<td>PC7</td>
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<td>5</td>
<td>2.5K</td>
<td>200</td>
<td>9</td>
<td>6.5</td>
</tr>
</tbody>
</table>

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ELECTRONICS Australia, August, 1965
ELECTRONICS Australia, August, 1965

Marra. Victoria.
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the so by writing on company letterhead
regarding the silicon transistors could do,
dum gives details of a 2W version using
this article was adapted was written by
audio equipment.
versatility and reliability of transistorised
improvement expect to see them used more and more
in the field of high-quality audio. We may
dance was slightly over 4M).
Noise,
and
noted in
Electronics Australia-
laboratory, usine
Australia,
report and addendum or further details
details of a SW %ersion, while an adden-
3W amplifier shown
in
transistors
would deliver only 2.6W before clipping
low performance was found to be substan-
the sample amplifier pictured, and
impedance is quoted as better than 2M
output as reference,
t---3dR1
and

Total harmonic distortion at
is
as
watts output of 105mV. 1 frequency re-
noise figure, as reference, is quoted at 57dB
for open circuit input and 60dB for
shorted input. Current drain at 3.5 watts
is 20mA, and for no signal 8mA at 25
degrees C. (10mA at 50 degrees). Input
impedance is quoted as better than 25M
(These figures were checked in the
"Electronics Australia" laboratory, using
the sample amplifier pictured, and the
performance was found to be substan-
tially as claimed. Small deviations were
noted in the case of power output and
low frequency response, the sample
would deliver only 2.6W before clipping
and had a lower corner frequency (3dB) of 400cps rather than 24000.
Noise distortion and sensitivity were
virtually as claimed; the input impe-
dance was slightly over 4M).

It is thus fairly clear that silicon
transistors offer definite advantages in
the field of high-quality audio. We may
expect to see them used more and more
in this field, with a corresponding im-
provement in the performance, cost,
versatility and reliability of transistorised
audio equipment.
The application report from which
this article was adapted was written by
M. Somogy and C. J. Henry, being
designated APP-A-4. In addition to the
3W amplifier shown the report gives
details of a 5W version, while an adden-
dum gives details of a 2W version using
only four transistors.

Designers interested in obtaining the
report and addendum or further details
regarding the silicon transistors could do
so by writing on company letterhead to
the Applications Laboratory, Fairchild
Australia, 46 Caroline Street. South
Yarra, Victoria.

(Editors' Note: We understand that
printed wiring boards for this amplifier
will soon be available from R.C.S. Radio
Pty. Ltd. at 681 Forest Road, Boxley,
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ELECTRONICS Australia, August, 1965
Recording a Jazz Convention

"Recorded live" or "Recorded on stage" are simple enough words when they appear on the jacket of an L.P. album but they can hide some headaches — and heartaches — for those responsible for making them in the first instance. This is a brief diary of two engineers charged with the responsibility of recording the last Melbourne Jazz Convention.

By W. E. Hawtin & T. C. Corbett

Early in November 1963 we were awarded the task of recording the entire proceedings of the 18th Australian Jazz Convention which was held in Melbourne between December 26th and 30th 1963. The convention is an annual event and is held in a different city of Australia each year, attracting musicians from all States and vast audiences.

The convention is recorded for the twofold purpose of providing participating musicians with recordings of the performances and for the archives of the organising committee. The program of the convention involved 25 hours of recording time compressed into a period of four days.

Venue for the convention was the Kew Civic Centre, Victoria, and our opening move was to inspect the building to determine the best place for equipment and personnel.

The Kew Civic Centre has a well designed auditorium seating about 2,000 people and a large well-draped stage having plenty of space in the wings. A second auditorium seating about 500 people is available and, by opening a double layer of folding doors, this second auditorium can be joined with the main auditorium. An elaborate sound reinforcement system is installed and, in view of this, it was decided to take a split from the recording equipment to feed the sound system. This permitted the use of one microphone plot only to save equipment and personnel.

As adequate off-stage space was available we decided to locate the mixing console, associated equipment and tape recorders together on one side of the stage, allowing an excellent view of the proceedings and easy access to the stage for rearrangement of microphones. Five microphones were used as follows:

- Two AKG type C28A condensers,
- One Neumann condenser, an AKG type D12 dynamic and a Shure type M55 dynamic.

All of these microphones were of, or were set to, a cardioid pick-up pattern. In the nominal "standard" set-up the first three microphones were spaced along the apron of the stage to accommodate the "front line" of a typical "traditional" jazz band, usually comprising trumpets, trombone and clarinet.

The other two microphones held a roving commission and were placed to pick up the rhythm section, usually drums, banjo and string bass. Needless to say this arrangement was not always adhered to. Some groups used a piano and, in this case, the D-12 was placed on a short stand behind the piano (an upright) towards the "treble" end of the sounding board.

It was sometimes necessary to bring one of the condenser microphones back into the rhythm section. The five microphones were fed to a seven channel mixer of our own design. Two Rola recorders, model type 66 operating at 71 IPS full track were used.

The recorders were fed from the mixer via a resistance splitting network, allowing fading from one recorder to the other without any loss of signal or audible effects in the public address system.

Pioneer earphones were used for monitoring the performers and their entourages. A further recorder feeding a speaker enclosure was installed in a dressing-room under-stage for playback purposes.

Long-play tape on tin reels was selected for recording, giving 45 minutes time per recorder before changeover was necessary. This allowed the stand-by recorder to be switched off to permit cooling, as the ambient temperatures encountered in the hall in Melbourne's summer were extremely high and, even after 45 minutes, the recorders became incredibly hot. However no ill effects resulted from this condition, other than to ourselves.

As the items recorded ranged from solo performances to 15-piece (or more) brass bands, considerable microphone rearrangement was necessary throughout the proceedings. Generally each group of musicians performed for a 30-minute period and thus large-scale microphone movement was normally only made in preparation for each group.

Adjustment of the sound system level was necessary from time to time to compensate for the rather incongruous location of the sound system equipment rack in the front office of the hall. In any case it was necessary to go into the auditorium at intervals to determine if the level was sufficient for the audience, which varied in number and noise output as much, and as frequently, as the performers!

Needless to say all was not plain sailing and various problems arose. The most unique of these was the total ignorance displayed by a major percentage of the musicians in the use of microphones, who fell into one or more of the following categories:

(a) The "fiddler," who feels compelled to adjust the microphone continuously whilst performing. The resulting effects were dramatic, to say the least, particularly in the case of the Neuman microphone which had a ring switch for altering its pick-up pattern characteristics. Thus the ardent "fiddler" usually managed to change its cardioid setting to an omnidirectional setting with a resulting earth-shattering roar of feedback from the sound system.

(b) The "blaster," or "I will be heard" type who considers that microphones are merely a pipe to the speakers which must be shouted down to convey intelligence to his enthusiastic audience.

(c) The "mover," who thinks that a microphone must be moved where he wants it and, even if the stand was nailed down, he would valiantly strive to move it to where he considered it should be.

(d) The "aggressive" type who appears to be oblivious to the microphone and walks through them, assaults them with assorted instruments and generally creates the impression that he will not be dictated to by all these "sticks" on the stage.

(e) The "shy" type who wouldn't go near a microphone for quids.

Despite all these fellows, who appeared in abundance, we are still reasonably well balanced mentally and no fistfights were resorted to.

Several technical faults in the equipment arose, the first being a BUZZ in the sound reinforcement system which appeared during the second day. This was finally traced to a cable fault in the permanent lines which, inevitably, were inaccessibly located below the stage! It was ultimately cured by vigorously slamming a footlight trapdoor (a perfect example of Thump's Law). On the third day the gain control on one of the recorders became scratchy and several tapes were slightly marred as a result of this.

Despite all these problems the general standard of the recordings on playback proved to be extremely high. In many cases close to studio quality and even the Press commented on the high standard of the sound reinforcement. We now have 30 reels of long-play tape full of good Australian Jazz, a lot of valuable "know-how" and a smug smile of satisfaction.
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**BELLINI, I Puritani — Highlights**


This is one of the works which Miss Sutherland is to perform during her forthcoming opera season and it really is worth discussing in detail. It could be a template. It was the composer’s last work and has never been satisfactory. Most people blame the libretto which is certainly foolish and it is based on Walter Scott’s novel “Old Mortality.” The story is reasonably satisfactory but the arrangement of the acts and the sequence of the scenes is completely wrong.

One has to compare it with Donizetti’s Lucia, which is similar in many ways, except that Lucia only goes mad once while in Elvira it becomes almost a habit with the heroine of Puritani.

However, a good deal of the trouble lies in the music. C. de la Poer Trevelyan has pointed out one of the most beautiful melodies ever written for a soprano voice. The bass solo Cinta la Fiori is excellent and the whole of the tenor part is rewarding but there are long stretches that are very humdrum. Many of these dull passages are missed in the highlights.

Miss Sutherland’s singing of Elvira displays all her good as well as her bad points. The chief of the latter is her inability in pronunciation and words on high notes and her habit of sliding on to notes. Against these faults must be placed her dashing singing of the coloratura passages and the many ornaments and variations with which she decorates the music. These latter are said to be the work of Mr. Bonynger and are always in excellent taste.

The tenor, Paul Duval, who is said to be a French Canadian, has a powerful singing voice, but displays little variety of tone. He dodges the top F but sings several brilliant Ds. Neither Flagello the bass, nor Capecchi the baritone is very good. Bonynge conducts in an alert musical fashion and the chorus and orchestra are satisfactory.

The recording is very clear.

**BEETHOVEN, Piano Concerto No. 4 in D major, op. 58. Emil Gilels, pianist and the Philharmonia Orchestra. Conductor: Leopold Ludwig. World Record Club. Stereo TE/252.**

The first performance of Beethoven’s Fourth Piano Concerto was an epoch marking an important stage in the history of Concertos: it had always begun with a long tutti for the orchestra in which all the material for the first movement was announced; then the soloist entered, generally playing something that had been altered or completely changed this in his Fourth Concerto.

The work begins with the piano playing the main theme of the first movement very simply and quietly. Then follows the tutti in which the rest of the themes for the movement are heard. The piano part is of the utmost brilliance but it is generally occupied in commenting on what the orchestra has said.

The second movement is a dialogue between the piano and the orchestra. The orchestral part is strong. the piano part consisting of smooth quiet playing. Gradually the solo part asserts itself and the orchestra accepts the situation. The piece is a light frivolous rondo which seems a strange contrast to the grave movement which has preceded it but seems to be inevitable. Once again, the piano part is of the utmost brilliance, alternating with passages of great delicacy.

I have heard Gilels once before, in a Rachmaninoff concerto when I thought he displayed a dazzling technique but a rather hard tone. This recording proves that judgment quite incorrect. His technique is still dazzling but he plays with the utmost sympathy and his tone is of beautiful quality. The cadenzas in the first and third movements are by Beethoven and fit perfectly into the picture. Ludwig and the Philharmonia Orchestra provide an excellent accompaniment.

The recording can be strongly recommended.


These scenes are taken from the recording of the complete opera Die Frau ohne Schatten which was performed at the opening of the rebuilt Munich Opera House.

The work contains some of the composer’s best music but the libretto by Hugo von Hofmannsthal is incredibly involved and full of symbolism. Consequently it is seldom performed on the stage and the recording of the complete work is almost impossible to follow. For this reason the issuing of certain of the scenes was an excellent idea. The first scene is devoted to the Nurse and the Heavenly Messenger and it, unfortunately, must be admitted that Miss Mooed’s good voice has been mellowed by Emrichetta. formerly a wonderful mezzo has hardly a steady note left. However, the next scene with the Emperor and the Empress, contains some splendid singing. Jess is the young American tenor and he is a bit afraid of high notes; nor does Ingrid Bjöer.

But the outstanding feature of the work is the singing of Fischer-Dieskau and Inge Borkh. Barak’s part in the first act is incredibly moving and was considered to be the highlight of the performance. Fischer-Dieskau certainly the greatest living singer. No one else has such intensity. Considering that it was taken at the performance, the recording is extremely good.

The opera was first produced in Vienna in 1919, but as I have said, is very seldom performed anywhere. The music is most difficult and wonderfully scored and I would advise any Strauss lover to buy this record, which gives a very good synopsis of the complete work.


Just as Rossini’s operas are part of the repertoire of most opera houses, his overtures are also a delightful part of the list of works played by all famous orchestras. Cenerentola, which is based on the well-known fairy-tale of Cinderella is unusual in that its heroine is a coloratura mezzo. Rossini wrote the whole opera in 24 days but it must be admitted he took the overture from an unsuccessful opera. Once again, the piano part is of the utmost brilliance, alternating with passages of great delicacy.

The recording is of the finest. H. F. Jackson, the oboist, of the English Chamber Orchestra, provides the record with the most excellent oboe in the recording. Rossini is far more successful in his overtures than in his operas. Rossini’s first real triumph and the work is based on Tasso’s Jerusalem Delivered. It was the composer’s first “opera seria” thought that would hardly be guessed from the sparkle of the music and the usual calculated crescendo.

Gazza Ladra was produced in Milan in 1817 and the work has deliberately set out to impress the Milanese who had, so far, remained indifferent to his work. It is the first large work for large orchestra and it must be admitted it is a great improvement on the earlier works in this form, both in its variety and in its orchestral colour. It has remained one of his most popular overtures.

Semiramis was another “opera seria” based on a tragedy by Voltaire. It begins with a splendid example of writing for a horn quartet but in general does not suggest the tragic Babylonian story. In fact, the only part of the opera which has been developed and advanced since he wrote Semiramis six years previously, is the masterly tone picture in four distinct scenes in the opera. The story of the Swedisch prince brought to the cross of struggle against his Austrian overlords.

Giuilini is an Italian conductor who has won great praise for his concert and opera work. Of his operatic work he has a warm and open voice; in his career one of his performances was heard on the air by Toscanini, who helped him greatly. and his performance
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of the Verdi Requiem is considered quite outstanding. His performances are among the finest in the world, and he always gives full attention to all details and this is well demonstrated in the playing of these and many other works. Faure's memory is no longer than 149 compositions for it, the reason being that his patron Prince Esterhazy was a competent performer on it. It was a close relation of the viola da gamba. Some years ago Piatiorgsky arranged some of his works for viola and piano, and in 1965 the 'celist asked Ingolf Dahl to orchestrate three of these movements to form a little concerto for viola and orchestra. The result is a charming work, in which the superb tone of the 'celist is splendidly displayed. Miklos Rozsa is well known as a composer of Hollywood film music. Heifetz and Piatiorgsky commissioned him to write a double concerto for violin and 'cello and the present work is the second of the concerto. It consists of a Hungarian sounding theme and seven variations and, although excellently written for the solo instruments, it does not offer a lower plane than the other works. The recording throughout is excellent and the record can be highly recommended. * * *


Gabriel Fauré was born in 1845. In 1856 he entered the Paris Conservatory where his great teacher was Professor Franck. Fauré was appointed Professor of Composition at the Conservatoire where one of his most distinguished and devoted pupils was Maurice Ravel. It has often been thought that Fauré is the last of the great French traditional composers, more human than the brilliant Ravel, more sane though less original than Debussy and always completely competent pianist. However, this is not the case, for he has written some of the finest songs, overtures. The Philharmonic Orchestra of London, conducted by Monteux, plays these with the greatest skill. Pizzicato does not have much to do in this selection but Berry and Reiter are brilliant, and the whole result is most satisfactory. We then expressed the opinion that this is perhaps the outstanding one; once again the writing is masterly in every respect. The second Lute Song of the Earl of Essex from Britten's Gloriana reminds one of the curious neglect that this opera receives. William Walton is represented by a song cycle "Anon in Love" but, although excellently performed, it has an air of artificiality about it.

The Four French Songs arranged by Matyas Seiber are charming but they do not exploit the special features of the guitar. The orchestras end with Raccine Fricker's setting of "O Mistress Mine" but I did not think this particularly successful.

The recording throughout is excellent and the unusual music is performed with the greatest skill.


In our last review we reviewed a performance of this work by the Vienna Philharmonic, conducted by Monteux. We then expressed the opinion that this is perhaps the first example of "program music" and wondered why composers like Berlioz and Liszt had been condemned for writing in such a manner. The cover note on the present record states that when Beethoven was asked...
the trend is towards solid state...

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this very question he refused to comment. "The hearer must find out the situations for himself, for this symphony is more an expression of feeling than of painting" he wrote. The cover note goes on to state that the work was possibly inspired by an earlier work of an obscure composer Justin Knecht (1758-1817) whose "Musical portrait of Nat-ure" has subtitles for each movement which bear a striking resemblance to those of the Sixth.

Krips is a notable conductor but his ideas are very different from those of Monteux. The performance of the London Symphony Orchestra is extremely good but the listener must decide for himself which interpretation he prefers.

---

The Sons of Bach, Vol. 1. Johann Christian: Symphony No. 2 in E flat major, op. 9. Wilhelm Fried-\n

This charming record comprises works by three of Johann Sebastian Bach's sons. The first is a symphony in three movements scored for strings and two flutes.

Johann Christian was the youngest of Bach's sons and, because of his father's death in 1750, he did not receive the initial musical training enjoyed by his elder brothers. At the age of twenty-two he went to Italy to study in Bologna with Martini and the success he had there attracted the attention of Signora Mattei who ran the King's Theatre, London. She engaged Bach who arrived in England in 1762 and there enjoyed a great musical and social success. The playing of the work is completely satisfying.

The next work is a concerto for flute, oboe and strings by Wilhelm Friedman, who was the second child and eldest son of Johann Sebastian and Maria Barbara. After matriculating at Leipzig he was appointed to the Sophirli-Kirche in Dresden and soon occupied an important position in the Saxon capital. He left Dresden and went to Halle but resigned his appointment in 1764 and led an aimless existence in the last twenty years of his life. He wrote five symphonies and, of these, only the present one is in the form of a French overture, that is a prelude and fugue.

The flute is played by Kurt Redel, the conductor of the orchestra, and the oboe by Claude Masonneuve but these instruments are only heard in the charming prelude. The fugue for strings only is a work of great strength and conviction.

The third work is a concerto in D minor for flute and strings by Carl Philipp Emanuel who was the second son of Johann Sebastian and Maria Barbara. He became musical director of Hamburg where he died in 1755. As well as being regarded as the father of modern piano playing, he is the most prominent composer between the periods of his father and Haydn. The concerto is in three movements. Redel proves to be an expert flautist as well as a most capable director of the orchestra. The last movement is particularly interesting, as it displays the modern sonata form of which the composer is thought to be the originator.

The works are excellently played and would give great pleasure to all people interested in the music of this period.
Chairman of the BBC. A giant of a man.

THE RED BADGE OF COURAGE - recorded and read by Sir Donald Ogden. Philips (C6TOM TC 1040 Mono).

The book itself, by Stephen Crane, is an American classic. Esteemed critic H. L. Mencken maintains that modern impressionism would be "almost unthinkable without it." The American literature stems from it. The author was only twenty-three when he wrote it and an extract from R. G. Vosburgh's description of Crane at work on "The Red Badge," gives an indication of his style.... "His daring phrases and short, intense descriptions pleased him greatly. They were studied out with much care and, after they had been trimmed and turned and changed to the final form, he would repeat them aloud and dwell on them lovingly. Impressionism was his faith. Impressionism, he said, was truth, and no man could be great who was not an impressionist.

It is largely this impressionism in the writing that makes the recording so successful. The writing lends itself to recitation and, as such, it makes the utmost of the powerful and emotional language in which the story abounds. It never flags; indeed, climax follows climax with such relentless intensity that there is a constant temptation at the first hearing to skip the pick-up on to hear what happens next. It stands well both with the American Civil War and the fortunes of a youth who suffers the agonies of fear that must be the normal man who faces death for the first time. The action is encompassed in only two days of battle, flight and renewed battle. Within this space of time, the young man experiences the horror of cowardice, recovery and ultimate triumph over his own fear. Yet the red badge of courage, his wound, he achieves not by heroism but by accident.

The concentration of the story into the confines of an L.P. record and the direction, by Howard O. Sackler, arc exceptionally powerful.

LORD BOOTHBY and LORD REITH, FACE TO FACE WITH JOHN FREEMAN. Pye Pleaddilly Series FTF38503 (Mono).

The "Face To Face" television series is known and respected wherever it has been shown. In fact, it brought a new dimension to the technique of interview in any medium.

John Freeman has a mind which is the envy of his competitors in the field and a simlarity to draw from his subjects, no matter how eminent or brilliant, is their despair. Invariably, he is so well informed about his interviewee that he appears, time and again, to catch him off guard. Yet, this is no trickery; he has merely done his homework. Freeman is not always objective but deliberately he takes an opposing viewpoint or attitude with the result that the whole proceedings have much of the excitement and partisanship of a duel.

This interview with Lord Reith, ex-Chairman of the BBC, a giant of a man in every way, has even more than the usual number of thrills and dramatic moments. As Reith is almost brutally frank, often against himself some times in his defence. The whole half-hour is moving to a degree and the ultimate resolution left with the viewer or listener is intensely human.

The fascinating thing about Freeman is that he never descends to rudeness, he is never aggressive and he never asks a question that is in itself unfair. He appears, time and again, to catch him unawares.

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The Red Badge of Courage - reviewed by Ellis Blain.

A WORL D OF SEARCHING EYES - recorded by Howard O. Sackler. Philips CAEDOM TC 1040 (Mono).

"Mr. Donat has, I suppose, read the novel, since he gives the impression that this record carries one of the great intense descriptions of the book. It is a pity as Boothby is a fascinating character, described by Freeman's own words of the jacket in these words: "I think he is one of the most gifted and idealistic - and truthful - men anywhere in public life. I also think he's lazy, self-indulgent, vain and overgenerous. All these qualities mixed up together have led to the comparative failure of his public career. And they've led to the total success of his personal friendships."

ROBERT DONAT READS FAVOURITE POETRY AT HOME.

Argo Spoken Arts Series 848 (Mono).

After the illness which ultimately destroyed him, had made it impossible for him to continue his successful career as an actor. Robert Donat found some solace in his tape-recorder. With the machine as audience and critic, he continued his striving for perfection. Recording and re-recording until, at last, he was satisfied that he could do no better.

But, all the time, asthma was gaining upon him and, in these tracks, which were the last he made, the constantly increasing struggle for release from its physical grip is, at times, apparent in the fight for breath or against the ever-recurring need to cough. But these are minor and, to anyone who admired Donat, touchingly human aspects of an intensely human performance. The choice of poems, too, is personal, as is the manner of reciting, for they were never intended for publication. But his son, John Donat, has made them available and we are the beneficiaries.

The recorded sound is no better or worse than is to be expected from the average home recorder not too expertly operated. But the interest is in the man who made them.

THE RED BADGE OF COURAGE.

Deliberately, I have omitted from the title the eye-catching name on the jacket, that of John Betjeman who chose the verse - who does not appear in any other capacity. Only, to say that the verse is not made better or worse by being selected by this authority on English accents, I feel that this resemblance to Betjeman's own work.

Of the material on the record one can say only that it is subject to the pleasures and faults common to most attempts at poetry by children. As entertainment, per se, it is negligible except to anyone who has a professional interest in such matters. From the point of view of the Australian listener, too, the sometimes quite marked regional English accents of the children who read — incidentally, not the children who wrote - must lessen the appeal of the record.

Despite these criticisms, teachers and others with a special interest in the subject may find this experiment both interesting and valuable. Recorded sound is good.

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ELECTRONICS Australia, August, 1965 91
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FROM STAGE AND SCREEN
SONGS TO SHAKESPEARE PLAYS—T. A. Arne, Maureen Forrester, alto, Alexander Young, tenor, Mar- tin Wilt, harp, horned, with the Vienna Academy Chamber Choir and the Vienna Radio Orchestra conducted by Brian Priestman. Westminster 12-inch stereo, SWC-931,560, Also in mono on WC-31,560.

Interest: Shakespearean song. Performance: Sensitive. Recording: Low level but good. Stereo Quality: Good. For Shakespeare lovers, a recording of Arne's settings of some twelve songs from the plays. The soloists are Maureen Forrester, famous Canadian alto, and English tenor Alexander Young—well known for his operatic and oratorio singing at Glyndebourne, Covent Garden and Sadler's Wells. They are backed in bright but fairly standard fashion by the Vienna Radio Orchestra conducted by Brian Priestman.


In terms of technical quality, the disc is excellent, smooth, wide-range sound, no background and with well spread stereo. Recommended.


Interest: Sacred Easter songs. Performance: Might have been good. Quality: Poor.

This record is an escape from the Easter season but it wouldn't have mattered much had it not reappeared! According to the jacket notes, it is intended as a companion disc to Fred Waring's "Song of Christmas" but, whatever merits it might have had, have been let down by the recording itself, at least as interpreted by my compatible stereo equipment. The signal is lacking both in response and dynamic range and punctuated with spasms of tracing distortion.

On side 1, Fred Waring narrates "The Song Of Easter." The Easter story woven around 14 Negro spirituals. This is a disappointment. (W.N.W.)


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ELECTRONICS Australia, August, 1965
quite distant and blurred by reverberation effects. Also at times the two characters involved in the action are virtually superimposed upon one another spatially — and this leads me to the second criticism.

This is that the stereo facility is employed in what I can only describe as a "photographic" fashion. Characters are as often as not huddled over to one side, virtually crawling over one another in the corner of the stage. Either this or the shrinking from one side of the stereo panorama — sometimes during a speech, and sometimes between speeches, which is even more confusing.

The microphone may be all right in a stereo demonstration record, but in a dramatic work it is downright annoying. Particularly so when microphone balance was sufficiently out to cause a character to "fade out" in the middle of his translation from one side to the other. The effect was most distracting, as if the actor was being swung through a vast parabola on a length of elastic.

Apart from these criticisms, however, the recording is of high standard, as I said before — and if you can enjoy the play itself the technical shortcomings will soon fade into insignificance.

All told, then, a most interesting recording and one which should appeal to students and lovers of Greek drama. Critics inclined to stereo may well find it of use both in its own right and as an example of an outstanding Greek tragedy. Those responsible for its production are to be congratulated.

(J.R.)

MARY Poppins. The "living Voices" with Orchestra. Arranged and conducted by Anita Kerr. Stereo, RCA Camden, CAS-881. (Also available in mono.)

Interest: Music from "Mary Poppins.
Performance: Excellent.
Quality: Excellent.
Stereo: Normal spread.

To quote the jacket notes: "The music from Walt Disney's 'Mary Poppins' is a shrill delight for the whole family. And it certainly sounds that way, as recorded on this album from the RCA Nashville studio. To say any more would be to lose the point that is simple, delightful presentation that you'll play over and over again.

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THE BAND WAGGON. Sound track recording, with Fred Astaire, Nanette Fabray, Jack Buchanan, India Adams. MGM Studio Orchestra and Chorus, conducted by Adolph Deutsch. Mono, MGM Encore Series MGMV-02-9112.

Interest: Show music.
Performance: Sounds okay.
Quality: Routine.

I must confess that Band Waggan is a show that I know nothing about and the jacket, in keeping with the budget-priced Encore policy, has nothing whatsoever to say, by way of explanation. The music struck me as being of the fairily routine show variety, heavily dependent on the visual, and therefore most likely to appeal to those who saw the film from which it is derived.


The sound quality can be described only as routine, rather prominent in the middle register and not as clean as it might be in some spots. If you're keen on the music, don't let this remark stop you: I feel it isn't up-to-the-minute hi-fi fare. (W.N.W.)

THE SOUND OF MUSIC — The Living Strings, arranged and conducted by Johnny Douglas, RCA Camden 12-inch stereo, CAS-869.

Stereo Quality: Widespread.

For lovers of Rodgers and Hammerstein's extremely popular musical "The Sound Of Music," another version of the music. On this disc the Living Strings play most of the featured tunes, for those to whom the lyrics are less important. The arrangements by conductor Johnny Douglas are smooth, and the playing bright.


The recording is excellent, and the stereo widely spread, making the disc an excellent value as an "economy label" recording. It can be warmly recommended. (J.R.)

CHU CHIN CHOW — Inia Te Wiata, Julie Bryant, Barbara Leigh, Charles Young, The Williams Singers, Michael Collins and his orchestra. RCA Camden, CAS-881. (Also available in mono.)

Interest: Musical comedy.
Performance: Bright, warm.
Recording: Smooth.
Stereo Quality: Smoothly spread.

I had the pleasure of reviewing the mono version of this recording some time ago, and my reaction has been the same on both occasions — I don't think one could want a brighter or warmer recording of the vocal highlights from "Chu Chin Chow." The principal parts are sung in fine style, with Inia Te Wiata outstanding as Chu Chin Chow, and the orchestra gives firm and disciplined support.

The recording, while not perhaps quite up to the latest standards, is nevertheless of high quality. Particularly in stereo, a fine recording and excellent value. Recommended! (J.R.)

WALTZ TIME With The Living Strings, arranged and conducted by Johnny Douglas. Stereo, RCA Camden CAS-885. (Also available in mono.)

Interest: Modern waltzes.
Performance: Smooth, romantic.
Quality: Excellent.
Stereo: Normal.

The combination of waltzes and Johnny Douglas' Living Strings produces exactly the kind of sound that you'd expect — smooth, lush, romantic. It's easy on the ear and just the kind of sound to go with soft lights.


Good value on the Camden label. (W.N.W.)

THE WORLD OF LIGHT MUSIC. The Pro Arte Orchestra, conducted by Gilbert Vinter. H.M.V. 12-inch mono, OCLP-1836. Also on mono on OCS-1588.

Interest: Light classics.
Performance: Brisken, warm.
Recording: Excellent.

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"Mardi Gras" (Grave)
"A La Clair Fontaine" (Faron)
and "March" (Arnold)

The guest conductor, Gilbert Vinter, should be familiar to short-wave listeners from his many broadcastings conducting the B.R.C. Midland Light Orchestra. Under his baton, the Pro Arte gives a brisk and lively performance, with sufficient warmth and humour to prevent the string of works from becoming monotonous.

The recording quality is excellent, although the monophonic version sent for review naturally sounds slightly more

For those who are lovers of the light classics, a disc well worth your attention. (J.R.)
THE WORLD'S GREATEST MARCHES, The Boston Symphony Orchestra and the Boston Pops Orchestra, stereo, RCA Dynagroove ISC-2757. (Also available in mono.)

Interest: Great marches.
Performance: Tops.
Quality: Very good.
Stereo: Good sound.

This one of those records which offers the full symphonic orchestral sound with music which should suit those hi-fi enthusiasts who might be deterred by chauvinistic references. Dynamic range, spread and definition are right up on modern standards. And, having said this, I have probably let off enough to tempt others to try and buy.

Conducted by Erich Leinsdorf, the Boston Symphony Orchestra presents "Tambourine March," "Radetzky March," and "Stars And Stripes Forever."


Well played and well recorded, with not a trace of noise or distortion to spoil the sound, this album is a bargain at its price.

** ** **
THE ITALIAN TOUCH. Romantic Mediterranean Favourites by Ray Anthony and his Orchestra. Mono.

Interest: Italian romantics.
Performance: Capable.
Quality: Excellent.
Stereo: Not especially.

Ray Anthony leads off with his trumpet and lots of sonic "bite" but this isn't to set the style of the music — other than the contrast which, with the time, the sound stage is occupied by marimba, mandolin, accordion, reflecting rather more the Mediterranean mood.


Technically, the sound quality is first rate (W.N.W.).

** ** ** BEAUTIFUL. Andre Previn, piano, with instrumental accompaniment, Stereo, Universal Record Club SUP-496. (Also available in mono: 0-361-5.)

Interest: Piano music.
Performance: Excellent.
Quality: Normal.
Stereo: Not especially.

This particular disc has been in circulation for quite a while and I noticed on it recently among the Universal Club record listings which means that it can be obtained quite cheaply.

Andre Previn has the typical nimble fingers of a pianist-entertainer and the ability to pay, pensive or romantic hints of the names of the pieces which are recorded, they are "Allegro," "Etude," "Capriccio," "Preludio," and "Capriccio." The price is for this selection only.

But at will. He offers all three moods here, adding up to that kind of disc which can be let play softly in the background while you read or relax.


At the again at the dividend price.

(W.N.W.)

MOLIN ROUGE. The Melachrino Strings and Orchestra, Mono. RCA Standard Series 45EP. 10244.

Interest: French melodies.
Performance: Average.
Quality: Okay, but...

French melodies can be very pleasant, as also can the sound of the Melachrino Strings—but not when slight eccentricity causes a vague pitch waver as on side 1. This doesn't help "The Song From The Moulin Rouge" or "J'Attendrai" but "La Seine" and "La Mer" are okay.

(W.N.W.)

INVITATION. Peter Duchin, His Piano And Strings. Stereo, Festival SFL-91361. (Also available in mono: FL-31.364.)

Interest: "Soft lights" music.
Performance: Good.
Quality: Normal.
Stereo: Pronounced.

Peter Duchin could hardly fail to please with this new disc. He offers all the smoothness, the dexterity and the polish of a polished performer.

As a featured popular pianist, he has shown himself capable of introducing "The Song From The Moulin Rouge" or "J'Attendrai" but "La Seine" and "La Mer" are okay.

(W.N.W.)

GEORGE WRIGHT PLAYS GERSHWIN At The Wurlitzer Pipe Organ. Stereo, Dot (Festival) SFL-91361. (Also available in mono: O-361-5.)

Interest: Wurlitzer pipe organ.
Performance: Virtuoso.
Quality: Clean and "hard."

Stereo: Good.

For this recording, George Wright used his own 29-rank Wurlitzer pipe organ installed in a hard "live" studio, with 4,000 square feet of floor space.

Not surprisingly, the sound is hard and clean, with sharp attack and fairly short decay.

Quite evidently, also, everything about the organ works — and reliably while the layout and the microphone placement has been approved for a high order of stereo separation.

All this makes demands upon the player which George Wright is well able to meet. Surprisingly, however, he omits "Rhapsody in Blue" on the grounds that he feels unable to do justice to a number which he has the originally intended full treatment, with... (Continued on Page 101)
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CONCERT CLASSICS. Kenneth McKellar with orchestra conducted by Robert Sharples. Piano: Denis Woolford. Stereo: Decca SKL4 4663. (Also available in mono LKA 4663).


Scottish artist Kenneth McKellar has built his very considerable popularity on the old-fashioned qualities of a good voice, and good musicianship. In this new recording he presents a generous group of his concert classics, some accompanied by orchestra under Robert Sharples, some by his regular and very capable pianist Denis Woolford.


If you've an ear for traditional vocals, well sung and well presented, you'll certainly enjoy this disc. Technically, the sound quality is excellent, clean and well balanced, with no trace of surface noise. Recommended. (N.W.N.)

12 IMMORTAL SONGS. DICK CONTINO, accordion. Dot (Festival) 12-inch stereo. 3631,605. Also in mono on ZL-31,605.


A recent recording of romantic favourites played by Dick Contino on the accordion and electronic "Chord-O-Vox." It would be very suitable for dancing at a party, for a quiet evening or for pleasant background music while one is working.


The recording quality is quite good, with low noise and distortion. The accompaniment and arrangement are recorded on separate channels to accentuate separation and provide interest, but the effect is not exaggerated. (J.R.)

PRE-RECORDED TAPE

PROVOCATIVE PERCUSSION—Volume 4. Enoch Light and The Light Brigade, 4-track stereo, 71ips, Command RS 4T 834.


The Festival company, which distributes Command tapes in Australia, advise that this is one of a "Provocative Percussion" series, obtainable on 4-track, pre-recorded tape or on stereo or mono LP discs.

The stereo disc "Provocative Percussion — Volume 4" was reviewed by Jamieson Rowe, on Page 115 of "Record Reviews" in 1964 issue. His summary of the music I quote:

"It carries on the traditions of its predecessors with exuberant, fresh andrubber mat has strobo lines moulded in. The plastic arm of new design, will take interchangeable heads. We offer choice of ceramic stereo cartridge (Maruolo—a really first class ceramic) or stereo magnetic (the famous B and O SPI). Both have diamond stylus. Pressure is adjusted by screwdriver.

The 643 arm has an automatic stop arrangement and a simple and gentle lowering device to protect your records. A pre amplifier may be fitted to the 643 model F. Power supply comes from the special motor windings.

Here is a new turntable made by S.R.T. (Scandinavian Radio and T.V. Co. of Denmark). It is a marvellous looking job especially when mounted on its imported palisander wood base and with its smoky plastic cover—and it has the following advantages.

The well proved belt drive (same as on Lebercraft 605) ensures no rumble, wow or flutter even after years of use. No maintenance is required under normal conditions of use—the turntable being extremely trouble free.

Speed adjustment ± 10%; on all 4 speeds is made easy because the rubber mat has strobo lines moulded in. The plastic arm of new design, will take interchangeable heads. We offer choice of ceramic stereo cartridge (Maruolo—a really first class ceramic) or stereo magnetic (the famous B and O SPI). Both have diamond styli. Stylus pressure is adjusted by screwdriver.

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Throughout the world professional audio equipment is now fully transistorised: domestic amplifiers are following this step forward to solid state circuitry. Solid state (transistorised) equipment is half the weight, half the size and is far more reliable and heat problems may be discounted. The LEAK "Stereo 30" is advanced in design — LEAK amplifiers have always been years ahead. Power output is ten watts per channel into a 15 ohm load. Frequency response is plus or minus 1 db. from 30 c/s to 20 kc/s. Distortion is less than 0.1 per cent at full output. You are invited to compare the LEAK "Stereo 30" with any other stereophonic amplifier — and listen to the astounding difference provided by LEAK high fidelity sound.

* Heavy magnet treble unit.
* Isolated compartment for treble unit to eliminate cross modulation.
* Air tight outer cabinet hand-crafted from selected Scandinavian timbers.
* Interior cabinet surfaces coated with unique bituminous material to provide complete internal sound absorption.
* Bonded acetate fibre with polystyrene lining assures excellent bass response and freedom from resonance.
* The resolution of LEAK piston action speaker—the cone is 200 times as stiff as conventional units. Sound is reproduced free of break-up distortion. Response is outstanding!
* Highly compliant surround allows long cone excursion.
* Removable front panel enables change of speaker fabric to match room decor.

The revolutionary LEAK SANDWICH speaker system

When LEAK introduced this new speaker system, the description given was "a totally new concept in sound reproduction." The LEAK SANDWICH is exactly that. Unique piston action provides purity of sound, free from all trace of distortion—giving outstanding transient response and remarkably smooth coverage of the sound spectrum. The cut-away view (left) shows how the LEAK SANDWICH is constructed — but in the final analysis your own ear must be the judge. Hear the revolutionary LEAK SANDWICH without delay!

* When you've installed your LEAK Stereo 30 and LEAK Sandwich Speaker systems, add to the perfect partnership the "Orpheus Silex" transcription turntable and "Ortofon" tone arms and cartridges are complementary!


"The Jazz Story" is the title of a book which contains a "definitive text on jazz" and written by Dave Dexter who is, incidentally, an executive producer at Capitol records. What could be more natural, therefore, than to choose the tracks on five LP's which bear the name of his book.

The record under review is number two of the set and, if the choice of numbers and bands it contains is any indication, then the rest of the set would be all right.

This particular disc illustrates jazz of the twenties but, thank goodness, not with recordings made in the twenties. The jazz of the twenties was cut out of the years between 1943 and 1963 but the music is pure jazz of the twenties and with the distinct advantage of modern recording techniques.

An excellent example of this is the wonderful track of Red Nichols playing "Ida." Musically this is as fine a drop of Nichols as you are ever likely to hear, but recorded in 1956 and with an audio quality that can certainly be classified as "very good." The rest of the tracks are equally satisfying, with the possible exception of "The Entertainers Rag" by Ray Turner. This track shows Turner to be rather "lighted jazz enthusiasts for more than 30 years and, the supreme compliment, there is hardly a soprano sax player

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CIRCULAR SLIDE RULE
3½in diameter. Will do the same work as the conventional slide rule. Instruction book included.
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Contains these lenses:
1 Lens. Focuss, 15½mm diameter.
1 Lens. 11/16in. Focuss. 1½ in.
1 Alu-sprayed Lens, 1¼in diameter.
1 Filer Lens. 1 Graticule.
1 Lamboolder.
18½ each. Post: N.S.W. 3/-; Interstate, 4/-.

PMG TYPE TELEPHONES
Standard desk type with magneto fully attended Elcon model. Insured runs.
Uses standard batteries at each end, and can be connected together on single line.
Complete with 600ft of 18 gauge wire.
£11/10/- pair (2 TELEPHONE SETS)
£10/- each.

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Car phone 70-85 mcs. 12 volt, with leads, connector and control unit.
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AERIAL CAMERAS
F.24 Mark IV 2½. Lens.stops 11, 8, 6, 4, 2.1/2.
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TRANSFORMERS
240 V to 6, or 12 V 2½ amps.
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AGC. Single phase, 1½ Kw primary volts 180-200, 110-220, 120-200, 130-200, 1700 at FL. PF equals 1.0. £11/10/-

12 CREAD TELEPRINTER
Tape printers model 47.R 240 volt 12v operated
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Number 22 (Aussie) is converted to Number 12 set, which is ideal for ship to ship and ship to shore radio service. Complete with power supply. Leads. Phones and Mikewell's crystal.
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TELEPHONE WIRE
21 gauge copper, plastic covered. Ideal telephone wire. 1000 foot reel.
£3.20fth. drum of twin equal ½ mils) £3/10/- per drum.
Post., N.S.W. 7/-; Interstate 12/-

455 Kc NATIONAL IF FILTER CRYSTALS
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HIGH IMPEDANCE HEADPHONES
29½ per pair
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CIRCUIT.png
TRADE REVIEWS AND RELEASES

AMPEX RECORDER, MODEL 2070

We recently had the opportunity to laboratory test the new Ampex Model 2070 recorder illustrated at right and found it to be an extremely well-engineered machine, constructed to professional standards and performance, but with an appearance and overall operating ease which must make it an attractive proposition to the domestic market for which it is intended.

In looking at this recorder the first thing one notices is the unique automatic threading mechanism which enables a tape to be placed on the machine in about the same time as it takes to place an L.P. record on a turntable. The heart of this mechanism is a special one-sided metal take-up spool which has a centre core consisting of a number of specially shaped "teeth." When the tape is pulled through the slot in the plastic covers over the take-up spool it passes through these teeth; when the start button is pressed the teeth grab the tape leader and wind it around the core in one smooth action.

A second major feature of the machine is its ability to play back tapes in both directions without the necessity for rewinding. The recorder is equipped with dual capstan drives, a reversible drive motor and dual playback heads; one for tracks 1 and 3 and the other for tracks 2 and 4.

The machine also comes complete with an automatic reversing mechanism and an automatic stop feature which switches everything off, both mechanically and electrically, at the completion of a tape. With these features the machine can play, automatically, both sides of a stereo or mono tape and then switch itself off at the end of the performance.

Although the machine will play back tapes in either direction, it can only be used for recording in the normal left to right direction because there is only one record/playback head and that arranged in the normal 1 and/or 3 combination. In order to record both sides of the tape it is necessary to replace the special automatic take-up spool with a normal spool—a very simple procedure. After recording on one side of the tape the spools may be reversed to record the other side in the normal manner.

Ampex are perhaps best known for the fine precision and instrumentality of their recorders and the mechanical side of this domestic machine is, in actual fact, a scaled-down version of their Model 300 instrumentation recorder.

The drive system consists of a constant-speed hysterisis-synchronous motor which has a reverse-driven dual capstan and another pulley for driving the reels. The capstan pulleys drive a belt which loops around two massive flywheels, one for each of the capstans.

In either direction of play, one capstan provides motion while the other creates a slight holdback tension. This combination, plus an ingenious automatic tensioner, eliminates the need for pressure pads and ensures precise tape tension and uniform tape travel across the heads, with almost ideal head-to-tape contact. The proof of this is in the wow and flutter figures which will be given later in our review.

The machine heads are mounted in a solid cast aluminum block and this, in turn, is securely bolted to the rugged diecast frame on which the remainder of the deck is assembled. The manufacturers claim that, even after a severe drop, the alignment of the system would not be affected.

The Ampex 2070 weighs 39lb but this weight is directly related to strength and, as such, is a worthwhile investment. The machine features a partly solid state, partly valve circuitry with all valves shock mounted to protect them against internal and external vibrations. The output circuit is solid state and transformerless and output power is 8 watts RMS per channel. External speakers would need to be used for best results but the unit does contain two wide-range speakers for monitoring or self-contained playback purposes.

The recorder is attractively finished in a silver and black metal case and panels and its appearance is such that it would not disappoint the most ardent professional while, at the same time, it would not look out of place in the average living-room set-up.

All controls are clearly labelled, conveniently grouped and easily accessible. The machine is engineered virtually to eliminate the possibility of damage through operating errors and even the most inexperienced person could play and enjoy the recorder.

Brief specifications of the Ampex 2070 are as follows: Overall record/playback frequency response — plus or minus 2dB from 30cps to 18KC at 73ips; plus or minus 3dB from 40cps to 12KC at 33ips; plus or minus 3dB from 40cps to 6KC at 125ips; signal to noise ratio — 52dB at 73ips; one control range— zero to plus 12dB at 100cps and minus 4 to plus 10dB at 10KC; wow and flutter—0.08% at 73ips, 0.12% at 33ips and 0.2% at 7.45ips; speed accuracy— plus or minus 0.3% at 73ips; fast wind time—11.5sec for 1200ft of tape.

In addition to the features listed the machine has: Automatic tape lifter to prevent head wear; convenient cord storage compartment; automatic digital counter; interlocked controls to eliminate tape stress and breakage; attractive "snap-on" dust cover; fold down carrying handle; easily accessible mike inputs; "hidden" external and input and output receptacles; friction loaded gain controls for simultaneous adjustment of individual channels; a two-way muting switch for monitoring during record.

When tested in our laboratory the machine performed exceptionally well and easily met all of those specifications which we were able to accurately measure. This is a particularly nice recorder to "drive" and its performance leaves very little, if anything, to be desired.

The Australian price of the Ampex 2070 has yet to be determined but the machine sells in America for 519 dollars, list. The model reviewed is the cheapest of the "2000" series available from Ampex, other models being available without the automatic features and, if desired, without the case and power amplifiers.

Accessories available include the "1000" and "2000" series external speaker systems, high performance dynamic microphones, Ampex slide projector actuator, Ampex special "500" series recording tape (the machines are specially adjusted for this tape), the Ampex 805 tape splicer.

Further enquiries on the model 2070 or any of the range of Ampex domestic recorders should be directed to Ampex (Australia) Pty. Ltd. of 29 Ridge Street, North Sydney, N.S.W. (K.W.J.)

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See:— HEALING (SALES) PTY. LTD.
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We invite you to visit our Quads and listen to the closest approach to the original sound.

WRITE FOR detailed literature and name of your nearest QUAD Distributor, who will gladly demonstrate this equipment.

TRANSCEIVERS FROM TELCON

Strato Communications Pty. Ltd. announce the release of a new 27MC transceiver to be known as the "Telecom Model 214." The transceiver runs a full 1 watt of input on transmit and is a high-performance type most suitable for arduous conditions of operation.

The new transceiver is housed in an attractive but rugged all-metal case which is finished in black crackle lacquer with silver anodised panels. Dual carrying handle rings are fitted to opposing corners of the case and the whole unit is shower proof. The retracting whip aerial is the full legal length of 60cm.

The receiver portion of the unit is a conventional superhetronic design with an RF stage wide range AGC, a very effective automatic noise limiter (switch operated) and an amplified squelch system which is very smooth in operation. The receiver sensitivity is 1 microvolt for 10DB S+N and maximum audio output is 250 millivolts. A local DX (RF) gain switch is provided and the receiver is switchable for any two pre-selected channels in the 27.23 to 27.28MC range.

The transmitter runs as previously mentioned, a full 1 watt of power input and Strato claim a minimum of 60 per cent efficiency from their final amplifier. Amplitude modulation of the transmitter is used and an internal compression circuit holds the modulation very close to its maximum level of 95 per cent under average speech conditions. A jack is provided for use with an external microphone where required. The transmitter may also be switched to any two pre-selected channels in the range of the "citizens' band."

In all the Telecom Model 214 transceiver uses 13 transistors and 5 valves and is powered by normal "penlight" torch batteries. The unit weighs 1lb 11th (including batteries) and measures 9 x 3 x 12 inches. It comes complete with a magnetic earphone and carrying case, a hand-strap and plugs for the external batteries and microphone jack. A nickel Cadmium battery and charger are an optional accessory.

The unit is PMG type approved and, in addition, has been approved by the Mines Department for use in explosive atmospheres. Transceivers of this model were used recently to provide communication in the Ball's Head Pyramid climb when contact was actually established at a distance of 62 miles over water.

In our checks of the units we found the ANL and squelch circuits to be most effective in use, and in most circumstances, easily silenced the "background clack" of automobile and electrical interference. In one test we maintained contact from inside two city buildings over a distance of some 20 miles.

Any further inquiries on these and other communications equipment should be directed to Strato Communications Pty. Ltd., of 25 Wentworth Street, Parramatta, N.S.W. (K.W.J.)

ELECTRONICS Australia, August, 1965
TRADE NEWS ... in brief

R. H. CUNNINGHAM PTY. LTD., advise that stocks are now available of Eddy- stone FC10 Transistorised Communications Receivers. This receiver has a coverage of 50KC to 30MC this range being covered in 5 bands without harmonics. Designed for AM and CW this receiver is also capable of receiving SSb. The manufacturers quote a sensitivity for 15dB signal-to-noise ratio as better than 5 microvolts on ranges 1 to 4 and better than 15 microvolts on range 5 (50-150KC).

The intermediate frequency of the receiver is 465KC. The selectivity is fixed to give a bandwidth of 5KC at the 608 points and 25KC at the 465KC. Power is derived from dry cells housed within the receiver, with provision for dial lighting via a spring return switch. Enquiries may be addressed to branches of R. H. Cunningham in Melbourne, Sydney, Brisbane or Perth.

FERRIS PROS. PTY. LTD., announce the release of a new model Ferris Portable Car Radio Receiver, with push button tuning. This is claimed to be the first Portable Car Radio incorporating push button tuning, to be manufactured in the world. The unit weighs 7lbs including battery, it has a power output of 350mW as a cradle mounted car radio. The retail price for the Ferris model 224 is 45 guineas.

FERRIS INDUSTRIES LIMITED announce that the building of a branch office in Brisbane is expected to begin in July with completion to be in early September. Negotiations are in progress for the building of branch premises in Melbourne.

TECNICO ELECTRONICS PTY. LTD. announce the release of the Pye Smooth - speed Regulator. Utilising a silicon control - device the regulator is capable of approximately two - thirds of the usual maxi- mum motor speed, and is designed for use in the sensing probe. These instruments, manufactured by F. W. Bell Inc., utilise the Hall Effect phenomena as the measuring technique. Benefits are higher accuracy, wider range and small probe size. Main instrument in the range is an Incremental Gaussmeter with a resolution of one part in ten thousand.

RONALD J. T. PAYNE PTY. LTD., are offering a new range of laser equipment released by their principals G. E. Bradley of the United Kingdom. The equipment described includes a Gas Laser type 602, Pulsed Ruby Laser type 351, Power Monitor types 151 and 152, Ruby Pulse Laser type 302 and DC Gas Laser types 611 and 612. Further information on this equipment may be obtained by application to company letterhead to Ronald J. T. Payne Pty. Ltd., 385-387 Bridge Road, Richmond, Victoria, or 12 Whiting Street, Aitkenmark, N.S.W.

MARCONI COMPANY LIMITED, exporters of Eddystone Receivers and equipment, advise that the manufacturers, Stratton and Company Ltd., have been officially renamed Eddystone Radio Limited. This follows the announcement last March that the Stratton radio interests had been acquired from Laughton and Sons Ltd. by English Electric, and that the company would be operated as a subsidiary of The Marconi Company.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD. have available a line of 40-ampere silicon power rectifiers, 1N1183A - 1N1190A, with PIV's ranging from 50V to 600V. Peak surge amps are 800, with operation up to 200 degrees C. Reverse polarity types are available. A.W.V. also have available a complete line of English Electric industrial thyristors. For further details on both silicon diodes and thyristors contact the sales department, 47 York Street, Sydney.

Every Switch-user wants ABSOLUTE RELIABILITY

RELIABILITY has been carefully built into this wide-range of OAK, CUTLER-HAMMER, NSF and other world-renowned designs

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**TWO-WAY RADIOS**

- Multi-120 Transistorised- 7.6 ea. or 3 for £1
- Said Subminiature Receiver- 6.5 ea. or 10 for £1
- GLORIA Extension Speakers (Plastic) Contents Boxed: 800.-
- RESIN CORE SOLDIER- 16 price

**SPEAKERS**

- MITYAMP Two Watt Audio Amplifier. £2/6

**COAXIAL CABLES**

- UR67 50 ohm Urn diam. coaxial cable 116 yd.

**MULTIMETERS**

- CENTRAL C.T. 10 Multimeter. 20,000 ohm DC.

**SPEAKERS**

- Brand New, Broadcast Speakers, Well-known Make. £1 Twin Tone. Twin 15 ohm C & £/1 Twin Tone. Four 15 ohm CV.

**WANTED TO BUY**

- COMMUNICATION EQUIPMENT. TRANSISTOR TEST EQUIPMENT, AMPLIFIERS. TRANSMITTERS. RECORDING TAPE RECORDER. SPEAKERS. TRANSISTORS. ETC.
AMATEUR BAND NEWS AND NOTES

Some concern has been expressed by all Divisional Councils of the Wireless Institute of Australia at the number of members who omit to remit their subscriptions for membership when they fall due in the first quarter of the year.

By Pierce Healy, VK2APQ*

Although a large percentage eventually rectify their oversight, never-the-less the work load imposed on the officers who carry on the management of Institute affairs in their spare time on an honorary basis is considerable and often unnecessary.

As the W.I.A. is the only recognised amateur radio body in Australia, full and uninterrupted support by all amateurs to their respective divisions is the only sure means of ensuring the continued expansion of the organisation and the services available to members.

NEW SOUTH WALES DIVISION

The June monthly meeting of the N.S.W. Division took the form of an Auction Sale. Business was kept to a minimum to allow members to participate in what proved to be the most popular type of meeting.

Quite a large amount of members' gear was submitted for sale and Noel Millar VK2AQH as auctioneer did an excellent job of enticing some spirited bidding from the ninety members present. From the satisfied expressions on the faces of the buyers, as well as the sellers, there is no doubt that the evening was a success.

A.O.C.P. CLASS

Vacancies exist in the current series of A.O.C.P. Classes run by the New South Wales Division at Wireless Institute Centre, 44 Alchison Street, Crow's Nest.

Intending amateurs who have not previously completed the course or who wish to brush up prior to the January 1966 examination should contact the Course Supervisor at the above address.

A correspondence course is also available for the Amateur Operator's Limited Certificate of Proficiency examinations.

W.I.C.E.N.

The reorganisation of the Wireless Institute Civil Emergency Network in New South Wales has been undertaken by Vic Cole VK2XL. Several proposals have been considered with the view of forming VHF and HF nets which will tie in with the State-wide net already in existence, based on the areas set out by the Civil Defence Organisation of N.S.W.

U.H.F. RECORD

A claim is being made for the longest distance yet worked in New South Wales on 432 MC.

The contact was made over a distance of 177 miles between Phil Lockley VK2ZPT from his home location at West Pennant Hills about 12 miles to the north west of Sydney to Eddie Penikis VK1VP operating portable at Mount Ginnin (5790ft) near Camden.

The equipment used by VK2ZPT was a crystal-controlled transmitter with an input of 85 watts to a QQE06/40, 432 MC, while VK1VP was receiving a high performance Yaesu 7, which John Glenn orbitted the earth.

All present agreed that it was a most interesting evening. Meetings are held on the third Friday of each month in the School of Arts Gosford at 8 p.m. Visitors are welcome. Study classes for the A.O.C.P. examinations as well as practical construction groups are part of the Section's activities.

ORANGE DISTRICT CLUB

The annual meeting of the Orange District Radio Society was held on Friday evening May 28th at the Club Rooms in Peel Street, Orange. Eight members were present.

In presenting his annual report the club president Frank Aplin expressed his satisfaction with the progress of the club during the past twelve months.

Four members of the club obtained their licence at the Worongary on the road and the attendance on Sunday mornings for the W.I.A. broadcasts and call backs was only missed three times.

All officers being declared vacant, the retiring secretary presided over the election of officers for the ensuing year.

Nominations were called for and the following were elected:- President, Frank Aplin, VK2ZFE; vice-presidents, Don Kirby VK2ALX, Lindsay Moffatt, VK2ZK; Secretary-treasurer, Keith Murrin VK2ZKN; councillors, Brian Warren, VK2ZGQ, Peter Nieuwenhuyk, Associate.

The evening concluded with members being invited to come along on Friday next.

An invitation is extended to those interested in amateur radio and living in Orange or surrounding districts to visit the club. Full details can be obtained from the secretary.

VICTORIA VHF GROUP

Over fifty members attended the June monthly meeting held at the rooms of the Victoria VHF Group at 478 Victoria Parade, East Melbourne.

The evening was devoted to a buy and sell night when a large amount of equipment changed hands.

It was also reported that VK3AHL had received signals from Osaor III on 145.85 MC during daylight hours of mid-july. However, as no night passes have been heard, it has been assumed the transmitter is being powered direct from the radio amateur.

The annual convention of the Victorian Division V.H.F. Group has been tentatively scheduled for October. Details of the arrangements will be given over divisional broadcasts and in these notes.

SOUTH AUSTRALIA

The council of the South Australian Division has circulated a "Questionnaire" to all members for them to express their views on several projects which the council is considering. These are:-

1. Holding a State Convention—annually or biennially.
2. Annual construction program—loan equipment to members.
3. Reference library for use by members.
4. An intra-State contest between city and country stations with worthwhile trophies.

In cooperation by members will assist council to plan for the future development of the division.

News and notes of Divisional and Club activities are contributed. Contributions in these columns, should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.

ELECTRONICS Australia, August, 1965

* Pierce Healy is the Regular Correspondent for amateur radio.
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it may be time to study

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IS YOUR AERIAL OUT-OF-DATE?
The 1965 Channel Master "Crossfire" may be your answer. Check up on its colossal performance.

WEST AUSTRALIA
From the West Australian Divisional bulletin it is learned that Brian Pemberton, VK6/VW, has taken over the duties of W.I.C.E.N. officer for that state.

TASMANIA
Full details of the office bearers of the Tasmanian Division are: President, Tom Allen, VK7AL; vice-presidents, Terry Connor, VK7CT, Ian Nicholls, VK7ZZ; treasurer, Tiny Down, VK7JD; secretary, Charlie Spragg, VK7KS; bulletin editor, Ted Beard, VK7EB; minute secretary, Geoff D'Emden, VK7ZAS; Federal councillor, Ted Cruise, VK7JE.

VALE
It is with regret that the death is recorded of a well known South Wales amateur operator, Jesse Carter VK2OC, after a long illness. Passed away on June 14. For some time prior to the beginning of this year Jesse was the division's librarian, and until then, was when his health permitted, active on 40 and 80 meters during the day.

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A cordial welcome will be extended to any amateurs who may be visiting the "Apple Isle" on holidays, particularly "mobiles."
fortunate the 80 and 40 metre frequency ranges are outside the Australian frequency allocations. The unit uses only three valves, these are the driver and power amplifier stages in the transmitter. There are 18 transistors and 18 diodes in the receiver, sideband generation, oscillators, and mixer sections. The possibility of a model being produced to suit Australian conditions is being investigated. It should become a popular piece of commercially built sideband equipment.

YOUTH RADIO SCHEME

Club Leaders are reminded that their members may participate in the Receiving Section of the Remembrance Day Contest. See Rules elsewhere in these notes. It is hoped that club competitions could afford quite a lot of entertainment for members over the weekend August 14th-15th.

WESTLAKES RADIO CLUB

A very successful Field Day was held at the Westlakes Radio Club on Sunday, June 13th.

100 attended and competitions were held throughout the day. Since the activities of the Westlakes Radio Club is associated with the Youth Radio Scheme, most of the contests were designed for junior members.

Eight transmitter hunts were held, six being for pedestrian hunters while two were for cars. The winners of the hunts were: Tony Mullen VK2ZCT, Jim Thompson VK2AHY, Henry Schroeder (Unr.), Paul Leader VK2UL and Bruce Morley, Ray Carpenter and Leon Scores.

Other contests held during the day were: Cipher Code copying, won by Ivan Agar, VK2AMV, Mystery voices won by Les Ruber VK2RJ; component recognition won by Chris Cowan VK2PZ. The mobile scramble resulted in a win for Col Jeffery VK2ACK, Ken Blundstone VK2CN. As many different QSOs could afford quite a large amount of enjoyment.

STATE TROPHY

South Australia

7.07

HIGHEST STATE LOG AVERAGE

Victoria 7.45

HIGHEST INDIVIDUAL SCORE

VK7PZ J McI. Vale, 1,270

AWARD WINNERS

OPEN

VK1JD R. Davis, 373

VK3BO E. L. Andrews, 607

VK3A1T I. F. Berwick, 843

VK4RH A. L. Hawt and J. S. Bradwell, 912

VK5ZP J. McI. Vale, 1,270

VK6MT I. H. Clinic, 560

VK7DK H. Mullen (Mr.), 376

VK9X1 Christmas Island Radio Club, 131

PHONE

VK1QI J. L. Weatherby, 371

VK2AZM R. J. Whyte, 1,080

VK3MO I. J. Williams, 865

VK4DA M. J. Swaby, 678

VK4HI G. H. Penrith, 1,132

VK6LR L. G. Rock, 520

VK7KH K. A. Hancock, 402

VK8BK D. A. McArthur, 512

VK9AG A. G. Nunn, 353

VK0PK P. King, 516

VK2QF L. F. Hine, 519

VK3AXK S. R. Coleston, 383

VK5ZC J. J. Burns, 347

VK6WT D. Couch, 374

VK8SM S. G. Moore, 984

VK8RX L. W. Wallbridge, 14

VK9GC A. H. Sandlands, 1,166

STOTT amateur radio students receive full particulars of your Course in Radio for Amateurs. Mail the coupon for full particulars of your Course in Radio for Amateurs. The contest will commence at 0000 GMT January 1, 1965 and end at 0000 GMT December 31, 1965.

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(See Tech. Review this issue.)

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Hobart.
1965 REMEMBRANCE DAY CONTEST

THE rules of this annual contest which perpetuates the memory of those members of the Wireless Institute of Australia who paid the supreme sacrifice in World War II have been extended and made available to Amateur Radio enthusiasts throughout the World.

Following discussions at the Wireless Institute of Australia’s AGM in late 1964, the contest was extended to take three years, an additional section has been added to the rules, and a new W.I.A. Trophy is being awarded.

The change will allow the holders of a Limited or Permanent licence in the QTHR country to enter in one contest band. Although this section will not be taken into account when assessing theкаръ are classified as CW to CW. However only one entry may be made.

RULES:

1. All Amateur Stations during this period.

2. The changed call “CP RD” or “CO Remembrance Day” will be eligible for awards.

3. Entries must be set out as shown in the example, using ONLY ONE SIDE of the paper wherever possible. Standard W.I.A. Log Sheets could be used. Entries must be clearly marked with the name of the contest organizer.

4. Logs received after the contest close date of 15th November, 1965, will not be marked.

5. The contest will be divided into two separate bands S2MC and above.

6. In all contacts made during the contest, stations may enter from all Divisional Stations during this period.

7. All Contacts made during the contest will be evaluated in accordance with the rules and the spirit of the contest.

8. All Contacts made during the contest will be submitted to the contest organizer, the Wireless Institute of Australia in accordance with the rules and the spirit of the contest.

9. All Contacts made during the contest will be submitted to the contest organizer, the Wireless Institute of Australia in accordance with the rules and the spirit of the contest.

10. All Contacts made during the contest will be submitted to the contest organizer, the Wireless Institute of Australia in accordance with the rules and the spirit of the contest.

EXAMPLE OF TRANSMITTING LOG

<table>
<thead>
<tr>
<th>DATE/TIME</th>
<th>BAND</th>
<th>EMISSION</th>
<th>CALL SIGN WORKED</th>
<th>R.S.T. No. SENT</th>
<th>R.S.T. No. RECEIVED</th>
<th>V.K. POINTS</th>
<th>V.H. POINTS CLAIMED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 1965</td>
<td>7MC</td>
<td>A3(a)</td>
<td>VK5PS</td>
<td>50002</td>
<td>VK6RU</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>14 0810</td>
<td>7MC</td>
<td>A3(a)</td>
<td>VK6RU</td>
<td>50007</td>
<td>VK7EJ</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>14 0811</td>
<td>52MC</td>
<td>A3</td>
<td>VK5AEEE</td>
<td>50025</td>
<td>VK5DOR</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>14 0812</td>
<td>52MC</td>
<td>A3</td>
<td>VK6AX</td>
<td>50025</td>
<td>VK5DOR</td>
<td>25</td>
<td>30</td>
</tr>
</tbody>
</table>

 Лицейewing Points:

1. A contestant who operates within the terms of Rule 6 and Rule 7 will be eligible for awards.

2. Multi-operator stations are not permitted.

3. A contestant who has operated more than one time during the contest period will be considered a member of the open section.

4. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

5. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

6. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

7. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

8. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

9. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

10. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

11. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

12. A contestant who has operated in the Contest area during the contest period will be considered a member of the open section.

13. The ruling of the Federal Contest Manager of the Wireless Institute of Australia is final and no disputes will be discussed.

AWARDS:

Certificates will be awarded to the top-scoring stations in sections (a), (b), (c) of Rule 10 above in each contest area. VK1 and VK2 will count as separate areas for awards. There will be no outright winner for Australia. Further Certificates may be awarded at the discretion of the Federal Contest Manager.

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Additional Notes:

1. This section is being introduced this year in answer to the request by many amateurs that provision be made for participation by Limited Licences. It is the opinion of the W.I.A. that by entering this new class of operators in an experiment and because of this this award is really a welcome addition to the contest and to the Trophy winner.

2. The W.I.A. Trophy will be awarded in the following way:

A. The average of the top six logs shall be added a bonus arrived at by adding to this average the points from the logs entered to the number of State Licences (excluding Limited Licences), multiplied by the total points from all entries in sections (a), (b), and (c) of Rule 10 above.

B. The winning contest shall be determined in the following way:

1. The W.I.A. Trophy will be awarded to the contestant who has the highest score in each of the bands above.

2. Logs may be submitted for one Transmitting Section other than Section (e) and Inter-State VHF contacts may be included in both sections.

3. Logs must be set out in the standard manner prescribed.

AWARDS:

Certificates will be awarded to the highest scorer in each call area. The W.I.A. Contest Manager emphasizes that for strict observance of Rule 9 the use of log sheets is not allowed. The use of log sheets is not allowed. The use of log sheets is not allowed.

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LISTENING AROUND THE WORLD

Art Cusden's monthly report on long-distance short-wave, television and broadcast bond reception.

THIRD STATION FOR UNI. OF NSW

The third station of the University of New South Wales in Sydney has commenced operating on their common frequency of 1750KC, following the success of the Sydney and Wollongong stations in this unique means of education.

The University of New South Wales announced recently that the new University Radio would be opened in Newcastle in July and would augment the facilities of the Sydney and Wollongong stations to aid in teaching by radio at home. The transmitting station at Newcastle will be on the same site as the privately owned station V2UV which commenced in 1961. The second station at Wollongong was established in 1963. The new station has been designed to continue to provide short courses in both postgraduate and extension type subjects, and must provide a radio bulletin of accurate broadcast lectures, and of the notes issued in association with them, to further their knowledge on a wide range of subjects.

The new station at Newcastle will have its transmitter located at the Waratah reservoir and, according to Professor Baxter of the University of New South Wales, transmission for the start will be for one evening a week. It is hoped to have to be broadcast will be called "Medical School of the Air," followed by a series on income-tax law dealing with the business and professional man. The Sydney station has expanded its broadcast hours and range of subject matter, and there were over 3,000 radio enrolments last year.

The power of Sydney and Wollongong is 300 watts and the Newcastle station 150 watts.

The Sydney station is on the air week-days from 0800 to 1200, except Tuesday and Wednesday when it is on from 1000 to 1200 to allow the frequency to be used by Wollongong, and on Thursday 1000-1200 for the Newcastle station. The Wollongong station is on the air on Wednesday 1000-1200 until August 16 when the schedule is reduced to 1100-1200 GMT. Reception reports from listeners have been received from all States in Australia as well as New Zealand.

RADIO MALAYSIA STATIONS

Two new frequencies for Radio Malaysia have been noted in the 60 metre band and both at good level. The new Radio Malaysia-Singapore outlet on 935KC has news in English at 1130GMT, and the program which follows is all in English. Kuala Lumpur outlet on 998KC has a program in English and also giving good signals at 1000GMT.

BRUSSELS ON 9615KC

A new frequency of 9615KC has been observed in use by the Belgium Radio and Television Service, when carrying its transmission to Latin America from 2115GMT in Flemish. The station has news at 2130, a sports newreel program at 2140, and identification at 2145. This station is also assigned to use 8640 and 9740KC, and the station apparently having given poor reception of the Belgium program in South America. The Brussels stations uses the mailing address of the Belgian National Broadcasting System, P.O. Box 28, Brussels. Belgium, and verification is promptly received in the form of an attractive QSL card and letter. The station in former years was known as the "Goodwill Station," but its cessation of operations is not expected to commence to operate in August and its official publication is "Australian DX News." The address of the Club is 103 Edinburgh Road, Castlecrag, New South Wales. A sample copy of the Club's magazine can be obtained, and an address. Editor of the "Australian DX News" is Robert Ronai.

BROADCAST EXPANSION

The recent change in title from the BBC General Overseas Service, to the BBC World Service is a recognition of the expansion in radio services from London. It is estimated that 100 million new radio listeners are added to the radio audiences in the last few years, and that in addition, there is an increase of radio listening in Africa, Middle East, Asia, Latin America and the West Indies, due mainly to the tremendous growth of population, and the intense interest of the new developing countries in radio broadcasts.

Recently Mr Edward Bowmanton, the Chief Engineer of the BBC External Services, reviewed the BBC expansion plans throughout its broadcasting. The first experiments leading to Empire broadcasting commenced in 1921, with short broadcasts of 10 to 15 minutes, aiming at determining whether a general listening audience existed as well as fulfilling other objectives. This led to the establishment of the Empire station at Daventry. The BBC commenced regular transmissions in November 1932, using two 15KW transmitters. In 1937 the Empire Service was given a new transmitter on 965KHz, and in 1941 an additional transmitter was added.

The present expansion at Bush House commenced in 1945 and was aimed at the concentration of all overseas transmissions in the new building. The use of 15 transmitters and 36 studios and overseas broadcasts are made in over 40 languages. Also, relay bases on remote and short waves were increased to aid the service into Cyprus, Malta, Liberia, Singapore and Perim Islands to give better coverage to specified audiences.

FRAGUS RADIO MONITORS

The announcement by the Czechoslovakian Radio of the establishment of a Radio Monitors Club follows the recent success of the Radio Canada Short Wave Club, Portugal DX Club and the Hungarian DX Club. All these organisations are incepted with their stations which require five reception reports from listeners to become a member, after which members must report regularly on the reception to maintain their association with the organisation. Radio Carthage is the only organisation of this type which merits the interest of readers, as its program each Saturday at 0745GMT on 970 and 9630KC includes many interesting features, as well as supplying club members with competitions and information of local interest.

The newly announced Prague Club is on the same lines, overseas listeners must send in seven reception reports from different countries and number them.

A certificate of membership is given, and in return the station receives from its listeners in many parts of the world a regular report of the reception of its latest transmission. However, there seems no incentive to the listeners to report on their reception, as they are not supposed to.

Further details on the Prague Moni-
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DIRECT DISPOSALS
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FRANCE has been noted in a new transmission from N.S.W.; and our own observations: 4775KC tuned at 1000GMT onwards throughout the signals in New Zealand.

This is the case for the service to the Caribbean. America, which is on the air from 0135 to 0155. New Zealand leaves the frequency: 6105 OAXM Radio Nacional, Tucua, Peru. Four daily programs are in Spanish, and 6105 YNWA broadcasts in Portuguese. Bogota, heard with note chimes and news 1200; 6200 YNJS Sonora, Nicaragua, "Radio del Norte" news at 1200 and music; 6205 TJIB Radio Reloj, San Jose. Strong signals at 1200.

NEW TRANSMITTERS FOR FEBC: A test transmission from the Far East Broadcasting Company in Manila has been observed in the past few days on 11920KC at 0630 to 0800 and, from announcements, a transmitter new 5OKW one. Details from the FEBC Manila show that this is the first of the four new 5OKW transmitters to be installed, and the station expects to have all in operation within 18 months.

The tests on 11920KC are carried on the north south beam with Japan and Indonesia as the target areas. FEBC Manila states that full power of 5OKW was not reached at the time of these tests due to power supply problems to the transmitter buildings. But, by the time this reaches our readers, the full power of 5OKW will be in use.

LATIN-AMERICANS ROUNDUP: Brazil has stepped up its English transmissions as the 25th anniversary of its 1190KC, which is also only referred to as the 25 metre band outfit, gives good signals in New Zealand.

PARIS has stepped up its English transmissions. As well as the reported service 0515-0530 on 15445, 11093 and 9525KC. The station has English at 1300GMT on 11850, 15245 and 21580KC. A program is heard at 0200GMT on 6175KC with the service directed to listeners in New Zealand.

ETHIOPIAN station ETLF in Addis Ababa has been heard between 1435-1455 with a program in Arabic on 9750KC. ETLF, the Radio Voice of the Gospel, has also been heard on this frequency at 1900GMT with test transmission for listeners in East Africa.

BELGRADE in Yugoslavia is on the air in English from 1800-1900. The service is for listeners in East Africa.

MANILA station DZF2 of the Far East Broadcasting Company is heard testing at good level on 11920KC at 0630 in the test transmission for Japan, Malaysia and Indonesia. Some strong signals are in Arabic except on odd days.

BONAI Readio, Philipines, has been heard with notes of the Day and the week from 1430-1500 with the service directed to the Far Eastern states.

FRANCE has been noted in a new service for its service to North America from 0345 to 0515GMT. The station is using 9705KC over the air for the service.

LIBERIA has made a frequency change in its service to North America from 0130-1300 to 0210-1400 from 9710KC. The channel is not a good one as this is a long-established channel assigned to the USSR.

The station opens at 0130 in French, 0200 in Arabic, 0230 in English, 0300 in Arabic, 0330 in Spanish and 0400 in French. The service is for foreign residents and is for all stations.

NIGERIA in its overseas services from Lagos has extended its External Service a further two hours. The new service is on 0900-1000GMT, 1100-1200GMT, 1400-1500GMT and 1700-1800GMT.

The station's schedule is heard testing at 1300GMT on 6190KC, 11905 and 9525KC. According to the station's schedule.

BUDAPEST in Hungary has English transmission to the United Kingdom from 1900 to 2000 on 7305 and 9832KC; 2200-2300 on 6234, 7215, 7405 and 9833; 2330-2400, 6234KC. To North America 0300-0500, 0500-0700, 0700-0900, 0900-1100, 1100-1300, 1300-1500, 1500-1700, 1700-1900 and 1900-2100.

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at present relaying the program of Radio Nederland from 2200 to 2220 GMT, on the new frequency of 15220KC. The program is in English and Dutch. Another new frequency, 9590KC, is used for English, Dutch and Spanish from 0140 to 0440 GMT, and the transmission is directed to North and Central America.

TAHITI is being heard opening at 1630GMT on its shortwave and broadcast band frequencies, 1400KC on BC providing good reception. The present schedule of the station, according to August Balbi of California, is 1615-1815, 2100-2300 and 0000-0800 when 11825, 6130 and 1400KC are used, and on Sundays until 2000-2300. Radio Tahiti on 11825KC is heard with Tahitian program at 0600 and then to sign off at 0800. The transmission is in French.

CAIRO, with the transmission "The Voice of the Arabs," has increased the number of transmitters in use from three to four. The service in Arabic is heard from 0400 to 2400 GMT, 7050, 9490, 11740 and 15100KC. The new frequency of 15100KC is used by the new transmitter of the Egyptian Radio.

PYONGYANG in North Korea has shortened the transmissions to the Middle East and Africa and is now on the air in English 1400-2000 and French 2000-2200, when the frequencies are 6540, 7580, 9875 and 11750KC. Another session in English 1400-0300 is on 1420 and 15200KC.

CLANDESTINE station which has operated from the stars of the Spanish Civil War and known as "Radio Espana Independencia" has at last been located as broadcasting from Raumuni. The transmissions, which have long puzzled listeners in this area, are now heard 7690, 8680, and 10100KC, and heard 1630-2300, and also at 0600GMT which gives best reception here.

BROADCAST, TV DX

Thailand—Transmission of the English half hour over Radio 20 in Bangkok, makes identification of the Thai Station easy. The signals, on 1520KC with 10 KW, are well received from 1500 to 1530 GMT. The Thai stations are notorious for frequent moves and the lack of details about medium wave stations in the country, but Radio 20 and the Television Station on 1400KC are the most consistent heard, the latter closing in English at 1700GMT.

The program of Radio 20 gives English news at 1500, then a documentary at 1510 and weather at 1520 with light music to 1530 when the station program is again in Thai. The station invited listeners to tune in tomorrow at 10 p.m. Bangkok time, (1500GMT), for another English program.

Siberia—The Radio Moscow relay station in Siberia is being used to carry the English transmissions to Australia and New Zealand on broadcast band as well as on short wave and three frequencies, 548, 629 and 1250KC, are in the various transmissions for morning and evening reception in this area.

1230-2200, 11600-5940, 9610, 7180, 7280, 6600, 1250 and 5480KC
1130-1230, 11690, 9540, 7280, 6290KC
1100-1300, 11690, 9540, 6290, 5480KC
1330-1400, 11690, 7280, 5960 and 6290KC.

The Moscow Mailbag session in which letters from listeners are broadcast at 1145 and 1245 on Saturday.

TELEVISION DX

The reception of television signals over any distance is unpredictable and not regular in any sense, but from time to time readers report the signals and picture of television stations over some long distances. This is the case with Alvyn Backhouse, of Norman- west, Sydney with reception of the Townsville, Queensland, station on Channel 3. The station AITFO is over 1000 miles north of Sydney and overpowered. NRN3 (Newcastle, N.S.W.), on the same channel. Reception was from 0545GMT onwards, and was visual only.
F M T U N E R
C.E.G. (North Balwyn, Vic.) asks whether we would like to design an FM tuner covering the TV channel frequencies to allow recording of good quality sound. He feels that recording from the audio stages of his existing set leaves traces of distracting noises. It is probable that these distracting noises are remnants of picture information feeding into the TV channel. It is possible that a separate tuner for the sound channels may help to obviate the trouble, but we feel that the demand at this stage would be too small to warrant describing an FM tuner with such a wide frequency coverage. However, we will keep the idea in mind and will write whether other readers have a similar need.

B A S S A M P L I F I E R
M.C. (Erlin, Qld.), writes asking for an estimate of the construction costs for a Bass Amplifier. We regret that we are unable to give price estimates for our projects as these are likely to vary considerably according to suitability of parts, source of supply, etc. In this instance we have not described a suitable amplifier and could not therefore supply either plans or estimates.

T A P E G A D D E T S
A.N. (Albury, N.S.W.), has sent in brief details of tape gadgets which were described in the November issue of the magazine. He would like to have these plans published in columns for April. He also comments on our Basic Radio Control gadget as being an excellent introduction to the subject for beginners.

M U S I C A L T U N I N G
J.W.D. (Bowden, S.A.) writes particularly to thank us for the article on musical tuning in the June issue. He says that he has been reading the article longer than he cares to remember and always enjoys the articles by Calvin Walters and The Serviceman. He likes this subject, but we have to organise things all over again!

S H O R T - W A V E C O N V E R T E R
G.P. (Forbes, N.S.W.), says he has been reading this journal for 10 years or so and finds it in much to interest him. He suggests we could follow up our recent short-wave converter with a bandspread unit especially designed for listening to the long-wave bands. If something could be done to facilitate SSB reception, so much the better.

T R A N S I S T O R P R O J E C T S
On this basis, we have no file of circuits for commercial radio or TV sets, etc.

A L V I N G E N E R A T O R
J.S. (Vaucluse, Sydney) asks whether we can direct him to details of an SSB service which could double the frequency of all sounds fed to it. He thinks it is called an "Alvin Generator" and is used for the production of Chipmunk records. As far as we know, we have never published anything on such a device, although heterodyne and rectification techniques can modify the frequency contents of sounds fed into them, as happens with SSB transmission and reception. If you want to produce the quaint results of trying to mouth words at half speed, the tape recorder speed is doubled. Alternatively, if you can double record, using two machines or a four-track machine with listen/record facilities, you can record a normal accompaniment at normal speed and then play it back at half speed, at the same time recording the vocal or interspersed s네ет at the slow tempo. If, together, the music reverts to normal but the vocal jumps an octave, this is comprised to the correct tempo by adjusting the output. Musical accompaniment can be provided in the same way but played at half speed an octave down. Alternatively if you can double record, using two machines or a four-track machine with listen/record facilities, you can record a normal accompaniment at normal speed and then play it back at half speed, at the same time recording the vocal or interspersed s네et at the slow tempo. If, together, the music reverts to normal but the vocal jumps an octave, this is comprised to the correct tempo by adjusting the output.
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These new miniature eleven-position single-bank switches are 1" diam. with 1" spindle, they have silver-plated contacts and high quality insulation suitable for H.F. use.

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New electrolytic condensers, 250v. 3000u., 5/-6. Post, N.S.W., 3/-6; Interstate, 4/6. Transformer for above, 37/-6. Post, N.S.W., 3/-6; Interstate, 4/6.

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<td>70 mfd</td>
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All amplifiers are fitted with A. and R. output transformers with voice coil tapings of 2 to 15 ohms.

The 15 watt amplifier can be supplied with line output transformer tapped from 100 to 800 ohms if required for a/c. extra.

Inputs provided for microphone, pick-up and radio with mixing facilities and tone control.

The 15 watts is as above but using two 6805 valves in push-pull output.

12in speaker for above (10 watt) £67/6

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240V A.C. operated, 4 band 110 kc to 390 Mecs.

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These new small motors, size 3in x 3in x 3½in, are £12 5/0.

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<tr>
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<tr>
<td>NA101</td>
<td>OC35</td>
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<td>NA105</td>
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<tr>
<td>NA177</td>
<td>OC77</td>
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Decoy type SFT 123 equiv. OC74 Available in matched pairs of 15/ part AUDIO OUTPUT Post and packing on transistors 1 6 any quantity.

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Published by

THE TECHNICAL PRESS LTD., LONDON

Australian Agents: The Australasian Publishing Co. Pty. Ltd., 55 York St., Sydney

124 ELECTRONICS Australia, August, 1965
Some of the hints, those obvious for service.

Installation and Maintenance of Industrial Switchgear covers the procedures for installing and maintaining industrial switchgear falling within the range of 415 volts to 11 kilovolts. All types of industrial switchgear within the voltage limits mentioned, whether air-break, oil-break or air-blast, are covered.

As mentioned by the author, it would be impossible in such a small book to give other than broad details of the subject, but the basic principles as outlined will find ready application by the factory engineer. In the maintenance section of the book, many illustrations are given of typical faults and the point where components may be replaced or repaired is discussed.

The final title of the series, Cable Jointing, details the practical skills and procedures required for joining and connecting cables and fitting any necessary mechanical protective enclosures. The handbook covers cables up to 11 kV.

Jointing is a highly specialised field and the author has treated the subject in fine detail. Properties of tin-lead alloys are discussed and such items as soldering of aluminium sheathed cables are covered in full. Profusely illustrated throughout the text, this book seems ideal for the jointer who wishes to further his knowledge in this field.

Each of these handbooks show merit as a reference book in their specialised fields. The texts are presented in an easily assimilated form and contain plenty of practical knowledge. Our review copies from Technical Book and Magazine Co. Pty. Ltd., 295-299 Swanston Street, Melbourne, (K.W.)

HI-FI TROUBLES—How you can avoid them: how you can cure them. By Norman Burstein. Stiff paper cover, 160 pages 53 x 8 jin, freely illustrated. Published by Gernsback Library Inc., New York. American price 3.95 dollars. (Our copy direct from publishers.)

The author of this text has set himself a tough assignment. He sets out presenting "technicalities without tears" to readers who, it is assumed, have no prior knowledge of the subject. The ever present fear is that the text will degenerate into a recitation of three-quarter truths, the remaining 25 per cent being represented by cases which do not conform to the usual pattern of things on which the explanation is based.

Undoubtedly some criticism of this sort could be levelled at this new book but Her- man Burstein, a regular contributor to...

100 Years of History
FROM SEMAPHORE TO SATELLITE, ITU 1865-1965.
343 pages, 11 x 8 inches, stiff cloth cover, embossed. Published by the International Telecommunication Union, who supplied the original copy for our review. Available from the Publications Service of the ITU, Place des Nations, 1211 Geneva 20, Switzerland. Price 40 Swiss francs (US 9.50 dollars).

In the editorial of our May issue, we commented on the fact that, this year, the International Telecommunication Union celebrates its centenary. To mark the occasion, they have issued this very excellent book, as illustrated...

And there is more to the title than its alliteration; it is strictly factual.

The book opens with a discussion of the very real communication problems in the seventeenth and eighteenth centuries, their methods of signalling and the gradual development of the visual telegraph system. The text is illustrated with sketches from the eighteenth century. This leads naturally into the evolution of electrical telegraphy, the earliest date mentioned being 1753, with a proposal for an adaptation of electrostatic phenomena. The part played subsequently by men like Cooke, Wheatstone, Morse and Vail is mentioned, as also the stimulus supplied by railway equipment. Also described is the subsequent development of point to point and long distance radio telegraphy.

So the story continues, through under-sea cables to telephony and the modern telephone.

Section 2 of the book has to do with Radio. It goes back to Joseph Henry who, in 1842, discovered the oscillatory character of electrical discharges. From such beginnings, the development of wireless, broadcasting, radar and wartime communications, microwave and modern television.

The final section of the book is devoted to the I T U itself, its various functions and communications and its role in present-day communications—with a good deal of emphasis on space research. As an illustration of the social significance of modern communication, a map shows the communication and Flying Doctor network serving inland Australia.

 Appropriately, this is an international story, although it is too much to hope that the contents of any book will please every potential critic, in terms of what has been put in and what has been left out or interpreted.

But, for this reviewer, the book has been put aside for attention during the next available leave period. It's the kind of book that invites reading, quite upon its own merits, very considerable reading indeed.

It is superbly produced, with high quality paper and binding and open, attractive layout, largely made possible by the large format. Illustrations, taking up probably more than half the total space, range from early drawings and patent specifications through technical and artistic illustrations, including one of the telescopes at Parkes, N.S.W.

In conclusion, this book is the kind of book that invites reading, quite upon its own merits, very considerable reading indeed.

ELECTRONICS Australia, August, 1965

TECHNICAL BOOKS AND PUBLICATIONS

SELECTED SEMICONDUCTOR CIRCUITS, by the Editorial Staff of Tech-Press Publications, Brownsburg, Indiana. 83 illustrations, 80 pages, Circuits, some text. Price in Australia 11/6 posted.

A guidebook of volume of useful transistor and diode circuits for the amateur, experi- menter, hobbyist and technician. Each circuit is explained in brief and the necessary notes. Some of the transistors specified may not be available locally, but near equivalents should be available in many cases.

Perhaps not a book of wide appeal, but one which may be of interest to those having no recent experience who need only the circuit and brief details of a project. It makes a good reference to designers as a guide to design trends.

Our copy came from McGills Authorized Newnes Book stores, 83 Elizabeth Street, Mel- bourne. (J.R.)

MINIWATT ELECTRONICS HAND-BOOK 1, published by the Miniwatt Electronics Corporation, Minowatt, Melbourne Pty. Ltd., Hard cover, 5 by 7 inches, approximately 484 pages. Australian price 25/.

Philips have assembled in this handy size book data and graphs for the Australian Miniwatt preferred range of Radio Receivers, Valves, Television Receiver Valves, Audio Transformers, and Television Tubes. This information includes physical dimensions, baying connections, typical maximum ratings, characteristic curves and application instructions.

In the early pages of the book, a cross-reference of type numbers is given and a valve classification guide which allows the selection at a glance of the preferred valve for the application required.

A handy reference book for engineers, technicians and service personnel and students.


In the handbook of Installation and Maintenance of Industrial Transformers the author points out the necessary steps to ensure the safe operation of the equipment. In the case of industrial transformers, of ratings up to about 10,000 KVA and 33KV, together with auxiliary equipments. He also shows how to choose the site for a new installation and deals with the installation work and preparation for service.

This book includes many photographs of typical maintenance and installation procedures. Some of the hints, those obvious when pointed out, are applicable in other fields of engineering. One clue is the method of connecting a spanner by a short cord to the operator's wrist. How many times have you and I used a spanner in an inaccessible place?

Under the second title of this series, Industrial Switchgear, the author has discussed the practical aspects of the subject are dealt with in relation to the factory engineer. A discus is to be considered when selecting a motor and its
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- **ELECTRICITY**
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- **TELEVISION**

**THE STANDARDS ASSOCIATION OF AUSTRALIA** has announced that Part I of the SAA Wiring Rules is under revision with a new edition being planned for January 1968. The current edition (as amended by amendments Nos. 1, 2 and 3) is invited from organisations and persons with experience in electrical matters both in the field and should be forwarded to the following address not later than 31st August, 1965, to the S.A.A. Engineering Rules and Wiring Rules, Standards Association of Australia, 157 Gloucester Street, Sydney, N.S.W.

**LITTON INDUSTRIES** advise the release of a new 64 page 'Handbook of High Precision Potentiometers', some 40 pages of which are used to illustrate various model potentiometers and describe their application to various design requirements. Subjects covered include potentiometer testing circuits, push-on-pull-off functions, loading effects and tracking; and millivolt meters for shock and vibration. Also discussed are quadrature, noise measurement, and potentiometer definitions. This reference book is available on request from the head office at 3717 Third Street, Mount Vernon, N.Y.

**SARGENT AND GREEFF, INC.** forward leaflets describing their Resonant Reed Relay, Resonant Reed Oscillator Control and Barrer Moller. The excellent electronics and electronic equipment, leaflets or further details of these items may be procured by writing or telephone inquiry to Companies, 332 West 21st Street, New York, N.Y. 10011, U.S.A.

**STC COMPONENTS AND EQUIPMENT REVIEW** for May, 1965 (Vol. 2, No. 5) gives details of multi-pole printed wiring connectors and ISAP standised silicon rectifier units for valve replacement, gas tube surge protectors, midget relays, signal relays and relay applications. Also included is a data table of higher power silicon PN-P transistors and a further article in the series dealing with the Design of Transistor Amplifiers. Available from the Editor, Industrial Products Div., Standard Telephones and Cables Pty. Ltd., Mountainbank, Avenue, Liverpool, N.S.W.

**SAMPLE ENGINEERING SALES CORP. LTD.** have data sheets and applications pamphlets for Silicone rubber, a range of "plastic steels," plastic packaging and curing urethane rubbers, manufactured by Devcon Chemicals of Danvers, Massachusetts, U.S.A. In addition, they supply a wide range of materials made by the Devcon Corp. in the U.S.A., who provide a regular information service with relevant articles found in the trade press. Under the S.A.A. Wiring Rules. Subscribers to the S.A.A. Wiring Rules, Standards Association of Australia, 157 Gloucester Street, Sydney, N.S.W.

**B.C.N. AGENCIES PTY. LTD.** advise that they are agents in Australia for Lowry-Croft Abstracts of Illinois, U.S.A., who provide a regular information service to researchers in the fields of food processing, laser technology, printed circuits, microelectronics, and cold-curing applications. The organisation searches continually through almost every available journal published worldwide for the latest research ideas and supplies the subscriber with 100-word or so abstracts of all relevant articles found—complete with full reference and listing details. Subscription to the "microelectronics" abstract service is £11.00 per year (post free). (B.C.N. Agencies Pty. Ltd., 62 Wellington Pike, East Melbourne, C.2, Victoria.)
The ADC-40 Pritchard Tone Arm by the Audio Dynamics Corporation is made to complement high compliance cartridges. Its simplicity of design and special attention to engineering detail offer the best possible working conditions for today's high quality cartridges.

The ADC-40 when used with the ADC-4 cartridge will track correctly at 4 gram. Records sound better and last longer when played under these conditions.

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ADC cartridges are distinguished by the exceptionally low mass of the moving system, which is genuinely below all others and results in superior square wave response.

The use of a fixed magnet, separate from the moving system, inducing its field into an armature of extremely light weight, reduces mass to half or less than that of systems previously regarded as low-mass designs.

Another worthwhile virtue is the exceptional ease of stylus replacement by the user. Prices for these cartridges are:

- ADC Point Four E: £35
- ADC Point Four: £30
- ADC 660 E: £25
- ADC 660: £20
- ADC 770: £13

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The JH synchronous turntable is a lightweight model that uses the advantages of lightness to the full. Constructed of aluminium and suspended on a teflon bearing, the platter requires so little torque that it is driven by a small 12-pole hysteresis synchronous motor. Specifications are:

- Power Requirements: 200 to 250 volts AC, 50 cps, 5 watts.
- Speeds: 33 1/3 and 45 r.p.m.
- Method of Propulsion: Belt Drive.
- Rumble: Unmeasurably small.
- Wow and Flutter: Better than 0.04%.
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- Diameter of Platter: 12in.

Price is £25

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84 KING ST., SYDNEY, N.S.W. Telephone 25-3886

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166 GLEBE RD., GLEBE, N.S.W. Telephone 68-1014

BRISBANE AGENCIES
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