RADIO AND ELECTRONICS

Vol. 7, No. 4 June 1st, 1952

Page

OUR COVER

This month's cover shows a view of the seven-valve radiogram designed and built by our technical staff and described in this issue on page 4.

Official Journal of:

The N.Z. Electronics Institute (Incorporated).

The N.Z. Radio and Television Manufacturers' Federation.

The N.Z. Radio Traders' Federation.

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Advertising Manager:
CHAS. H. ROSER

Subscriptions: 1/10d. per copy; 23/- per annum, posted

Advertising Rates supplied on application.

CORRESPONDENCE:

All correspondence and contributions should be addressed to:

The Editor,
"Radio and Electronics,"
P.O. Box 8022,
Wellington, N.Z.

OFFICES AND LABORATORY

Radio and Electronics (N.Z.), Ltd.,
46 Mercer Street, Wellington.
Telephone, Wellington, 70-216
Telegrams and Cables:
"Radel," Wellington.

SOLE ADVERTISING REPRESENTATIVES FOR THE U.K.:

Cowlishaw and Lawrence (Advertising) Ltd., 28 New Bridge Street, London, E.C.4. Telephone City 5118. Cables: Cowlawads Cent, London.

AUCKLAND REPRESENTATIVE:

Mr. J. Kirk,
No. 11 Keans Building,
150 Queen Street, Auckland.
Telephone 48-113. P.O. Box 1744.

Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington.

PRINTED BY HARRY H. TOMBS, LTD., WINGFIELD STREET, WELLINGTON.

Caring For Long-Playing Records

Readers will have noticed that considerable space in recent issues of *Radio and Electronics* has been devoted to discussion of the problems involved in the reproduction of the (to us in New Zealand) new long-playing records. This is merely a reflection of the great current interest in the most significant technical development in the recording and reproduction of music that has taken place for many years. However, nothing at all has been said in these pages on the subject of looking after the records themselves. This is a matter to which a good many record enthusiasts have probably given scant attention, whereas the economics of the thing dictate that L/P records should be used with a good deal more care than ordinary 78 r.p.m. records. One difficulty about the new records that affects both those who buy and those who sell them is their high unit price. One sometimes hears the cry that they are too expensive, but a moment's thought will convince anyone that in terms of playing-time (which is what we are really buying when we pay for any record) the L/P record has a slight advantage in price over the old-style recordings. This still does not get over the difficulty that the purchaser has to find a considerably greater sum of money to buy one twelve-inch L/P record than one ordinary record of the same size. By the same token, should an L/P record be ruined by careless handling, it is much more of a disaster for the owner than the loss of a 78 recording.

The fact that L/P records are pressed in vinylite, which is a flexible plastic material, much lighter than shellac, and not at all brittle, tends to obscure the fact that the L/P record is much more easily damaged than the 78 disc, in every way except that of simple fracture. This is not a reflection on the manufacturers of L/P records. Far from it, since the L/P disc is inherently more delicate than the other, and, indeed, calls for far more exact standards of manufacture. It is simply a statement of certain physical characteristics of L/P records, that are probably not sufficiently realized by many users of them.

In the first place, the grooves of the L/P record, being much finer, are less strong mechanically. This means that any maltreatment of the record, such as dropping of pick-ups on it, or scoring a scratch across the grooves, has a greater effect on the reproduction than similar treatment induces on a 78 r.p.m. disc. Perhaps the most important effect, however, is that of dust which is allowed to settled in the grooves of the microgroove record, through allowing it to lie about, out of its protective cover. With a 78 record, dust in the grooves causes a certain amount of abrasion when the record is played, but its effect is not very noticeable on account of the already high inherent surface noise that the record possesses, even when quite new. With the microgroove record, on the other hand, the abrasive effect of dust is much more marked, because the material of the record is not so hard, and therefore is more easily abraded than is the hard shellac surface of the other record. Then again, on account of the very perfection (comparatively speaking) of the L/P record, with its exceedingly low surface noise, any noises caused by dust abrasion are very readily heard. Thus, it is that the increase in surface noises due to dust is very much more marked with the L/P record, and is, therefore, all the more to be guarded against.

All this does not mean that microgroove records are so difficult to handle as to make them undesirable. All that is required is a little more than ordinary care, which will be amply repaid by a life that should be longer than that of their conventional counterparts. This is so because of the extremely light weight of the pick-ups used with them, and, as we have pointed out elsewhere, the advent of the L/P record must have a beneficial effect on the playing quality and life of existing 78 discs, if only because of the improved pick-ups that are needed to play both types. The makers of L/P records have clearly realized the need for more careful handling, as is shown by their provision of much more robust and effective dust-covers for the L/P variety. The record, plus its cover, is very little thicker than a 78 disc, so that the long-playing feature effectively increases the available storage space by a factor equal to the ratio of playing times of the types of record. In addition, realizing that the increased outlay involved in the purchase of an L/P record makes perfection in the new article more important than ever, sellers of records are following the practice of providing only unplayed copies of L/P records. This has its inconvenient side, in that demonstration playings are not, in general, possible, but now that the New Zealand Broadcasting Service is commencing to use L/P records in its programmes it should be possible for enthusiasts to hear the newest L/P releases over the air, and buy accordingly. In this connection, it is to be hoped that the larger record stores at least, will set aside a copy of each record, to be used as a demonstration disc. This will certainly cost them money, but is a service that the buyer would appreciate, in addition to the knowledge that his own copy is brand new and unplayed.

The "R. and E." 1952 Radiogram

The radio-gramophone circuit described in this article is the result of considerable thought on the part of our design department, and while providing entirely adequate performance on radio (both broadcast and short-wave) has been carefully engineered to give much better than average audio quality on both radio and gram. positions. Two-position selectivity arrangements have enabled the A.F. performance on radio to rival that from records—a feature that is not always provided even in the most expensive commercial instruments.

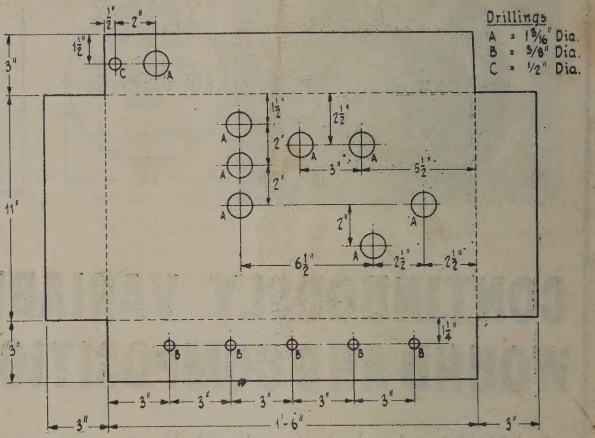
INTRODUCTION

It has always been a matter of some surprise to the writer than highly priced commercial radio-gramophones do not provide better audio quality than they do. This is not a "crack" at the expense of the manufacturer of such articles, nor at their designers; it is in some measure a reflection of the relatively uneducated state of the general public with regard to quality of reproduction. One very good reason why things are so is that it has become customary in this country for the high-priced radio-gram to be more of a "radio" than a "gram." For example, these instruments usually have everything that opens and shuts on the radio side, such as all-wave coverage, and lots of spread bands. These things are expensive to provide, and in an article which is to sell at a given maximum price, eat up a good deal of production cost that it would be possible to apply to other ends, such as making a really slap-up job of the audio section. Of course, there is a section of the public which expects these things rather than a set without the R.F. "frills," as they might be called, but *with* extra good audio quality. At the same time, it is our belief that there is also a large section of the potential market that would prefer a set in which most of the money and effort has been expended in producing good audio quality on both radio and gramophone reproduction.

THE VALVE LINE-UP

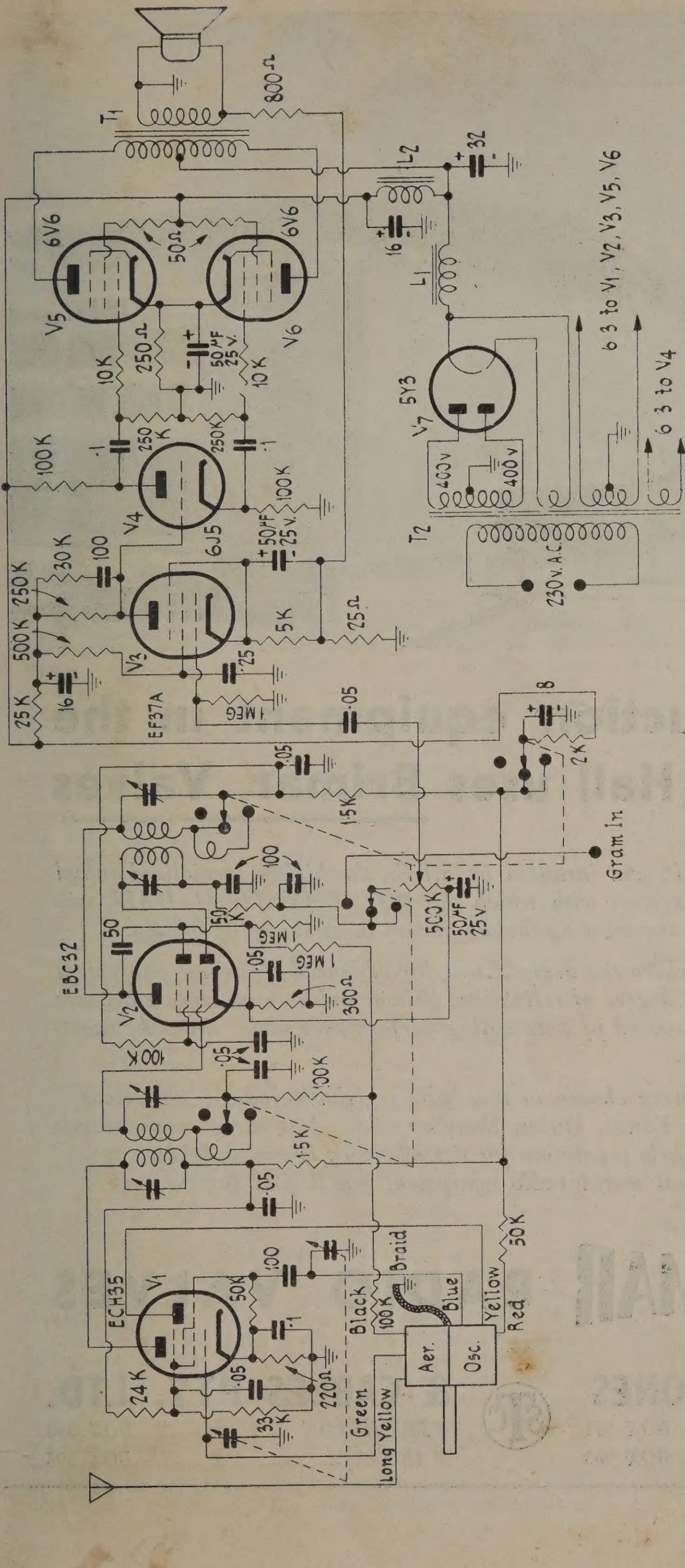
It is with these ideas in view that the present set was designed. The R.F. end is very similar in most respects to that of a normal five-valve superhet, in that it omits an R.F. amplifier stage, and commences with an oscillator-mixer. An ECH35 was chosen for this position, because of its known excellent performance, but there is no reason why others of the several excellent oscillator-mixer valves available today should not have been utilized. The second valve is an EBF32, which is an extremely useful R.F. pentode, combined with two diodes, rather than the older American 6B8, only with rather better characteristics. The pentode section is the I.F. amplifier, one diode is the second detector, and the other is a separate A.V.C. rectifier, fed from the primary of the last I.F. transformer, as is our usual design practice. Thus, the R.F. end of the set is complete in two valves. In spite of this, its performance leaves little to be desired for a set of this nature. The sensitivity on both broadcast and short-wave is excellent, and for those who want this feature, in addition to the main one of high-quality reproduction, it will be found more than adequate. Indeed, when the set was under test in our laboratory, which is in a very noisy part of the city, it was bringing in American broadcast stations one evening at very good strength. This is a feat that speaks very well for a simple R.F. section such as this set has, and, incidentally, shows that there is no need for an R.F. stage, at least for broadcast reception. However, in order to make the set a complete one for those who do like to listen to short-wave stations occasionally, a dual-wave coil unit was installed, and here again it was found that very acceptable performance was obtained.

The question of providing for high-quality reception of local broadcast stations was given considerable thought, and in the end, we decided upon the scheme of using a pair of commercially available I.F. transformers of the kind having two-point selectivity built in. These transformers have a third winding, of a few turns only,



that are closely coupled to one winding, but which are connected, when in use, in series with the other winding. They act as a coupling link, adding their coupling to the existing inductive coupling, which is just great enough to give the set normal selectivity for ordinary situations, such as listening to distant broadcast stations or on short-wave. When switched to the "broad" position, the additional coupling provided by the link considerably broadens the pass-band of the I.F. transformers without having any noticeable effect on the skirt selectivity—that is, the selectivity in relation to stations far removed in frequency from the one being received. The amount of broadening of the top of the I.F. response curve is sufficient to give the set a great deal more high-frequency response than when it is in the "narrow" position, and therefore improved frequency response when it is compared with a conventional receiver with only one, fixed, bandwidth in the I.F. section. In the set we are dealing with, use has also been made of the wafer switch, which effects the change-over from "narrow" to "broad" in the I.F., to eliminate the need for a separate switch to change over from Radio to Gram. this switch is a three-position affair, giving one position for Gram, and the two Radio positions, broad and narrow.

The audio section of the set employs a couple of 6V6s, tetrode-connected, in push-pull. These are preceded by a 6J5 phase inverter, direct-coupled to an

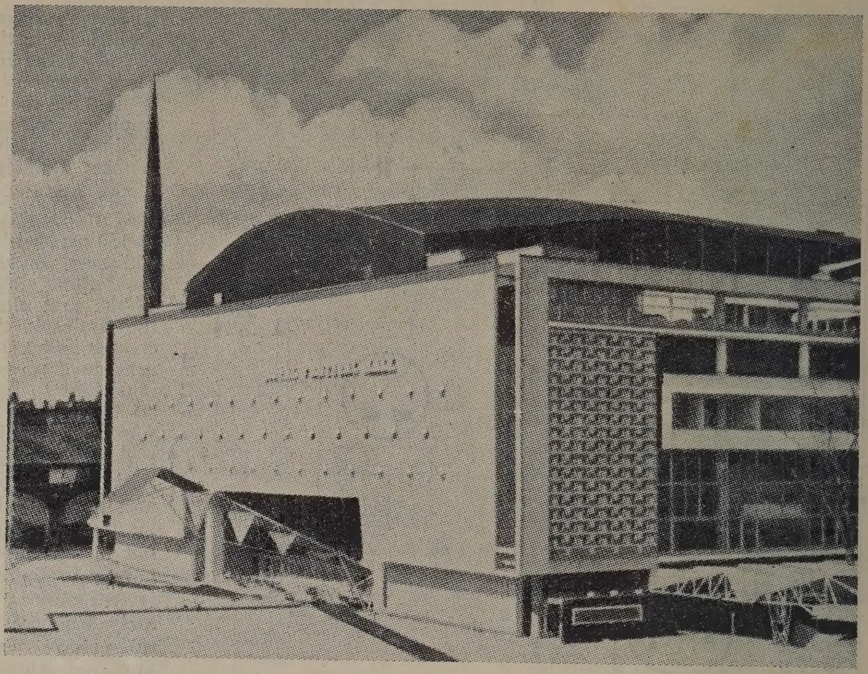


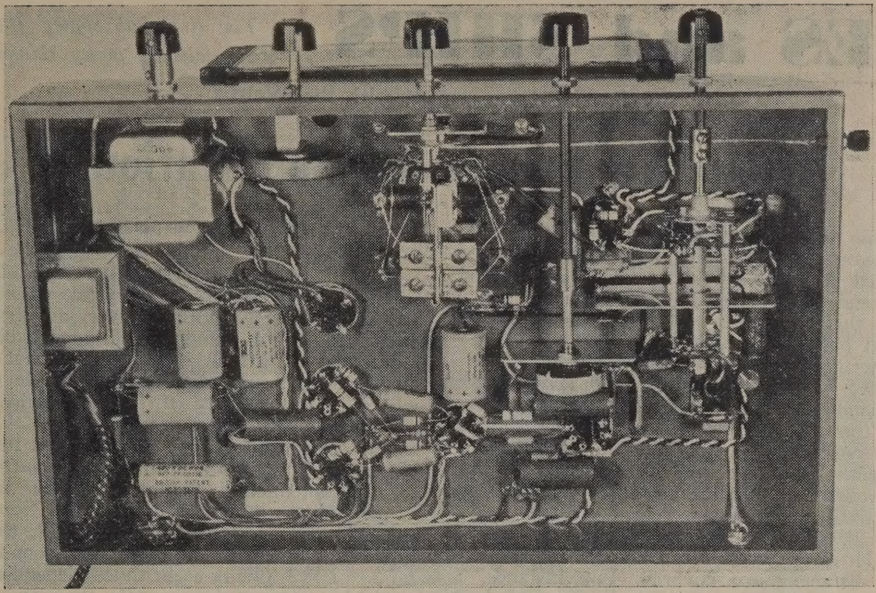
EF37A voltage amplifier. Feedback is applied from the voice-coil to the cathode circuit of the EF37A, and a simple CR network, previously described in this journal, is used in the plate circuit of the voltage amplifier to ensure that high frequency oscillation of the audio amplifier as a whole is most unlikely to take place.

The power supply in the original model uses a 400v.-a-side power transformer rated at 150 ma., with choke input, followed by an additional smoothing section. The plates of the output stage are fed from the output of the first filter section, where, because of the feedback, the hum voltage is at a low enough level not to cause trouble. In a pentode push-pull stage, it is much more important to have very well smoothed H.T. on the screens than on the plates, and this fact can be made use of to make the smoothing arrangements considerably less expensive. The reason for this is that the plates are in push-pull, so that any hum existing on the H.T. line to the plates is cancelled out in the output transformer, and does not appear in the output of the amplifier. This is true only if the push-pull stage is accurately balanced—that is to say, if the two tubes have identical D.C. plate currents, but even where the balance is not perfect, it does mean that considerably more hum can be tolerated in the plate circuit than can be put up with in the screen supply. The screens, of course, are connected in parallel, and any hum voltage in their H.T. supply is passed on by electron coupling. Hum of this kind is not in correct phase to cancel out in the output transformer, and therefore does appear in the amplifier output. This is why the screen supply needs as good hum filtering as can be provided. Fortunately, the screen currents are very small, and extra filtering is not expensive to provide. Thus, L_1, the input choke is the only one of the two which has to carry the full current of the set. L_2, the choke in the second filter section, only has to carry the currents of the early stages, together with the screen currents of the output stage, and so is considerably smaller and cheaper than L_1. The alternative approach would have been to use a transformer with a lower voltage from the main secondary winding, together with a condenser input filter. In this case, a larger choke still would be needed, and even then the smoothing of the whole supply would not be as good as is the filtering for the screens and early stages in the arrangement used here.

CIRCUIT IN DETAIL

Except for the use of band-spreading I.F. transformers, the R.F. circuit is quite straightforward and ordinary, and requires little in the way of special comment. The ECH35 circuit is not different from the standard one for this valve, nor is there much that needs elucidation in the circuit





of the EBF32, except perhaps for the switching arrangements referred to above. It will be seen that a four-pole wafer switch is used, having three positions. One section is used for each of the I.F. transformers, and the remaining two are concerned with the change-over from Radio to Gram. An input socket is provided for the pick-up (or its pre-amplifier, if one is used) to plug into. The third switch section, therefore, switches the input end of the volume control potentiometer from the diode detector circuit, where it is for the two radio positions, to the pick-up socket for Gram. The remaining section silences the tuner portion of the set so as to prevent radio break-through in the Gram. position. It does this by breaking the H.T. feed to the plate and screen of the EBF32, which thus becomes completely inoperative on Gram. Builders are advised that it in no way pays to omit this switching, because unless it is done, there will be quite noticeable feed-through of radio signals when the set is switched to Gram. This is due to the minute, but unavoidable capacity between the switch contacts, and to the fact that even though the circuit of the diode detector is broken by removing the volume control from the circuit, in which it plays the part of the diode load resistor, some sort of rectification takes place, and leaks through to the audio amplifier.

Another point worth noting is that double bypassing of the EBF32 cathode has been employed. At the valve socket is a 0.05 μf. condenser, which is effective at R.F., but which is only partially effective at audio frequencies. As a result, the cathode resistor becomes effectively, a part of the diode load resistor, and unless the cathode is heavily bypassed by a high-capacity electrolytic condenser, there is quite a large and annoying minimum volume effect. In other words, when the volume control is turned right off, there is still a substantial audio signal fed to the grid of the first audio tube, and zero volume is impossible to achieve. The electrolytic condenser is connected at the lower end of the volume control potentiometer, as shown in the circuit drawing, as this relieves the congestion of parts round the EBF32 socket, which has enough parts grouped around it as it is. Followers of the audio amplifier circuits published in this journal will probably recognize the audio amplifier section as a slight modification of the main amplifier portion of the "78-L/P Special," described in the April, 1952, issue. In order to relieve the expense of the set somewhat, and still give excellent quality, the original did not use a high-fidelity output transformer, though excellent 10-watt transformers are available that would be admirably suited to this amplifier. If you have one of these, by all means make use of it, but if you are faced with purchasing a transformer specially for the set, it will be cheaper to do as we did and buy a 20-watt multi-match P.A. transformer. At the output levels used in a domestic set, these transformers perform almost as well, in a properly designed feedback amplifier, as the much more expensive article, at only about half the cost, and so are a worth-while investment. The feedback constants have been chosen to suit one of these transformers, in that a margin has been left for stability purposes, in addition to the use of the phase shift network in the plate circuit of the EF37A. This does not mean, however, that anything will have to be changed if a better output transformer is used instead of the 20-watt P.A. one.

The direct coupling between the plate of the EF37A and the grid of the phase inverter needs a little watching. The correct biasing conditions for the 6J5 depend, among other things, on the values of the EF37As plate load resistor, and also on the value of its de-coupling resistor. The latter is bypassed by an electrolytic condenser, and should this by chance have much greater than average leakage (all electrolytics have some) then the biasing on the 6J5 is likely to be upset. However, this is not unduly critical, or we would not have incorporated it in the circuit. An account of the cathode follower action of the phase inverter, the exact grid voltage is not nearly as critical as it might otherwise be, and quite large changes in the voltage at the grid will result in only minor changes in grid bias.

LAYOUT AND CONSTRUCTION

The layout and construction of the set are well shown in the photographs and the chassis diagram. Liberal use of aluminium mounting brackets has been made in order to shorten some leads that would otherwise have had to

(Continued on Page 33.)

SHOES and SHIPS

"The time has come," the Walrus said,
"To talk of many things. . . . "

By Special Arrangement with the Walrus

High Frequency Communication

Radio telephone seems to be coming quite the thing these days and many and varied are the different types of equipment offered for this purpose. One of the most interesting is intended for use in the very high frequency range and it is this type of set that is becoming most popular today. It has considerable advantages in its favour, namely a certain freedom from noise troubles normally encountered in industrial areas, and comparative freedom to expand since band space is available more readily around the 100 megacycle mark. True enough, ranges in miles covered by a service is not as great as could be done with lower frequency equipment, but this again is an advantage in that the same wavelengths can be used over and over again provided the particular locations where the services are to be used are widely enough spaced. However, even with this precaution taken some amazing distances are covered. For instance, a Wellington taxi company at one stage for several days was able to talk to a Christchurch fire brigade, then again the same company was hearing a Wanganui taxi business very clearly, and an amusing instance is recorded of a Wellington car accepting a job from the Wanganui base station before the circumstances were realized.

These results, of course, are exceptional and are in the main dependent on certain weather conditions whereby ducts are formed in the upper atmosphere.

Returning more closely to our subject, however, indications are that R/T (as it is commonly known) is more freely employed overseas than it is in New Zealand. This, to a large extent, is dependent on the policy adopted by the controlling authorities who allocate the frequencies and lay down the conditions of use. It is, however, finding its way into New Zealand industry in ever-increasing streams where it can be seen in taxi services, carrying companies, power board, traffic and police vehicles and even on motor bicycles.

A very interesting unit to have been seen lately is a small walkie-talkie manufactured by an English company. This little instrument measuring approximately 8 in. x 7 in. x 3½ in. houses a complete transmitter-receiver with batteries and built-up microphone.

A small whip aerial projects up from the set which is held in position on the operator's chest quite comfortably. A small earpiece of the deaf-aid type serves for the receiver and gives a surprising volume of sound output.

When one comes to consider that this set is intended for use in the very high frequency band, has to have crystal control on both receiver and transmitter which means having to use multipliers to bring the crystal frequency up to the 80 or 90 megacycle mark, and yet keep battery drain to a minimum, some of the difficulties will be appreciated.

Walkie-talkies are a much simpler proposition on low frequency than on very high frequency, but band space on the lower frequencies is rapidly becoming exhausted and anyway, as mentioned previously, noise troubles in a city would preclude its use.

That the little V.H.F. set does its job there is no doubt, and results are surprisingly good for such a small instrument.

One of the more interesting sidelights of the radio telephone business is in the crystals employed to lock the sets on frequency. With receivers and transmitters operating up on a hundred-odd megacycles it is quite impossible to grind a crystal for that particular frequency. The usual practice is to make them for somewhere in the vicinity of 10 megacycles and even they are getting very thin indeed. The crystal is then operated as an ordinary oscillator and several tuned circuits are employed to pick up and amplify the harmonics generated by the fundamental oscillator until the multiplied output is around the hundred megacycles. Some sets multiply the crystal frequency by nine, that is, three times in the first stage by three times in the second, or they might go 2 x 2 x 2, giving eight times, depending on the crystal used. In making the crystals they are machined down fairly close to the required frequency and then the final adjustment is made by immersing them in acid for a certain time to etch down to the desired point. This is obviously a ticklish business and calls for great care and attention.

The final operation is to mount them in a holder, and this also is a very important and exacting business in that the type of holder and method of mounting will have a definite bearing on both frequency and activity of the finished product. Some of the best crystals are of the evacuated type, these being sandwiched between goldfoil plates and mounted in either special crystal holders or otherwise miniature seven-pin button-base valve envelopes. Being operated in a vacuum, the crystal is much more active than usual and is less subject to temperature changes. This type of crystal, however, can only be successfully made overseas so it's just too bad if one gets broken.

CHAIRMAN OF BRITISH I.R.E. COUNCIL VISITS NEW ZEALAND

Mr. J. Langham Thompson, Managing Director of J. Langham Thompson Limited, Research and Development Engineers of Springland Laboratories, Stanmore, Middlesex, visited Auckland recently, following a trip to Australia in connection with the guided missile researches and developments there.

Mr. Thompson is also Chairman of the Council of the British Institution of Radio Engineers, and, despite his crowded itinerary, at the request of Brit.I.R.E., he very kindly agreed to pay a brief visit to New Zealand to meet representatives of the British Institution in New Zealand, Mr. William J. Blackwell, M.Brit.I.R.E., Mr. David P. Joseph, A.M.Brit.I.R.E., and Mr. George F. Joseph, Secretary.

Plans for the further development of the British Institution of Radio Engineers, New Zealand Section, were discussed at some length, and Mr. Thompson regretted he could not spend more time in New Zealand to meet other members. His generous action in including New Zealand in his itinerary even though for so short a visit, is greatly appreciated, and the New Zealand Section will benefit greatly from his wise counsels.

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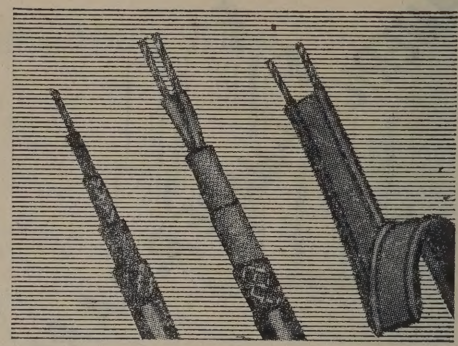

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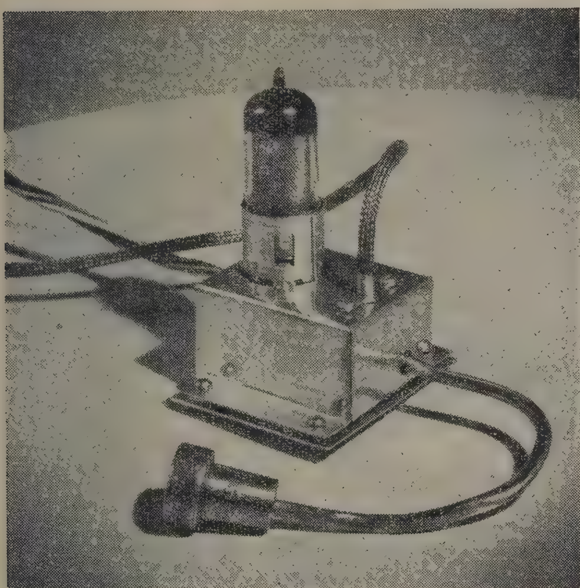


The heading illustration shows a pre-amplifier that was built to give the required frequency compensation for a high-quality magnetic pick-up, for 78 r.p.m. records. Also shown is the circuit, which is suitable for attaching to almost any amplifier or radio receiver.

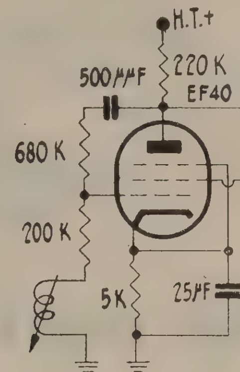
The arrangement uses an EF40, which is a valve specially designed for low microphonic effect and low heater-cathode hum voltage. As long as the H.T. line is well filtered, the hum introduced by this arrangement will be completely negligible.

FOR ANY HIGH-QUALITY MAGNETIC

As well as providing equalization, the circuit has an amplification at middle and high frequencies of approximately three times. It is thus very suitable for use with existing amplifiers, and sets, in which there is already plenty of gain, because the additional gain is small, and is not enough to be an embarrassment, as often happens when a high-gain circuit is attached ahead of an audio section whose amplification is already high. The most suitable pick-up for use with this circuit is one which has a reasonably large unequalized output, in the region of 0.1 to 0.25 volts. There is no reason, however, why it should not be used with pick-ups whose output is much less than this, except that a second stage of amplification will sometimes be necessary. For example, the G.E. variable reluctance head has an output of only 15 millivolts or so. The equalized output with this circuit would still be only 45 millivolts, but any succeeding pre-amplifier stage would only need a gain of ten times to bring the output up to almost half a volt—ample for many amplifiers.

CIRCUIT ARRANGEMENTS

The circuit arrangement has been seen before in these pages, and is probably the simplest possible one for performing the needed compensation. It has the advantage over the ordinary compensation networks that the boost at the very low audio frequencies does not fall off, or start to do so, at about 100 c/sec. Indeed, a frequency run on the completed pre-amplifier showed a flatter response curve for the combination of record plus pick-up and pre-amplifier, than the writer has seen before. Negative feedback from plate to grid provides the necessary reduction in gain at middle and high frequencies, while the point at which the response starts to rise is governed by the size of the condenser in the feedback chain. This condenser also does duty as a blocking condenser, preventing the H.T. voltage from reaching the grid.



WHY SO SMALL?

The idea behind making up the circuit in such compact form was just to demonstrate that additional units like this one need not be large and bulky, and can be built small enough for space to be found for them in any cabinet whatever. The ideal place for the unit would be underneath the gramophone motor board, with a short shielded lead to the pick-up, and power leads as long as may be necessary. The short lead with the plug attached is the output connection.

MODIFICATION FOR BOTH TYPES OF RECORD

Some readers will no doubt be wondering whether simple modifications can be made to this circuit to enable the different compensation needed for 78 and L/P records, respectively, to be seelcted at will. This could certainly be done with little trouble, but the size of the chassis would have to be increased slightly to accommodate a switch. A midget wafer switch having two poles and two positions would do all that is required. One pole would change the value of the 500 μμf. condenser to 300 μμf. and the other would connect a 100 μμf. condenser across the 680k. resistor, disconnecting it in the 78 position.

DECOUPLING NEEDED IN SOME CASES

If the H.T. voltage is to be taken from an existing amplifier, it is quite possible for motor-boating to be encountered as soon as the pre-amplifier is connected. Thus it may be necessary to include a decoupling resistor and condenser in the H.T. line to the pre-amplifier. If the first stage of the amplifier proper is already heavily decoupled, the best place to take the H.T. feed from would be the output of its decoupling filter, since the

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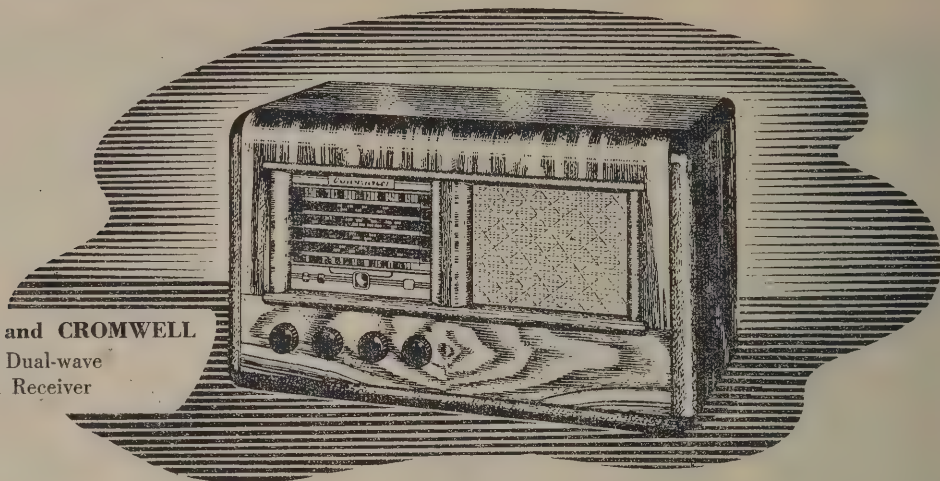
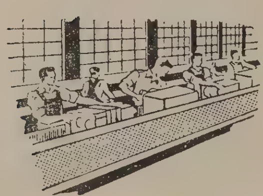




Some New Circuits for Radio Control Receivers

PART II

Part I of this article, published last month, described a recent development in super-regenerative detector circuits for radio control, and a new method of filtering out the undesirable quench frequency voltages from the succeeding circuits, as well as describing a complete receiver using these ideas. Part II, presented here, describes other circuit developments, and in particular a method of using square-wave modulation of the transmitter to obtain a system giving absolute and controlled positioning of the final control surface, and doing away with sequences and stepped controls.

INTRODUCTION

At the end of Part I of this article, mention was made of the usefulness of a receiver which would pass a wide band of audio frequencies, unrestricted by the use of ordinary RC filters for removing voltages of quench frequency from the audio amplifier system of the receiver. It was stated that a receiver of this nature was essential for certain special purposes, which would be described in a later article. The actual purpose envisaged was the production of a receiver and transmitter that would enable fully proportional control of a function, rather than a simple system, such as has been used in the past, and which is limited to three positions, say (in the case of directional control) right, left, and centre. Moreover, it has become standard practice in radio control activities to avoid the necessity for more than one communication channel, by introducing a stepping, or sequence, mechanism, which, when successive signals are sent, runs through the sequence R-C-L-C-R-C-L-C, and so on. If such a sequence is not used, entirely separate channels are needed in order to obtain either right or left; using the sequential method avoids this, but in turn introduces the complication that it is not possible to select right or left at will. That is, if the last movement was left, then the next movement can only be right. In order to perform two movements of the same kind, one after the other, with this scheme, it is necessary to pass through the unwanted movement so quickly that the controlled object, aircraft, boat, or what you will, has no time to respond to it. Another disadvantage of the sequence method is that intermediate control positions are not possible, except by inventing a more complicated sequence, too difficult to use. The disadvantage of this—and it is a very real one—is that it is very difficult to remember just what the last movement, was and therefore, how many signals need be sent to give particular one next. Accordingly, those who have been practically concerned in the control of models by radio have for a considerable time been very keen to develop a control system which, as well as giving right to left at will, would enable any degree of each to be sent, just as if one were in manual control of the rudder. The advantages of such a scheme are self-evident, provided that it can be carried out without too much complexity, and at a size and weight of equipment at the receiving end that would not require a full-sized aircraft to carry.

In modelling circles, a control such as we have just described has come to be termed a proportional system, in contradistinction to the usual sequence-plus-three-positions, or so called "bang-bang" control.

This portion of the article is devoted to a description of a system which has been developed to solve this problem, in such a manner that the resulting equipment can be installed in a model aircraft. At this stage, the receiver and transmitter have been built and bench-tested, with satisfactory performance, but have not yet been flown in a model. There is, however, no reason to expect that successful flight tests will not be accomplished, since the receiver employs individual pieces of design which have proved themselves perfectly practicable in powered flying models.

PREVIOUS ATTEMPTS AT PROPORTIONAL SYSTEMS

Several systems have been devised, and many of them flown in model aircraft, which partially solve the problem of proportional control. That is to say, they eliminate the sequence, and they do give a measure of control over the degree of each order transmitted to the remote receiver. Most of them have depended upon modulating

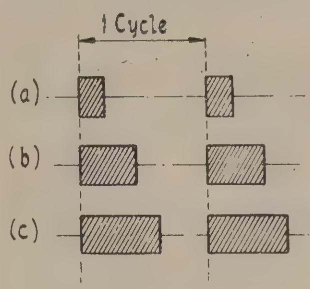


Fig. 7

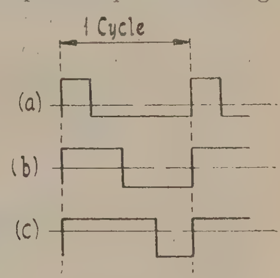


Fig. 8

the transmitter with very low-frequency square waves, whose mark-space ratio is controllable. Thus, the transmitter is turned on and off at a rate of ten to twelve times a second, and the ratio between the 'on" and "off" periods is continuously variable. The rate is not important, except that it must be slow enough for a relay at the receiver to follow. In this way, a conventional receiver can be used without modification. The relay then operates a solenoid, or similar device, which pulls the rudder to, say, the left, for the duration of the "on" periods. In the "off" periods, the rudder is pulled to the right by a return spring. When the "on" and "off" periods are of equal duration, the rudder flaps right and left for periods of equal duration, and the net effect is as if the rudder did not move at all, because the inertia of the aircraft prevents it from responding to these fast rudder movements individually. The many variations of this scheme differ solely in the detail of the method used to translate the relay movements into rudder movements. It is clear that with no signal at all (i.e., transmitter continuously off) a maximum rudder deflection takes place towards the right, while if the transmitter is continuously on, maximum left rudder is applied. Intermediate degrees of turn in either direction are obtained at mark-space ratios intermediate between these extremes, since if the rudder dwells longer in the right-hand deflection than in the left, the result will be the same as a partial deflection of the rudder to the right.

While these systems have been made to work well by some experimenters, they all suffer from several disadvantages. The worst of these is that should radio contact be lost, for any reason whatever, the rudder will stay at maximum deflection in one direction. In the case of a model aircraft, this can result only in a write-off! The other chief disadvantage is that the electric motors, or solenoids, used to move the rudder are being operated in such a way that they are drawing full current from their batteries at all times. This is expensive in battery capacity, and usually means in practice that heavy batteries have to be carried, greatly increasing the weight of the receiving gear. Electric motors, if they are used, are also being run effectively in a stalled condition, thereby drawing much more than their normal full-load current, and sometimes enough to shorten their life through overheating.

From the point of view of the ideal system, these so-called proportional schemes leave much to be desired, because they are not true positioning mechanisms. This is because the effective position of the rudder is determined as much by the tension of a return spring as by the signal sent to the receiver, and so is not strictly and uniquely determined by the signal.

THE PRINCIPLE OF OPERATION

The system to be described here is a true positioning mechanism. Each signal sent to the receiver corresponds on one, and only one position of the final shaft, as long as the receiver is within working range of the transmitter. Should the transmitter or the receiver fail, then the final shaft, and therefore the rudder, which is linked to it, returns automatically to its neutral position. There is thus no danger of a model aircraft ending up in a "spin" or a downward spiral, should the control fail for any reason. The transmission is of exactly the type described in the previous section, except that the frequency of the modulating square-wave is considerably higher. The experimental set-up uses 200 c/sec The radio frequency signals emitted by the transmitter for centre, and for the extreme positions of the control are shown in Fig. 7. Signals between these in shape result in intermediate positions being taken up by the controlled shaft. In the receiver, these signals after detection, result in waveforms as in Fig. 8. They are then amplified, and fed to a discriminator circuit, which produces from them positive or negative D.C. voltages, whose amplitude depends on the exact shape of the original signal. The mechanism by which this is done will be described when the actual circuits are under discussion. Of course, the signal of equal mark-space ratio, shown in (b) in both the above figures, results in zero output voltage from the discriminator. It will be seen, then, that so far the system involves nothing new, at least in principle. At this stage, it can be seen that the sequence has been eliminated, just as in the partially proportional systems referred to above. It remains to provide a device which will regulate the amount of control in either direction, in exact accordance with the magnitude of the D.C. voltage, either positive or negative, produced by the discriminator circuit.

The arrangement that does this is illustrated diagrammatically in Fig. 9. The valve V_3 receives its signal directly from the discriminator, and so passes a plate current that is dependent on the polarity and magnitude of this signal. In its plate circuit is one coil of a polarized relay, the other coil of which is provided with a constant current from the H.T. supply. The relay, in addition to being polarized, has contacts that are normally open when the relay is de-energized, or else has equal currents flowing in the two windings. Thus, when the valve current is equal to the bleed current through the second relay coil, the relay is in its neutral position, and neither set of contacts is closed. The electric motor is therefore stopped *and the whole thing is in equilibrium.* It is clear that the valve current at which this equilibrium exists depends only on the setting of the current through the second relay coil and this current can be set at such a value that the valve is being operated somewhere near the middle of its characteristic. The exact grid voltage corresponding to the equilibrium position is not at all important, as will shortly be seen. For the sake of illustration, let us assume that the valve current is 2 ma., and that a fixed bias has been applied so that this current flows, and the system is balanced, and therefore at rest. Now if a positive signal voltage is applied to the grid of the relay tube, the plate current increases, and closes the relay in one direction. This brings one of the motor batteries into circuit, and the motor turns, in the appropriate direction. If a negative signal is applied, the valve current decreases, closing the other pair of relay contacts, and bringing into circuit the other battery, which turns the motor in the opposite direction. By these means, the positive or negative signal from the discriminator is translated into mechanical motion of a shaft, in one direction or the other. So far, nothing in the system determines by how much the shaft shall move. The potentiometer and battery perform this function, in the following way. The moving arm of the potentiometer is connected to the grid of the relay valve, so that the grid voltage of this tube depends not only on the signal voltage sent from the receiver, but also on the position of the potentiometer. The latter is driven, through gearing, by the electric motor. Now, if the potentiometer, when it moves, applies a voltage to the tube of such polarity as to neutralize the signal voltage, a position of the potentiometer will eventually be reached in which the signal voltage is exactly neutralized. When this happens, the grid voltage of the valve will be the same as if no signal at all were applied to the valve. The plate current is therefore at the value that allows the relay to open, and the motor to stop. The motor does so, and the system comes to rest. In this condition, the motor, and therefore the rudder, which is linked to it mechanically, has moved by a fixed amount, determined solely by the size of the signal sent to the grid of the relay valve. If the signal is a small one, the motor has to move only a small distance before the potentiometer has changed the grid voltage sufficiently to neutralize the signal voltage. If the signal was a large one, a much greater movement is necessary before the motor stops. Thus, the final position of the motor depends uniquely on the signal voltage, which in turn depends on the mark-space ratio of the transmission, which is itself manually controlled by the operator.

The next question is, what happens when the signal is removed? Let us suppose that the signal was a positive one, of 2 volts. The motor has turned the potentiometer until it has fed a signal of —2 volts to the grid, thus stopping the motor. Here the motor will stay as long as the signal is held on. But if the signal is returned to zero, as is done when the mark-space ratio is made unity again, the potentiometer signal of —2 volts remains on the grid of the relay tube. The relay therefore closes *on the opposite side,* which reverses the motor, turning it towards the central position of the control surface. When the potentiometer has returned to the neutral position, the relay opens, the motor stops, and the control is in neutral again.

From the above description, it can be seen that return to neutral is quite automatic, whether zero signal is caused by a failure of the transmitter, or by a purposeful return of the control to the neutral position. Further-

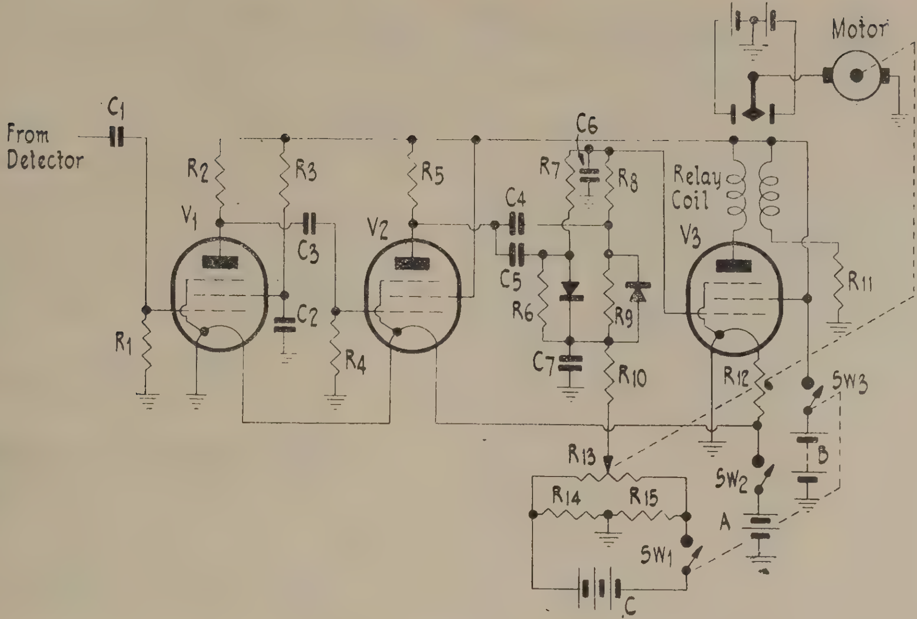


Fig. 9

more, the motor moves, and draws current, only while the rudder is being moved. When the rudder is stationary, so is the motor, and this applies just as much when the rudder is being held in any position, as when it is in neutral.

CIRCUITS REQUIRED

Fig. 9 shows the complete circuit of the receiving system. The detector is a super-regenerative circuit, similar in all respect to those shown in Part I of this article. The twin-T quench-filter is used and the detector output is applied to an audio amplifier. This comprises two stages employing 1T4 valves. Two stages are required, because the detector output is not quite sufficient to result in a constant-amplitude square-wave from the first stage, whatever type of valve is used in this position. After the second stage, comes the mark-space discriminator circuit. This is nothing more than a pair of diode detectors, one of which is arranged to conduct on positive peaks of the input waveform, and the other on negative peaks. The circuits are identical with those used in peak-reading diode detector circuits, where the D.C. output is proportional to the peak input voltage. With a sine-wave signal both positive and negative peaks are the same in amplitude, but here, the different types of signal have different relative amplitudes in their positive and negative peaks. In the signal of Fig. 8 (*a*), the positive and negative peak voltages are the same.

Now, the diode D_1 in the circuit diagram gives a positive output, and D_2 a negative one, so that when their outputs are added, as they are by simply filtering out the audio components and connecting the two outputs together, this kind of signal results in zero output voltage. Now let us consider the signal of Fig. 8 (*a*). Here, the positive peaks are much larger than the negative peaks, so that D_2 will give a large negative output voltage, when D_1 will give a small positive one. The output at the junction of the filter resistors will, therefore, be a large negative voltage; when the signal waveform has the opposite shape, with large negative peaks and small positive peaks, the output will be positive. In case some readers may be a little confused by the polarities, we would remind them that the diode circuit which conducts on positive signal peaks has a *negative* D.C. output, and vice versa.

COMPONENT LIST

V_1, 1S5 (diode unused).
V_2, 3S4 (one half of filament unused.)
V_3, 1T4.
R_1, 10 meg.
R_2, 250k.
R_3, R_6, R_7, R_8, R_9, R_{10}, 1 meg.
R_4, 3 meg.
R_5, 25k.
R_{11}, 45k.
R_{12}, 30 ohms.
R_{13}, 10k. driven potentiometer.
R_{14}, R_{15}, 50k.
C_1, C_2, C_3, C_6, 0.01 μf.
C_4, C_5, C_7, 0.05 μf.

Batteries
A, 3v.
B, 45v.
C, 22½v.
Motor—to suit motor used.

Crystal diodes, CG4–C (D_1 across R_6, D_2 across R_9)
Sw_1, Sw_2, and Sw_3, two-pole three-position for On/Off.
Relay, centre-stable polarized relay, as sensitive as possible.

SOME FACTS ABOUT THE RECEIVER

An interesting point about the receiver is that when a square-wave is used to modulate the transmitter in the manner described, the output square-wave from the detector is very large in amplitude compared with normal modulated signals, and amounts to some 4 volts peak-to-peak. Unfortunately, this is not quite enough to allow of only a single audio amplifier stage being used. It might at first be queried whether it would be necessary to use any audio amplification at all, since signal voltages of almost four volts could be obtained directly from the detector valve. This matter is concerned with the sensitivity of the miniature servo-mechanism that gives us the mechanical movements required. The servo proper includes all that part of the receiver which follows the discriminator, i.e., the relay valve, the polarized relay, the driven potentiometer, and the electric motor. Now, if we are to be able to have almost continuous control over the position of the rudder, this means that the maximum signal voltage available from the discriminator must be much larger than the signal voltage required to close the relay. For instance, suppose the relays needs 150 μamps. current change through one winding before the contacts close, and suppose further that the valve has a Gm of 1.5 ma./v.; a change in grid voltage of 0.1v. will just close the relay. Now suppose the maximum signal voltage that can be obtained from the discriminator is only 1.5 volts. This would mean that the motor could take up only $1.5/0.1 = 15$ positions, between centre and each extreme. This might seem more than sufficient sensitivity, because if the maximum rudder movement is fifteen degrees, which is a practical figure, then even this amount of sensitivity allows the rudder to be set to within one degree. However, there are several reasons why a much greater maximum output voltage from the discriminator than this is desirable.

(To be continued.)

Non-Sinusoidal Wave Forms

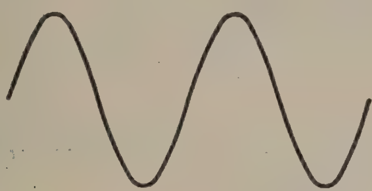
By the Engineering Department, Aerovox Corporation

PART I—PASSIVE WAVE-SHAPING

CIRCUITS

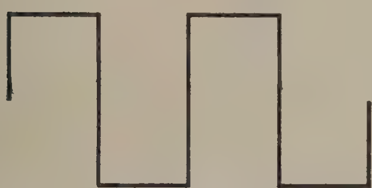
The recent rapid advance of such developments as radar, all-electronic television, pulse modulation systems,[1] electronic navigational aids, computers, and other electronic devices has focused attention to an ever-increasing extent upon the "care and feeding" of non-sinusoidal electrical impulses of special shapes. As used in modern terminology, a non-sinusoidal voltage or current may be described as one whose variation with time does not satisfy the equation:

$$(1) \qquad E_t = E_{max} \sin \omega t$$

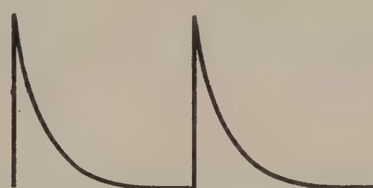


(a) SINE WAVE

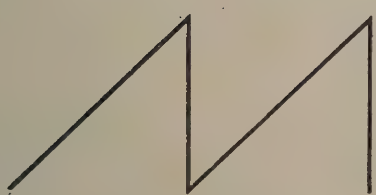
(g) PULSE



(b) SQUARE WAVE



(f) EXPONENTIAL WAVE



(c) SAWTOOTH WAVE

(d) RECTIFIED SINE WAVE

(e) TRAPEZOIDAL WAVE

This admittedly "back-handed" way of defining what a non-sinusoidal impulse *isn't* is perhaps simpler and more concise than a lengthy definition of what one *is*. Fig. 1 depicts graphically several of the more common types of voltage waveforms which may be encountered in modern timing circuits. A more or less general discussion of the generation, shaping, amplification, and use of some of these waveforms, using techniques available to the circuit engineer, will comprise the bulk of this article. The present issue is confined to the passive circuits which may be used to form non-sinusoidal waves, while the succeeding part will treat self-sustaining generators and other wave forming circuits which employ non-linear elements such as vacuum tubes.

Perhaps the simplest types of waveform shapers, as they are called, are the circuits composed of various combinations of the passive, linear network elements, namely: resistors, capacitors, and inductors. Consider first for example the circuit of Fig. 2, in which are shown a hypothetical signal generator capable of producing any of the waveforms of Fig. 1, a pulse shaper in which AA and BB denote terminals to which may be connected any of the passive circuit elements so that various network configurations may be studied, and an oscilloscope for viewing the output voltage of the pulse shaper. The series combination of resistance and capacitance shown connected to the terminals in this case is usually termed an "R-C differentiator" or "pulse sharpener," since the output voltage measured across the resistor is, within certain limits, closely proportional to the *time derivitive* of the input voltage. Other basic configurations of passive elements which are of importance are shown in Fig. 3.

We will first consider the R-C differentiator in some detail. It may be seen from a mathematical consideration that if the applied voltage in Fig. 2 is a pure sine wave, such as may be obtained from a good audio oscillator, the steady state output of the shaper will also be a pure sinusoid of identical frequency and waveform. In general, the only difference between the two will be their relative amplitudes and phases; the output leading the input by a phase angle given by:

$$(2)\qquad \phi = \arc\tan\left[\frac{1}{\omega RC}\right]$$

and reduced in amplitude as shown by the equation:

$$(3)\qquad E_{out} = E_{in}\left[\frac{1}{\sqrt{1+1/\omega^2R^2C^2}}\right]$$

current (3c) or the applied voltage (3d). It should be mentioned in passing that the phase and attenuation characteristics of integrator circuits, which are essentially low-pass filters, are frequency dependant, like those of the differentiators (or high-pass filters) mentioned above. The major difference between the two is that integrators display (1) a lagging, rather than a leading phase angle, and (2) attenuation and phase angle which increase rather than decrease with increasing frequency.

Another type of differentiator circuit which, although little used in the past, is of sufficient interest to warrant

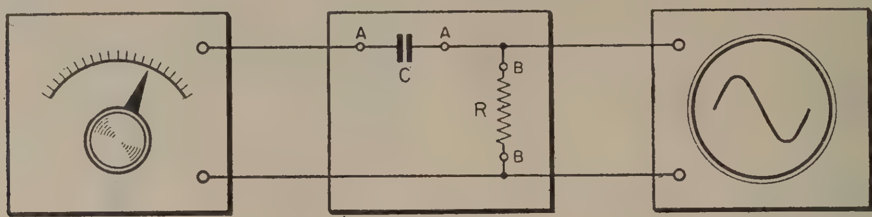


FIG. 2

FIG. 3

Inspection of Eqs. 2 and 3 shows that the phase angle and attenuation both decrease with increasing frequency. It should also be noted that the phase angle may approach but never quite reach 90 electrical degrees for a single R-C differentiator, since a phase shift of 90 degrees requires that the total series circuit resistance be zero—in which case the output voltage would also be zero. Thus, the output voltage of an electrical differentiating circuit is never, in the mathematical sense, an exact time derivitive of the input voltage.

A set of somewhat similar equations governing the phase and attenuation characteristics of the so-called R-L differentiators (Fig. 3b) for which the output voltage is proportional to the time derivitive of the input *current*, rather than the input voltage as in the previous case, may be found in the literature.[2] The phase shifting characteristic of resistor-capacitor and resistor-inductor networks is made use of where an accurately predetermined time or phase difference is required between trigger pulses. A typical phase shifter circuit which may be used to accomplish this is shown in Fig. 4. With this device, relative phase differences of almost 180 electrical degrees between input and either of the outputs, or nearly 360 degrees between outputs, may be readily achieved. Thus, although the phase shift for a single R-C or R-L network is limited to somewhat less than 90 degrees, it is possible to increase the total shift to any desired value by cascading two or more networks.

The "integrator" circuits (Fig. 3c and 3d) are so-named because of the fact that the output voltage is proportional to the time *integral* of either the circuit

a brief discussion here is the transformer or "mutual inductance" type shown in Fig. 5. This circuit offers several distinct advantages over the previously described types. As in the standard R-L differentiator, the output voltage is again proportional to the time derivitive of the input current as shown by the equation:

$$(4)\qquad E_{out} = M\frac{di}{dt}$$

where M (the mutual inductance) is the proportionality factor relating the coefficient of coupling and the primary and secondary inductances. The transformer, like the R-C differentiator, is an A.C. coupled device, and as such provides more flexibility than does the R-L circuit, in which the input and output are conductively coupled. Thus, it is possible to use the transformer differentiator as a coupling device between two circuits operating at different D.C. levels (as in the plate and grid circuits of amplifier stages) without resorting to complicated biasing arrangements. Another advantage to the circuit is the comparative ease with which polarity reversal and voltage step-up may be effected, if desired.

An important concept which will aid in gaining a clearer understanding of the behaviour of the passive wave shaping circuits of Fig. 3 is that of the *time constant*, T. Simply defined, T is the time in seconds required for an uncharged condenser C to charge through a resistor R to 63 per cent. of the applied voltage V. Conversely, for a charged condenser discharging through a resistance, T is equal to the time required for the voltage to decay exponentially to 37 per cent. of its

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initial value. In similar manner, T may be defined for an R-L circuit as the time required for the *current* to rise to 63 per cent. of its maximum value E/R, or as the time in which the current will fall to 37 per cent. of the initial value. The equations:

(5) (a) $T = RC$ (b) $T = L/R$

are the mathematical conventions which have been adopted.

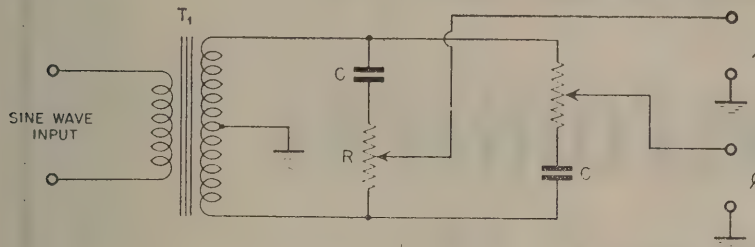
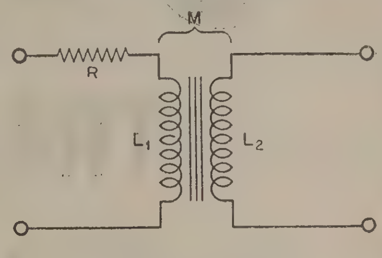


FIG. 4



MUTUAL INDUCTANCE DIFFERENTIATOR

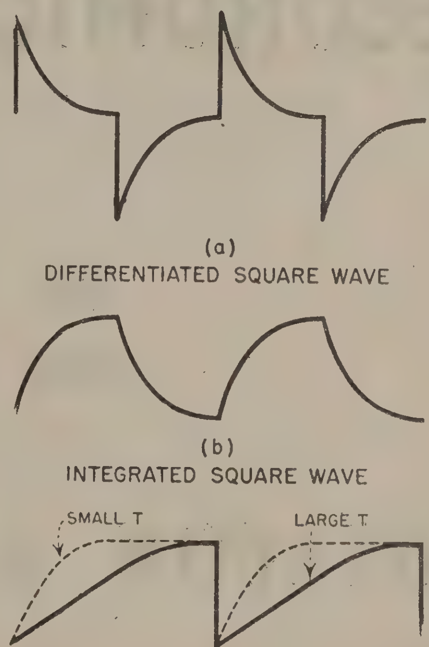
FIG. 5

Let us now consider the response of the circuits of Fig. 3 to non-sinusoidal waveforms. It will be remembered that for these circuits the input and output waveforms were identical under conditions of sine wave excitation, as mentioned above. Such is not the case for the non-sinusoidal waveforms, however. If, for example, a square wave of voltage (Fig. 1b) is applied to the input of either type of differentiator shown in Fig. 3, the nature of the output voltage developed depends on the value of the time constant T in relation to the period t occupied by one cycle of the input voltage. If the ration T/t is small, the output under these conditions will appear as a succession of alternatively positive and negative pulses which are narrow near the peaks but broader at the base as in Fig. 6a.

The output of an integrator circuit, on the other hand, with similar square wave excitation and time constant, will resemble Fig. 6b. As may be inferred by comparison of Figs. 6a and 6b with the original square wave, it can be said in a more or less qualitative manner that the differentiator circuits transmit only the higher order frequencies contained in a complex waveform, while the integrator networks, conversely, pass only the lower frequency components. The resolution of a complex waveform into its component frequencies is illustrated in Fig. 2 of Ref. 1.

The qualitative analysis of the preceding paragraph may be extended to include waveforms other than the square wave. For example, consider the sawtooth wave shown in Fig. 1c. The output of a differentiator with sawtooth excitation will, for large values of T, resemble the input in shape. As T decreases, the waveform will in general be distorted as shown by Fig. 6c. This distortion of a given complex waveform by passive networks has been recognized by Waidelich[3], Rockett[4], and others as providing a rapid method of checking circuit and amplifier characteristics. Since the sawtooth waveform contains both even and odd harmonics of the fundamental, as compared with the square wave which contains only odd harmonics, the use of the former in such applications will result in a much more complete picture of amplifier performance.

Integrator and differentiator circuits have received their widest applications in the home television receiver field. Here they serve the function of separating the high frequency horizontal pulses and the low frequency vertical pulses from the composite "sync" signal which contains both horizontal and vertical synchronization information. The time constants of the sync separators must be so adjusted that none of the horizontal sync pulses appear at the output of the integrator, and none of the vertical sync pulses appear at the output of the differentiator. In this application, the integrators are usually made up of two or three cascaded sections in order to assure more perfect separation and also to provide comparative freedom from random electrical disturbances such as auto ignition interference.



(a) DIFFERENTIATED SQUARE WAVE

(b) INTEGRATED SQUARE WAVE

(c) SAWTOOTH RESPONSE

FIG. 6

REFERENCES

(1) Aerovox Research Worker, April, 1950.

(2) "Reference Data for Radio Engineers." Federal Telephone and Radio Corp. 3rd edition, page 98.

The "RADIO and ELECTRONICS" Abstract Service

AERIALS AND TRANSMISSION LINES

Simplified adjustment of the T and Gamma matches for aerials. A Maxwell Bridge circuit is given which is especially convenient for the job of matching the impedances.
—*QST* (U.S.A.), February, 1952, p. 32.

The "Aluminium Foil Beam" aerial described as made by an amateur at very low cost. The aerials are made of aluminium foil wrapped around suitable poles, only hand tools are needed and the aerial may be made without metal working apparatus. Suggestions for matching are given.
—*Radio and Television News* (U.S.A.), February, 1952, p. 55.

AUDIO EQUIPMENT AND DESIGN

Another of a series of simplified articles on audio technique; deals with negative feed-back circuits, transformer coupling, cathode followers, phase inverters, and driver amplifiers. These articles are excellent for clarity of explanation with simple maths. given.
—*Ibid*, p. 70.

For many years the "frequency response curve" giving the relationship between sound pressure output and the frequency of the input has been the figure of merit for the loudspeaker. Description of apparatus combining a cathode ray tube with a camera for a presentation showing distortion as well as total output.
—*Wireless World* (Eng.), February, 1952, p. 58

Magnetic recording has now established itself as a means of high quality reproduction, but no complete theory has been advanced to account for all the observed facts. The article deals with the influence of asymmetrical hysteresis on the recording characteristics. Graphical representations given to simplify the theory and to show the reason for the H.F. bias.
—*Ibid*, p. 47.

The question of loudspeaker damping—reduction of overshoot and lag of the speaker cone caused by its inertia, especially at low frequencies. Negative feedback lowers the internal impedance of the amplifier so that the signal generated by the loudspeaker as a motor during its overshot is short-circuited by the amplifier and there is dynamic breaking. Methods given of achieving perfect or nearly perfect damping in an amplifier.
—*Audio Engineering* (U.S.A.), February, 1952, p. 11.

Compensated volume controls—all sorts of separate bass-boost amplifiers, etc., are possible but the happier solution is to combine the low-frequency compensator with the usual volume control potentiometer at the input to the audio amplifier for simultaneous one-knob operation.
—*Ibid*, p. 14.

CIRCUITS AND CIRCUIT ELEMENTS

The superheterodyne mixer may be stabilized by the employment of the difference frequency voltage as negative feed-back.. This results in increased gain stability, and in the case of the mixer couple, in increased gain-bandwidth product.
—*Proceedings of the I.R.E.* (U.S.A.), February, 1952, p. 202.

ELECTRONIC DEVICES

More light on radio-controlled models. The system described was designed in an effort to improve on the simple on-and-off control with a minimum of complexity. The basis is a square-wave signal; when the positive peak has the same duration as the negative peak, the control is in the neutral position—longer positive time than negative moves the control in one direction, and vice versa.
—*QST* (U.S.A.), February, 1952, p. 17.

A heart-rate recorder for biological experiments. The instrument described is for use on decerebrated or anaesthetized animals. The rate is shown as a continuous graph on a recording milliammeter and can be based at will on the auricular or ventricular action potentials.
—*Electronic Engineering* (Eng.), March, 1952, p. 102.

Anaethesiology is essentially an art of regulation and the anaesthetist has to continually adjust the concentration of his agent. Electronic control now steps into the operating room to aid the surgeon. Electrical activity of the patient's brain is an index of his depth of anaesthesia and is used to actuate a feedback network which controls the dosage of anaesthetic given to the patient.
—*Electrical Engineering* (U.S.A.), October, 1951, p. 852.

The most effective method of sensitive D.C. amplification for measurement purposes is preliminary conversion to alternating current and amplification as A.C. The induction galvanometer is admirably suited for making sensitive D.C. measurements. Its operating frequency may be in the megacycle region if desired, the conversion energy gain is high, and ample signal is obtained for A.C. amplification.
—*Ibid*, p. 893.

A professional type geiger counter; interest continues at a high level in the matter of prospecting for uranium deposits. Construction details are given of a thoroughly tested and practical low-cost counter which is easy to build.
—*Radio and Television News* (U.S.A.), February, 1952, p. 35.

INSTRUMENTS AND TEST GEAR

The ingenuity of C. S. Franklin of the Marconi Company of England has given us a variable frequency control circuit with stability equivalent to that of the finest crystal-controlled circuits. The Franklin oscillator has two cascaded tubes to obtain the "negative resistance" to sustain oscillation. Construction details given.
—*Ibid*, p. 56.

The valve voltmeter—the rectifier section. Anything with a rectifier in it calls for a good deal of consideration—the question of peak, mean, or r.m.s. values, and the simple maths. of the subject; the question of effective input resistance, calibration, etc.
—*Wireless World* (Eng.), March, 1952, p. 93.

For some years there has been a plentiful supply of reasonably cheap single-range meters in the surplus market. The single meter can, however, be used for a great variety of purposes and the article deals with the use of jacks in various parts of the equipment so that a reading can be taken when necessary without disturbing the circuit.
—*Ibid*, p. 113.

TELEVISION

Television ghosts—the effect of multi-path propagation in hilly country. Certain areas in England have become famous for this type of ghost. The article deals with methods of exorcising them—experiments with different aerials—the use of the reflected ray—television standing wave fields which can exist in certain areas—notes on installation of suitable aerials.
—*Wireless World* (Eng.), March, 1952, p. 84.

NTSC Compatible Colour Television. The first public disclosure of the technical basis of the field test specifications. The specification of colour requires three independent quantities such as the intensity of the three eprimaries. A satisfactory colour picture need not contain a great deal more information than the same picture in monochrome. In the NTSC system the information is transmitted by two simultaneous signals, one for the monochrome information, and a colour sub-carrier with the colouring information.
—*Electronics* (U.S.A.), February, 1952, p. 88.

Television set testing. An outline is given of the advantages of pulse technique over continuous wave methods.
—*Wireless World* (Eng.), February, 1952, p. 42.

MISCELLANEOUS

The study of the effects of electric shock on living animals has been pursued for over 200 years. The author reviews the literature which has been written on the subject, discusses animal experimentation and actual field cases. A very important article.
—*Electrical Engineering* (U.S.A.), October, 1951, p. 871.

The electricians' stake in atomic energy. A summary of the part played in researches, especially in relation to the acceleration of particles, the detecting of radio activity, reactor developments, and electronics in other fields.
—*Ibid*, December, 1951, p. 1037.

This year is the 200th anniversary of the flying of Benjamin Franklin's historic kite, which proved the electrical nature of lightning. Notes of his genius make interesting reading, especially of his surprisingly accurate theory of electricity.
—*Ibid*, January, 1952, p. 47.

A linear-scale audio frequency wattmeter; amplifier testing can be considerably speeded up if power output can be read directly in watts on a linear-scale meter.
—*Audio Engineering* (U.S.A.), February, 1952, p. 17.

The background of pulse-coded computors; mathematical logic, arithmetic and logic; arithmetical operations; division; digital and analogue systems.
—*Electronic Engineering* (U.S.A.), February, 1952, p. 66.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

The single-pulse dekatron; details of a new type of gas-filled cold cathode counting tube, which requires only a single pulse for each complete unit step. The principle of the valve is given, also an outline of its characteristic and its use.
—*Ibid*, p. 48.

"Trustworthy" valves; valves are said to be in this class when they are specially designed to meet certain conditions—for long life or for resistance to shocks. Complete analyses of many large groups of commercial valves have shown wherein most faults occur, and it has been found that the faults are mostly mechanical, so that improved design will vastly increase the life of the valves.
—*Wireless World* (Eng.), March, 1952, p. 105.

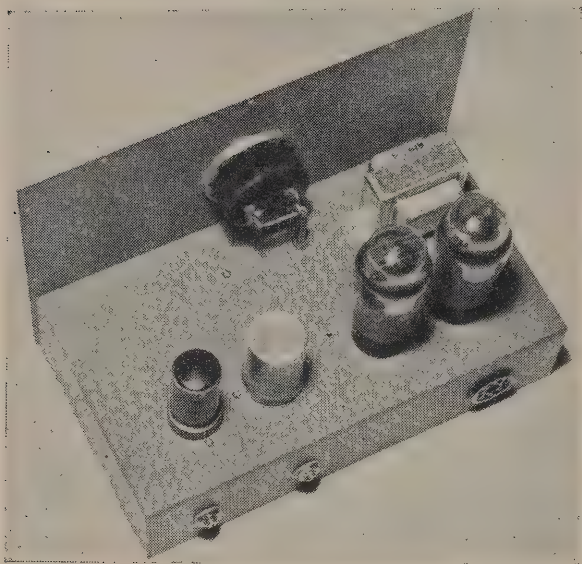
How to wire a transmitter. Some notes are given on soldering (just in case one should be still in doubt), methods of lacing cables, the use of braided wire, ground connections, and "dressing it up."
—*QST* (U.S.A.), February, 1952, p. 30.

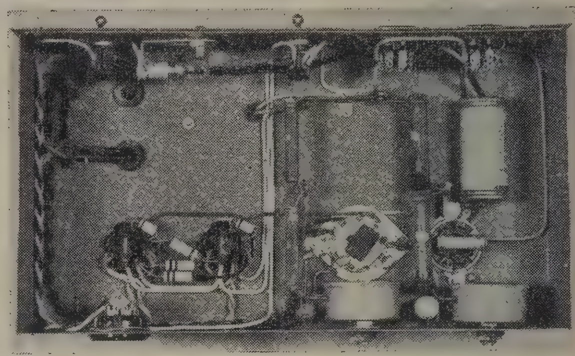
TRANSMITTERS AND TRANSMITTING

A battery-operated 2-metre portable station. The instrument is of the walkie-talkie type, is powered by dry batteries and a vibrator. Transmitter, modulator, and receiver details are given.
—*QST* (U.S.A.), February, 1952, p. 25.

The PHILIPS Experimenter

No. 56: A Regulated Power Supply for V.F.O.s Etcetera





INTRODUCTION

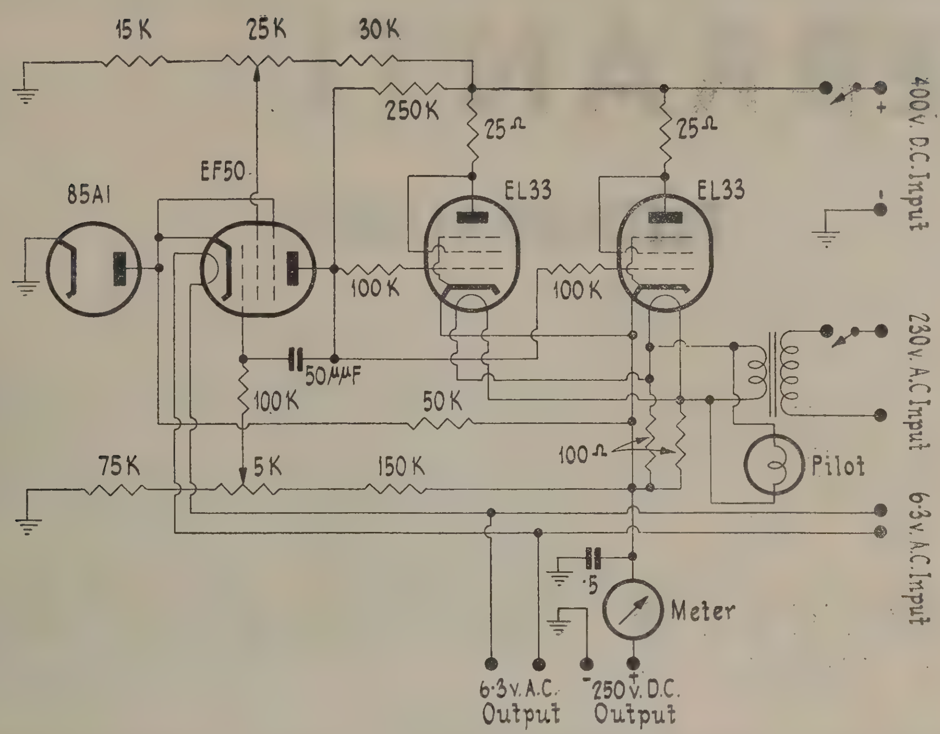
In these days, when 230 volts, 50 cycles is not always 50 cycles, and very often anything but 230 volts, it is more than ever necessary to ensure that equipment which is not tolerant to changes of supply voltage is provided with stabilized supply voltages. In addition, many pieces of gear will not work properly unless their supplies are regulated. For both of these reasons, a regulated power supply is a very handy thing to have about. It need not be large, bulky, or costly, especially when it is remembered that it is entirely practical to build a regulating unit, which takes its unregulated input voltage from a conventional power supply.

The regulator we are about to describe has been constructed as a separate device, intended to plug into an existing power supply, and to deliver up to 110 ma. at from 150 to 250 volts. Only four valves are needed, together with a handful of small parts, to give a supply whose output is regulated to within better than one per cent. over the whole output range, from zero to 110 ma. Over a limited range, such as is encountered in actual practice, the regulation must be very considerably better than this, and is probably of the order of one-fifth of one per cent., or even better. While no new principles are involved in the design of the unit described in this Experimenter, the exact data on a specific design are very helpful, because although such a circuit is not very complicated, or difficult to understand, its best performance is obtained only when its circuit constants are chosen carefully in relation to the exact valves for which it is intended. None of the Philips valves used in it are difficult to obtain, being all standard types, so that tube replacement will not become a difficult matter, and any retailer of Philips valves should be able to supply, if not from stock, to your order. We stress this point because it frequently happens that through nobody's fault in particular, magazine articles recommend circuits for valve types which periodically become difficult to obtain.

THE CIRCUIT ARRANGEMENT

The circuit is the well-known series regulator valve arrangement, with a D.C. amplifier to enhance the variations in output whose amplitude is to be reduced, before applying them to the control grid of the regulator valve. In addition, there is a voltage regulator tube whose job is to provide a stable reference voltage, against which the circuit compares the output voltage of the supply. Very often, the necessity for such a stable voltage source is not appreciated, so a word of explanation would not perhaps be amiss. ...

The output of the series-connected valves is applied, per medium of a voltage divider, to the grid of the Philips EF50. This must be a D.C. connection, because the variations in output voltage are altogether too slow to be passed through any practical-sized coupling condenser. This being the case the grid of the Philips EF50 must of necessity be at a quite high positive potential above the earth line. One might ask why a much smaller proportion of the output voltage is not applied to the grid than is actually done, but this is easily disposed of. If this were done, not only the D.C. potential, but also the variations of it, would be reduced at the same time, thereby reducing the sensitivity too much. For the job of the EF50 is to amplify these variations as much as possible. The greatest possible sensitivity would be obtained by taking the EF50 grid right to the output point, but this would be taking things to the point of imprac-



ticability. For the EF50 to function as an amplifier, it must have its grid normally biased, and since the grid is at a high positive potential, the cathode must also be at a similar potential. In fact, it must be a few volts positive with respect to the grid. If the latter were at plus 250 volts, then the cathode would have to be at, say, plus 255 volts for the valve to have its normal operating bias. This *could* be done, as long as the grid were not quite at the output line voltage, but it would mean that regulator valves would have to be connected in series, so as to make up something approaching 250 volts. We still have not yet shown why the regulator valve is necessary, however. It would be possible to provide a second voltage divider, either from the input or output D.C. lines, which would place the cathode at the correct potential, but if this were done, the regulating action would be almost completely lost. The reason is that when the output voltage varied, the voltage on both cathode and grid would vary in the same direction at the same time, and the change of plate current in the EF50 would almost vanish. It is actually a case of undesirable negative feedback, since the changes we are interested in are D.C. ones, and it is impossible to bypass any resistance in the cathode for D.C. changes. Thus, in order that changes in output voltage shall result in changes of grid-cathode voltage in the EF50, the cathode must be firmly fixed in potential. One way of doing this would be to use a battery, and in special cases, this is sometimes done. However, where there is a glow-tube voltage regulator that will provide a suitable potential for the cathode, it is much preferable to use it. This is the reason, then, for the use of the Philips 85A1 voltage regulator tube. Because of its action, the voltage of the EF50 cathode remains accurately at plus 85 volts, regardless of changes in the output voltage of the supply, or in the cathode current of the EF50. In order to ensure that this is so in actual practice, all that has to be done is to choose the correct value for a series resistor feeding the anode of the 85A1.

The screen of the EF50 is fed from the unregulated input voltage, instead of from the output.

In practice, this scheme works out very nicely indeed. It is even possible to get over-compensation, so that the output voltage rises slightly at some load values! However, for best results, the use of the screen in this manner means that the best operating conditions have to be found by experiment. It will be noticed that there are two preset controls, one for the grid voltage, and one for the screen. As a result, there is an infinite number of combinations of the settings of these two that will give 250 volts output. If the grid voltage is dropped, the screen voltage must be increased in order to bring the output to the same value once more. Thus, setting up the preset controls is a matter of placing various loads on the output, and adjusting the controls for 250 volts out, with a number of different settings of the screen potentiometer. At each combination of settings, the load is varied over the required range, and a note is made of the amount and type of the output voltage variation that takes place. A setting of the screen voltage will be found at which there is practically no perceptible variation in output voltage, whatever the load, from 0 ma. to 110 ma. This is NOT the setting which gives the exact 250 volts at both ends of the load scale. This particular setting gives a slight rise in output voltage at medium loads; it was found that about the best setting was one where the output dropped as the load was increased, the drop being about half a volt at a load of 100 ma., the 250 having been set with zero output current.

PLESSEY REPRESENTATIVE VISITS NEW ZEALAND

Combining business with convalescence from a serious illness which overtook him in 1951, Mr. H. T. Parker, Board's representative of the Plessey group of companies, England, arrived in Australia in March, and after spending some time visiting the main centres there, he arrived in Auckland early in April.

Mr. Parker is formerly of the General Electric Company of England, and joined Plessey five years ago to form their Sales Promotion Department, later being promoted General Manager, Marketing Division. Mr. Parker is the first representative of Plessey to call to these regions for a very considerable time, and his visit was of immense interest to the radio and other trades

with which Plessey is associated. During his brief visit to New Zealand's main centres, he was accompanied by local branch managers of Plessey's sole New Zealand agents, Swan Electric Co., Ltd., who introduced him to principal manufacturers and Government Departments so that he could learn at first hand industrial conditions in the country, particularly as applied to the marketing of Plessey products.

Mr. Parker's visit was of tremendous interest, particularly in so far as news of Plessey's development was concerned. The Plessey Company, with head office at Ilford, now has nigh on a score of factories throughout England, and employs a total staff of approximately 14,000. It is the largest unit of its kind in the British Empire. What a tribute to the founder and managing-director, Mr. A. G. Clark. It is interesting to note that the company's name was derived from a small-time radio manufacturing pioneer named Plessey, with whom Mr. Clark went into partnership in the late 1920s. The subsequent rapid growth was due solely to the breadth of vision, keen business sense and terrific driving personality of the founder. These virtues not only resulted in the growth of his company, but obtained Cabinet recognition in World War II. One of this war's production epics was Plessey's establishment of a fully equipped factory in five miles of unfinished tube railway near the parent works. Imagine, if you can, a five-mile railway tunnel, for this it was, operating as a major defence production unit. Distributed along the five miles were stores, machine lines, aircraft component assembly lines, tool rooms, machine shops, and all else that forms a self-contained war plant.

The war left Plessey a highly organized and wonderfully equipped company with a vast potential, due in large part to an army of the country's best research workers. Here again, Mr. Clark applied his genius and instead of reducing research, actually increased it by entering yet further fields of endeavour. And now again Plessey is busy serving its country. A very large proportion of the company's present output is associated with the British rearmament programme in which Plessey is undoubtedly a key industry. All this expansion and defence work have of necessity emphasized the engineering field, and they confidently claim that providing the product ties in with their plant capabilities they will make anything for anybody, anywhere.

And what plant have Plessey? What do they make?

In their vast press shops they mass produce six million piece parts per week, each with precision finish.

From their assembly lines pour a large part of Britain's hand-microphone telephone sets.

Twelve of the principal radio and television manufacturers put merely their own cabinets round receivers made in Plessey factories from Plessey parts—Plessey is the largest English manufacturer and assembler of radio and television built-up chasis.

Microgroove records will be received with even greater favour if played on a Plessey automatic three-speed changer.

Tools, jigs, dies are mass produced in Plessey's tool rooms than which few in Great Britain are larger or better equipped.

Petrol, gas turbine, jet aircraft built with Plessey electrical and mechanical assemblies fly safer with Plessey communications equipment.

Ships of war shoot quicker with guns operated by Plessey servo motors and actuators.

Plessey cartridge starters render simple the task of starting diesel engines.

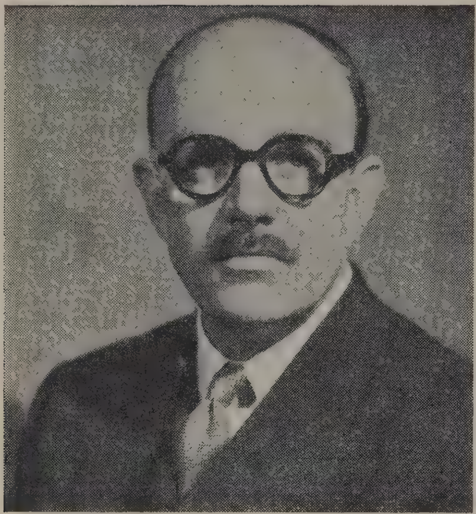
Industry runs smoothly with Plessey hydraulic pumps and valves.

Meteorological offices forecast with Plessey meteorological equipment.

Government revenue is collected cheaply from Plessey stamp and ticket vending machines and computed on Plessey house service meters.

All these, and thousands besides, paint a picture of an organization, large in size, diverse in its operations and yet withal a flexible group of productive units.

But most important of all perhaps, in view of the speed of present-day technological advances are the research and development engineers. The products mentioned earlier give but a meagre idea of the scale and breadth of the organization's potential in this field. We would need to devote our entire issue to do justice to the magnificently equipped laboratories and experimental workshops that are available to facilitate the work of the large and highly trained band of physicists, chemists, and electrical and mechanical engineers, that day by day keep pace with, and indeed often shape, the course of scientific progress.



Mr. H. T. Parker

And who better to inform New Zealand of this amazing company than their former Sales Promoter and Marketing Manager. Throughout his tour, Mr. Parker impressed all who met him not only with the size and splendour of the Plessey organization, but also with his own competence to adequately represent his Board of Directors.

Mr. Parker's connection with Plessey's publicity was suitably marked by a dinner party introduction to New Zealand's radio paper, held at the Royal Oak Hotel, in Wellington, on 7th April. The dinner, at which Mr. W. H. (Bill) Lee, Wellington Manager of Swan Electric Co., Ltd., was host, was attended by *Radio and Electronics* representatives, D. (Doug.) Foster, and C. H. (Charlie) Roser. An excellent table was provided and we are sure Mr. Parker will forgive us if we tell readers that in studying the menu he asked if hogget was a female or small pig. On the other hand, Mr. Parker could tell us the finer cuts of horse flesh although he stated that even this meat was appearing less frequently on English menus.

After dinner a few pleasing hours were yarned away in the lounge. Apart from giving much information of his company's activities, Mr. Parker made it clear that in the radio field, Plessey were out for business. New developments in variable condensers will be announced shortly, and here, he feels, Plessey will release a winner. Vibrators, carbon controls, iron-dust cores, wave-change switchers, automatic three-speed changers, and all their other components are in constant production and he stated that his company would make greater efforts to assist their energetic New Zealand agents, the Swan Electric Co., Ltd., with publicity, keen prices, and good service.

Mr. Parker's visit will undoubtedly be of great benefit to the industry in this country, once again proving the value of visits from the executives of overseas organizations.—P.B.A.

British Radio Component Show, 1952

From 7th to 9th April, Grosvenor House, Park Lane, London, was the scene of the Ninth Annual Private Exhibition of British Components, Valves, and Test Gear for the Radio, Television, Electronic, and Telecommunication Industries, organized by the Radio and Electronic Component Manufacturers' Federation, 22 Surrey Street, Strand, London, W.C.2.

Again, there were more than 100 exhibitors, and it was clear that each successive show brings new evidence of successful research by British component manufacturers to enable them to design and produce components which are increasingly reliable under extremes of atmospheric conditions, technically more efficient, and—many of them—smaller in size. It was also apparent that, in spite of the defence programme, manufacturers can still meet demands for components for every need, at home and abroad, including domestic radio and television, although shortages may be experienced from time to time, and it may be found also that supplies of certain new items are confined to Government use.

Some details of this year's exhibits are as follows:—

Wires, Cables, and Insulating Materials

A new grade of PVC compound, styled "VO," which can be used at temperatures up to 150 deg. C., and retains its flexibility at that temperature, was shown in the form of sleeving by Associated Technical Manufactures, Ltd. The same firm also showed a self-sealing PVC tape for binding cables, and bi-coloured insulated wires, the helically striped second colour of which extends the colour-coding range.

Another firm exhibiting heat-resisting sleeving was H. D. Symons & Co., Ltd. This is known as yellow varnished terylene, and may take the place of varnished glass fabrics where the operating temperature is up to 120 deg. C.

Enamelled wire weighing only one ounce for a length of more than three and a half miles was shown, among a very wide range of wires and specialized cables, by British Insulated Callenders Cables, Ltd. Oil-base enamel is used in successive layers even on this microscopic gauge of wire. Another exhibit by this firm was a self-bonding wire, of which the ordinary enamel insulation is covered by an extra coating of thermoplastic material. Heat treatment after winding bonds the adjacent turns of wire in a coil together.

Ceramic insulators made from more than six different types of material, each with special properties, were shown by Geo. Bray & Co., Ltd. This firm, by the way, supplied the Tubalox elements used in the modern B.B.C. high-power television transmitters for aerial de-icing.

There are now something like a dozen different grades of Delaron laminated plastic made by the Plastic Division of Thomas De La Rue & Co., Ltd. The importance of the textiles used for covering wires was emphasized, in another exhibit by Fine Wires, Ltd.

A cable-sorting machine which automatically indicates individual wires in a multi-way cable was an interesting exhibit by Hellerman Electric, Ltd. A moulding material which will absorb X-rays was among the exhibits of Mycalex Co., Ltd.

A new form of micanite to which the description "high heat" has been given was shown by Micanite & Insulators Co., Ltd. It is built-up mica which, owing to the use of an inorganic bond, is self-supporting at temperatures up to 500 deg. C.

Capacitors

Special nitrogol paper dielectric tubular capacitors for EHT flyback or R.F. oscillator circuits were shown by Dubilier Condenser Co. (1925), Ltd. These were assembled in a glazed ceramic tube with metal end-cap terminals.

Midget tubular capacitors measuring only three-sixteenths of an inch by seven-sixteenths were produced by A. H. Hunt (Capacitors), Ltd., under the name "Moldseal." New silvered mica capacitors, known as "Catacon" (category A condenser), were introduced by London Electrical Manufacturing Co., Ltd.; these have a new moulded finish. Telegraph Condenser Co., Ltd., showed a range of new high-temperature electrolytics which will work at 85 deg. C. without voltage derating.

Resistors

During the past year, the British Electric Resistance Co., Ltd. have developed a new protective coating for wire-wound resistors which will withstand temperatures up to 400 deg. C., yet does not require the high firing temperatures of vitreous enamel. Examples of Berco resistors with this coating were exhibited. The firm also showed a new range of power rheostats, the "Bercostat," available up to 100 watts dissipation.

Morganite Resistors, Ltd., showed their latest range of Government "type-approved" potentiometers and fired resistors.

Switches, Plugs, and Sockets

A new range of rotary switches with ceramic insulation was shown by A.B. Metal Products, Ltd., who also featured the "Minibank" switch, still the smallest multipole type in the world.

A. F. Bulgin & Co., Ltd., added to their thousands of products a new range of micro-switches. These include miniature types, and models for high operational pressure. Their ordinary switches have been improved as to moisture resistance and peak handling capacity.

Belling & Lee, Ltd., showed a miniature thermal delay switch for the protection of TV and electronic circuits, as well as new types of plugs and sockets, including a shrouded three-pin mains input type and a double-screened coaxial connector.

"Diamond H" Switches, Ltd., also had several new switches, including a range of 3 amp. one-hole fixing toggle types.

Record Reproducing Equipment

Birmingham Sound Reproducers, Ltd., showed a new three-speed record changer, which will play 7 in., 10 in., and 12 in. records mixed. Collaro, Ltd., also introduced some new record changers, incorporating a new method of record dropping, and a high-fidelity magnetic pick-up, the Orthodynamic. This is suitable for 78 r.p.m. and L.P. records, and has a twin point stylus of special alloy, said to be more durable than sapphire.

The Garrard Engineering & Manufacturing Co., Ltd. have concentrated this year on minor modifications of their existing range to improve efficiency in the light of experience gained with three-speed units.

Erwin Scharf had a wide range of new pick-ups, including a magnetic turn-over type, with automatic weight adjustment (Model 165).

Test Instruments

Several firms were exhibiting instruments for laboratory, workshop, and industrial use. Dawe Instruments, Ltd., showed a new ultrasonic thickness gauge and a dynamic balancing machine. Marconi Instruments, Ltd., had a comprehensive form of signal generator; Advance Components, Ltd., showed five different signal generators for various uses; while the Automatic Coil Winder & Electrical Equipment Co., Ltd., displayed a wide range of electronic instruments, including a fully tropicalized 96-range valve voltmeter.

Other Products at the Show

Permanent magnet speakers with totally enclosed magnets specially designed for TV receivers (Acoustic Products, Ltd.).

"Tri-Sol" resin-cored solder output is now doubled. Shipments are going to many places overseas (The Du Bois Co., Ltd.).

A new public address pressure-type loudspeaker unit, and vibration equipment for industrial research (Goodman Industries, Ltd.).

"Tailor-made" steel cabinets using prefabricated parts which can be packed flat for export and assembled on arrival (Hallam, Sleigh & Cheston, Ltd.).

Sintered composite magnets, with soft iron pole pieces on an Alnico type of body (Murex, Ltd.).

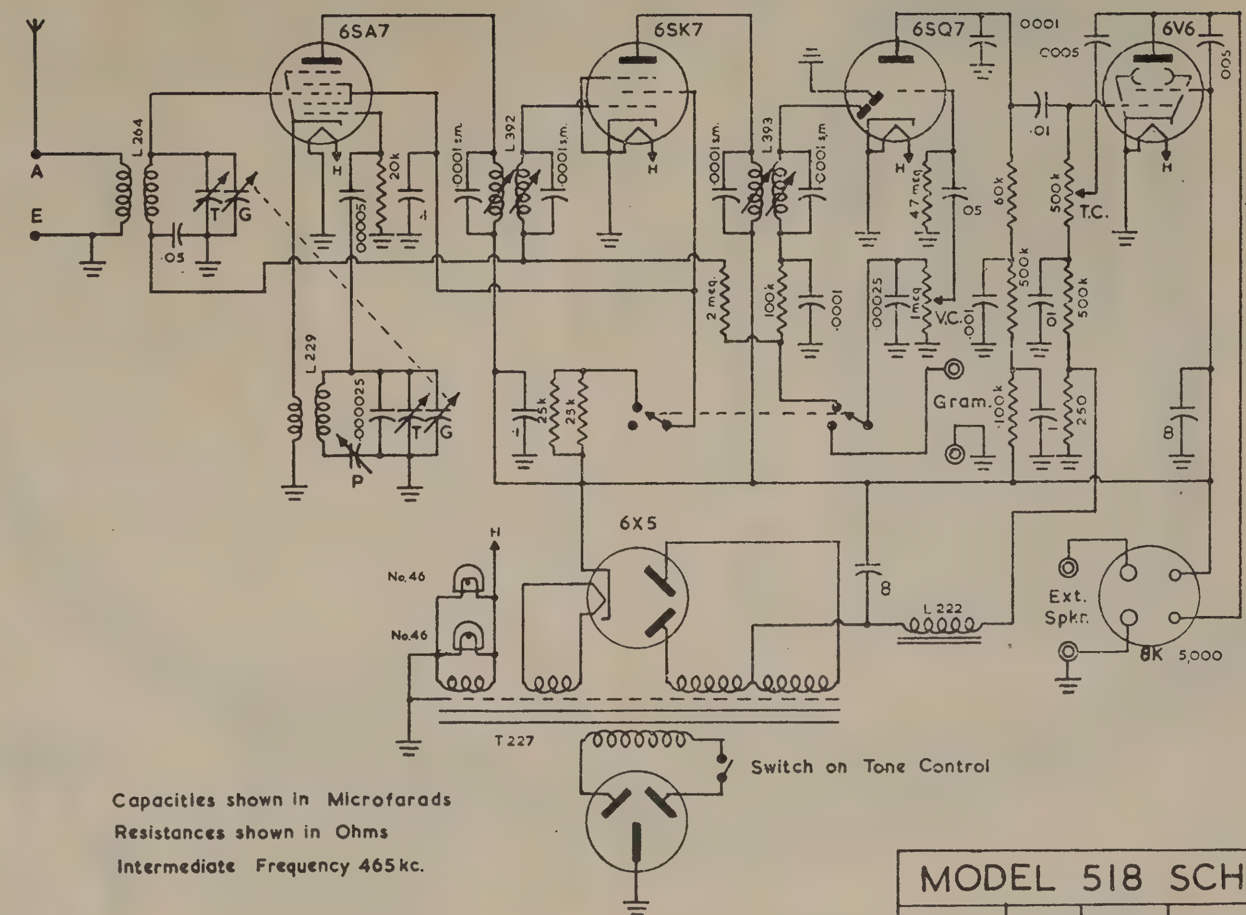
Quartz crystal units mounted on various types of valve bases, and a quartz crystal activity test set (Salford Electrical Instruments, Ltd.).

Steel clips and parts which eliminate inserts in plastic mouldings and provide considerable economies as well as speed in assembly (Simmonds Aerocessories, Ltd.).

Rectifiers of the selenium, copper-oxide, and germanium type for every purpose, including high-power lightweight types for aircraft (Westinghouse Brake & Signal Co., Ltd.).

New coils and transformers for TV receivers, and a range of miniature I.F. transformers for specialized operating frequencies (Weymouth Radio Manufacturing Co., Ltd.).

FOR THE SERVICEMAN—Akrad Model 518

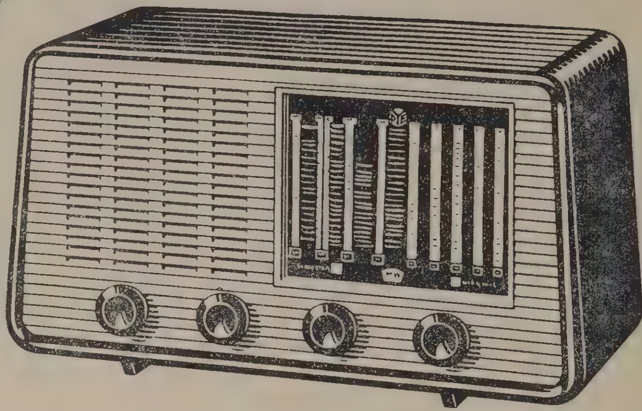


Capacities shown in Microfarads

Resistances shown in Ohms

Intermediate Frequency 465 kc.

MODEL 518 SCHEMATIC			
Drawn	E.W.S.	6/9/48	DRG. No 473
Traced	E.W.S.	6/9/48	AKRAD RADIO CORP. LTD. WAIHI
Checked	R.S.S.	9/9/48	



for the discriminating listener

Here is a new top-quality receiver that worthily upholds the Pye tradition of excellence, reliability and value. Providing unlimited choice of the world's programmes and true-to-life tone, Model "G" incorporates FULL BANDSPREADING on all short wavebands, ensuring simple, accurate station selection. These are just the qualities you will be looking for in your new radio. Visit your local Pye Agent today — see and hear the Model "G" for yourself!

PRICE £31-10-0

5-valve, 8-waveband, bandspread superhet for A.C. power.

Look for the distinctive PYE trademark at better radio dealers everywhere or for your nearest Pye Agent write to: Pye (New Zealand) Limited, P.O. Box 2839, Auckland.

PYE Radio and Television

1952 Radio-gram

(Continued from Page 17.)

go for long distances across the chassis. In particular, this applies to the volume control, which is mounted quite close to both the diode circuit, to which it belongs, and also to the change-over swtich. This can be seen in the under-chassis photograph, at the right-hand side. This switch is also mounted on a bracket in order to bring the wafers belonging to the I.F. switching close to their respective I.F. transformers, while the back wafer is conveniently placed with respect to the input of the audio amplifier and the pick-up input socket, on the back of the chassis directly behind the switch. The volume control is the one next to the switch. In the centre is the coil unit, and the wave-change switch, which is an integral part of it, and next to the left is the tuning knob. On the extreme left of the chassis is an On/Off switch, which we must admit was put there as much for the purpose of balancing the layout of the controls as for anything else!

The audio amplifier section is notable, among other things, for the small number of components in it, and this makes for easy application of the point-to-point wiring method in this part of this circuit. This can be easily seen in the lower left-hand part of the chassis in the underneath view. Where necessary, tie-points have been provided by screwing insulated solder lugs to appropriate spots on the chassis. These tie-points are used to terminate resistors or condensers of which one or both ends have no natural anchorage among the valve socket lugs or on earthed solder lugs. These insulated lugs are a little bit more bother to put in place, but result in a professional-looking job, in which there is little likelihood of short-circuits developing, owing to some of the component parts being floppily supported among the wiring.

Those who are keen on making a job that resembles the original as closely as possible are recommended to write to our office for a duplicate print of the under-chassis photograph. In this, the position of every small part is readily seen—much more easily so than in the reproduction, and with the aid of the photo and the circuit diagram, the exact run of the wiring can easily be followed.

ALIGNMENT OF THE TWO-POSITION I.F. TRANSFORMERS

There is nothing difficult about the alignment of the I.F. transformers of this set. Indeed, as long as one simple precaution is observed, there is no difference at all between aligning them and conventional I.F.s. The precaution consists of performing the alignment *with the selectivity switch in the Narrow position.*

This position is the one in which the small additional windings are out of circuit. The lead from the trimmer inside the I.F. can is coloured blue, and this goes to the common arm of each switch. The lead which goes to the bottom of the main secondary winding is black, and it is when the switch is in the position that connects the common arm to the black lead that the selectivity is in the narrow position. One thing that must be watched when the transformers are being wired up with the switch is to see that both transformers are wired in the narrow position, on the same position of the switch. If this is not done, the behaviour would be most puzzling, because operating the switch would put one transformer on Narrow when the other was on Broad, and changing to the other position would merely reverse the situation! After checking that the wiring is correct, and that the two transformers are both in wide and narrow together, the switch is set to Narrow, and the alignment is carried out in the ordinary way, peaking each winding for maximum output. Then when the switch is operated, the tuning is correct on the Broad position automatically. On no account should the trimmers be touched with the switch turned to Broad, as this will not result in any better alignment, and will only destroy what has been accomplished by the correct procedure, as outlined above.

For the same reason, tuning of the set to the station should only be done in Narrow. The other position is so wide that it is almost impossible to tune the set accurately when switched to this position. If you want to use the wide, as it is intended, for getting better high-frequency response from the strong local stations, the station should first of all be tuned in on Narrow, and the switch turned to Broad afterwards, and then *the tuning knob should be left severely alone.*

There is often a temptation to fiddle with the tuning control after switching to Broad, but this should be resisted completely. The temptation is due to the following effect. The high-frequency response of a set is increased when it is de-tuned from the station. It is not possible to take advantage of this fact, however, because the high frequencies obtained in this way are distorted, and give no satifaction on that account. When the owner of a set like this one first uses it, he tends to think that because more high frequencies are immediately apparent when the selectivity switch is operated, the set is not properly tuned in. It is, of course, and attempting to make things better by adjusting the tuning knob only

(Concluded on Page 48.)

TUBE DATA: The 802 R.F. Power Amplifier Pentode

PART II

The screen voltage may be obtained either from a separate source, from a potentiometer, or from the plate supply through a series resistor, depending on the service in which the tube is used (see Application). When the screen-resistor method is used, the resistor should have a value sufficient to drop the high voltage to a value which is within the maximum screen-voltage rating given under Maximum Ratings and Typical Operating Conditions. Suitable values of screen resistors are shown in the tabulations. In those classes of service where screen-voltage regulation is not an important factor, the series-resistance method of obtaining screen voltage is desirable since it serves to maintain the proper screen current. With this method, however, it is important that the high-voltage supply switch be opened before the filament circuit is opened or the R.F. excitation is removed; otherwise, full supply voltage will be placed on the screen. If the screen voltage is obtained from a separate source, or from a potentiometer, plate voltage should be applied before the screen voltage, or simultaneously with it; otherwise, with voltage on the screen only, the screen curent may be large enough to cause excessive screen dissipation. A D.C. milliammeter should be used in the screen circuit so that the screen current will always be known. The screen should never be allowed to attain a temperature corresponding to more than a barely perceptible red colour.

Suppressor voltage for the 802 may be obtained from any suitable D.C. supply. In cases where the suppressor draws current, the supply should be a battery or other D.C. source of good regulation.

The internal shield is brought out of the tube to its own separate base pin. The internal shield should be tied to a terminal operating at zero R.F. and/or A.F. potential. In most cases, this connection will be made to the cathode or suppressor terminal.

Adequate shielding and isolation of the input circuit and the output circuit are necessary if optimum results are to be obtained. If an external shield is employed with the 802, it should be designed to enclose the base end of the tube and extend up to a point level with the bottom of the internal shield. Clearance between the glass bulb and external shield should be at least 1/16 in. The impedance between the screen and cathode must be kept as low as possible by the use of a by-pass condenser. The capacity value of this condenser should be about 0.1 μf.

When a new circuit is tried or when adjustments are made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect. It is advisable to use a protective resistance of about 3000 ohms in series with the high-voltage plate lead during such adjustments. Suitable meters should be provided for measuring tube voltages and currents as well as for making transmitter adjustments. In modulated service, a cathode-ray oscillograph also is recommended to assist in the making of final adjustments for optimum performance.

The rated plate voltage of this tube is high enough to be dangerous to the user. Care should be taken during the adjustment of circuits, especially those in which the exposed circuit parts are at the high D.C. plate potential.

APPLICATION

As a Class A power amplifier pentode, 802 may be operated as shown under Characteristics. In this service the screen voltage should be obtained from a separate source or from a potentiometer connected across the power supply. The suppressor should be connected to the cathode at the socket. Control-grid bias may be obtained from a fixed supply or from a cathode-bias resistor. The D.C. resistance in the grid circuit should not exceed 10,000 ohms with fixed bias, or 500,000 ohms with cathode bias.

As a Class B radio-frequency amplifier pentode, 802 may be used as shown under Maximum Ratings and Typical Operating Conditions. In Class B R.F. service, the plate is supplied with unmodulated D.C. voltage and the grid is excited by R.F. voltage modulated at audio frequency in one of the preceding stages. Under these conditions, the plate dissipation is greatest when the carrier is unmodulated. It is important, therefore, that the plate dissipation for this class of operation should not exceed 10 watts for unmodulated conditions. In this service the screen voltage should be obtained from a separate source or from a potentiometer connected across the plate supply. The suppressor voltage may be obtained from any fixed D.C. supply. In cases where the suppressor draws current, the supply should be a battery or other D.C. source of good regulation. Control-grid bias for the 802 as a Class B R.F. amplifier should be obtained from a battery or other D.C. source of good regulation. It should not be obtained from a high-resistance supply such as a grid leak, nor from a rectifier, unless the latter has exceptionally good voltage regulation.

As a supressor-modulated Class C R.F. amplifier, 802 may be used as shown under Maximum Ratings and Typical Operating Conditions. In this service, the plate is supplied with unmodulated D.C. voltage and the D.C. suppressor voltage is modulated at audio frequency. The screen voltage should be obtained through a resistor in series with the *unmodulated* plate supply (see Installation). The D.C. suppressor voltage may be obtained from any fixed supply. Control-grid bias for this service may be obtained from a grid-leak of 11,300 to 20,000 ohms (5-watt size) depending on the amount of excitation available, from a cathode-bias resistor, or from a fixed supply. The cathode-bias method is advantageous due to the fact that the grid bias is automatically regulated in direct proportion to the sum of the plate, grid, and screen currents and that there is little chance of the plate current becoming dangerously high, even if the R.F. grid excitation is removed. The cathode resistor should be by-passed for audio and radio frequencies. The grid-leak-bias method has the advantage of simplicity and of automatically biasing the grid in proportion to the excitation voltage available. Special care must be observed with the use of this system because the accidental removal of the excitation will cause the grid bias to fall to zero and the plate current to rise to an excessive value. The use of a protective device designed to remove the screen and plate voltages on execessive rises of plate current will minimize the danger of overload (see Installation). Control-grid bias for Class C service is not particularly critical so that correct circuit adjustments may be obtained with widely different values.

As a grid-modulated Class C R.F. amplifier pentode, 802 may be used as shown under Maximum Ratings and Typical Operating Conditions. In this service the plate is supplied with unmodulated D.C. voltage and the grid bias is modulated at audio frequency. The screen voltage should be obtained from a separate source or from a potentiometer connected across the plate supply. The suppressor voltage should be obtained from a battery or other D.C. source of good regulation. It should not be obtained from a high-resistance supply.

As a plate-modulated Class C R.F. amplifier pentode, 802 is captable of being modulated 100 per cent. Operating conditions are shown under Maximum Ratings and Typical Operating Conditions. The screen voltage may be obtained from a fixed supply, or through a voltage-dropping resistor in series with the *modulated* plate supply. The screen voltage should be modulated with the plate voltage so that the percentage changes in both voltages are approximately equal. When a fixed screen-voltage supply is used, modulation of the screen voltage can be accomplished either by connecting the screen to a separate winding on the modulation transformer or by connecting it to a tap on the modulation transformer or choke, through a blocking condenser. With the latter method, an A.F. choke of suitable impedance should be connected in series with the screen-supply lead. Typical values of series screen resistors are given under Maximum Ratings and Typical Operating Conditions. The suppressor voltage may be obtained from any fixed supply. Control-grid bias for this service may be obtained from a grid leak, or from a combination of either grid leak and fixed supply or grid leak and cathode resistor.

As a plate-modulated Class C R.F. amplifier tetrode, 802 is capable of being modulated 100 per cent. Operating conditions for this service are shown under Maximum Ratings and Typical Operating Conditions. Grids No. 2 and No. 3 are connected together as the screen. The screen voltage should preferably be obtained through a voltage-dropping resistor in series with the *unmodulated* portion of the plate-voltage supply. In this case the series resistor develops its own modulating voltage. Typical values of screen resistors are given under Maximum Ratings and Typical Operating Conditions. The screen voltage may also be obtained from a separate source, or from a potentiometer across the plate-voltage supply, provided the screen voltage is modulated as discussed under plate-modulated Class C R.F. amplifier service (pentode connection) for a fixed screen supply. The suppressor voltage may be obtained from any fixed supply. Control-grid bias considerations are the same as those for plate-modulated Class C pentode service.

As a Class C R.F. amplifier or oscillator pentode for telegraph service, the 802 may be operated as shown above. The screen and suppressor voltages may be obtained by any of the methods shown under Installation. Control-grid bias may be obtained by any convenient method.

As a Class C R.F. amplifier or oscillator tetrode for telegraph service, the 802 may be operated as shown under Maximum Ratings and Typical Operating Conditions. Grids No. 2 and No. 3 are connected together as the screen. The screen voltage may be obtained by any of the methods shown under Installation. Control-grid bias may be obtained by any convenient method.

As a pentode or tetrode oscillator (crystal or self-excited), the 802 may be operated under the conditions shown for Class C telegraph services. Because the internal shielding in this tube is unusually effective, it generally is necessary to introduce external feed-back in those circuits which depend on the control-grid-to-plate capacity for oscillation. This may be done by the use of a small condenser not larger than 2 to 3 $\mu\mu$f. connected between control grid and plate.

They Don't Need To Be Large!

(Continued from Page 11.)

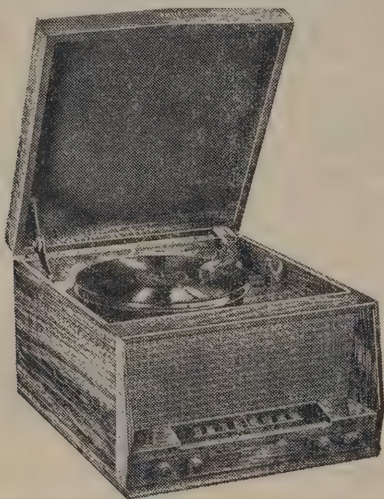
small amplification in the pre-amp. will not be likely to cause motor-boating as long as it is decoupled together with one other stage. If the first two stages of the amplifier have a common decoupling filter, it will be unwise to group the extra stage with them. Should there be any doubt about the best place, several points can easily be tried, and an entirely separate filter, specially for the extra stage can easily be installed on the main amplifier chassis.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

"PHILCO" MODEL 1254

And now "Philco the Leader" present the new 3-speed Radiogram Model 1254, which brings long-playing record equipment into a price class within reach of everyone.



Cabinet—Modern classic styling in American and African walnut, with gold plastic grille. Size 9 in. high, 15 in. wide, 17 5/16 in. deep.

Dial—Easy to view inclined scale of plastic with Australian and New Zealand stations clearly indicated.

Record Player—Collaro 3-speed Gramophone, plays 12 in, 10 in., and 7 in. records. Selection switch for standard 78 r.p.m., 45 r.p.m., or $33\frac{1}{3}$ r.p.m. records.

Tuning Range—Broadcast band from 535 to 1620 kilocycles.

Circuit—Special Philco 5-valve superheterodyne circuit using Philco developed loctal valves: 7S7 converter; 7B7, I.F. amplifier; 7C6, 2nd detector and 1st audio; 7C5, output; 7Y4, rectifier.

Speaker—$7\frac{1}{2}$ in. x 5 in. elliptical P.M. speaker, specially matched to cabinet design.

Tone Control—Continuously variable, of the frequency selective type.

Philco Model 1254 is a worthy addition to the 1952 Philco range and merits the claims of—"Philco—the Leader for 20 years."

New Zealand Distributors: Russell Import Co., Ltd., 20 Bond Street, Wellington.

* * *

THE NEW ULTIMATE OVEN ROASTER

Produced by Radio (1936) Ltd., this roasting dish fills a long-felt want—a roasting dish suitable for all ovens but built especially for the Ultimate Rangette (as an extra). Retail price, 35s. 3d.

Construction:

It is constructed entirely of aluminium, the body and lid being spun and highly polished to reduce cleaning to a minimum and to prevent souring of foods from particles of food being trapped in the metal pores.

Lid:

The lid has two new features:—

(1) Steam vents which allow the initial escape of unwanted water vapour, hence eliminating any tendency for the meat to become parboiled. These vents are sealed by a spun aluminium cap when roasting is to take place, thus retaining the full flavour and essential fats that make roast meats so much more palatable than either boiled or broiled meats.

(2) Spun concentric rings in the lid function as collectors of the gravy moisture and vaporized fats, returning them drip by drip to the meat, efficiently self-basting it with its own natural juices.

Body Handles:

Are constructed of stout, smoothly cast aluminium and are fitted to present a smooth, clean inside surface.

Size:

The body is $9\frac{3}{8}$ in. in diameter and is $2\frac{3}{8}$ in. deep. The inside height is $4\frac{3}{4}$ in.

The overall height from base to top of vents is $6\frac{1}{8}$ in. The greatest width (handle to handle) is $11\frac{3}{8}$ in.

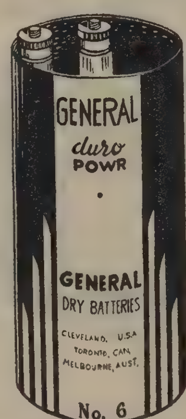
General:

There are no slides or mechanical features to gum up or present difficult cleaning problems. The roaster is spun from the highest grade 16-gauge aluminium to ensure strength and durability.

Important—Roasting dishes are available with every Rangette or orders will be accepted for early delivery in packages of two.

* * *

A NEW BATTERY



A new battery now available in New Zealand is the G.D.B. No. 6 Dry Cell, manufactured by General Dry Batteries (A/sia) Pty. Ltd.

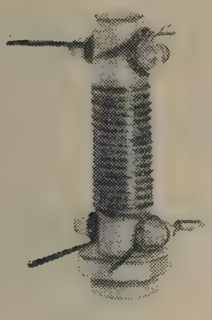
The sole New Zealand agents, Swan Electric Co., Ltd., in proudly announcing this new product, state that exclusive patented features keep the cell fresh for years and impart long service life. Its recuperative properties, high maintained voltage and current, assure efficient service when used for any purpose for which dry cells are suitable.

The battery, by its superior finish, looks and is a quality article, is fitted with sturdy screw terminals, and is attractively wrapped. Look for the blue and yellow wrapper.

* * *

NEW POLY "Q" COIL ASSEMBLIES

Inductance Specialists' new Poly "Q" coil assemblies, Type 44A and 74A, have been designed to provide a



high class tuning assembly easy to install and adjust, exceptionally stable in operation and less sensitive to variations in converter valve characteristics than other circuits in general use. Poly "Q" (coils wound on Polystyrene formers) are used throughout.

The circuit arrangement also allows greater accuracy in factory alignment, and is less affected by variations in layout, etc., when the assembly is installed in a receiver.
dials, and chassis to match.

Plate tuning of the oscillator section is employed to provide greater stability and minimize "pulling." A negative co-efficient silvered disc type oscillator trimmer is employed on the S.W. band which tends to compensate for the positive rise of the inductors, thus maintaining calibration more nearly constant with change of temperature.

When using either of our suggested circuits, only one filter condenser is essential in the A.V.C. circuit, but switching is employed to provide a shorter time constant on the S.W. band for rapid compensation of a fading signal.

A special very high gain aerial coil is used on the broadcast band to obtain maximum signal volts on the first grid to assist in providing a high receiver signal/noise ratio.

"Poly Q" coils, one of our latest developments, are wound on Polystyrene formers and give exceptionally low loss and a high degree of stability. All coils are fitted with adjustable slugs of various types, according to the operation frequency.

Assemblies are AIR TESTED AND ALIGNED BEFORE LEAVING THE FACTORY.

Two- and three-band assemblies available, with gangs, dials and chassis to match.

INTERNATIONAL RADIO-CONTROLLED MODELS WEEK-END

On August 16th and 17th, 1952, the above radio-controlled models event for boats and aircraft will be held at Blackpool, Lancashire, England. This will be the first joint event of its kind to be held in England, with an international contest for model boats on the Saturday (16th August) and an international contest for model aircraft on the Sunday (17th August). The latter event will be held on the Stanley Park Aerodrome, Blackpool, commencing at 10 a.m., and will be an event recognized by the F.A.I. The boats contest will commence at 10 a.m., on a portion of the Stanley Park Lake, Blackpool. This contest will have sections for all types of boats, including yachts and speed-boats controlled by radio.

Printed copies of the rules for these contests together with official entry forms, etc., are available from the address given below.

Hints have already been received from the U.S.A. and India that they may be represented at this special international week-end, and Sweden and France have also intimated that they will in all probability be competing in one or other of the contests.

An invitation is extended to Australia and New Zealand to participate if at all possible, and a hearty welcome will be extended to all competitors.

Both the contests are being organized by the International Radio-controlled Models Society. Further details may be obtained from Mr. R. Lawton, 10 Dalton Avenue, Whitefield, near Manchester, England.

Missing or Stolen Radios

The following reports have been received by the N.Z. Radio Traders' Federation, and should any member of the Federation or other reader have any knowledge of the present whereabouts of any of this radio equipment, he is asked to communicate with the nearest police station.

Police Station, Parnell, Auckland

Stolen 4-valve radio, vibrator-operated, black plastic cabinet, approximately 16 in. x 16 in. x 10 in. deep, letters "A.W.A." on front. White plastic grille over speaker. Manufactured by Amalgamated Wireless Limited.

Criminal Investigation Branch, Christchurch

Gulbransen "Little Jewel," 5-valve portable, all electric radio; green plastic case with metal strip on back and front; Serial No. 75255.

Home-made, 5-valve, portable radio; red rexine case measuring 16 in. x 10 in. x 10 in., has a black leather carrying handle. Three control knobs on the top; semi-circular dial approximately 4 in. across, has a dull metal rim. Back of the set screws on to reveal the aerial wound on cardboard.

Criminal Investigation Branch, Nelson

Missing, Philco A.C./D.C. portable (second hand) with batteries. Cabinet of brown coloured wood. Model 351.

State, 5-valve broadcast, model 5151, Serial No. 5178A or 5146A. Ivory bakelite cabinet. "Celestion" speaker and midget type valves.

Radiogram, "Pacemaker" 5-valve broadcast, wooden cabinet with lift-up lid, fitted with "Garrard" record-changer; square type dial.

Stolen from parked car, one Philips portable radio, 6-valve, battery radio, A.C. only, 15 in. by 7 in. by 10 in. in size, green rexine covered cabinet, two white tuning knobs, white plastic grille front, new batteries with date stamp of 24/3/52, dent on one corner on front side.

Stolen from motor-car, one "Emitron" H.M.V. car radio, silver grey, black dial and cream push buttons.

Stolen from motor-car, one "Columbus" car radio, 9 in. x 8 in., brown bakelite case, two dials, five-valve, 4-in. speaker. Model V.15; Serial No. 6392.

Criminal Investigation Branch, Christchurch

Stolen from a motor-car, "Ultimate" 6-valve, battery-electric portable. Dark fawn coloured rexine case. The three knobs for tuning, tone, and volume and the handle are made of white bone. Chassis No. 121-891. Identifiable.

Police Station, New Plymouth

Stolen from the Hawera District—

"Autocrat" motor-car radio, 8-valves, brown colour; Serial No. 50-1363.

Criminal Investigation Branch, Palmerston North

Stolen from the shop of Kenneth Raymond Hill, known as Radio and Electric (P.N.) Ltd.:

Five Star portable radio No. 23556. Six valves, black metal case with chrome facings. A.C. radio. Size 16 in. x 10 in. x 6 in.

Criminal Investigation Branch, Lower Hutt

Radio recovered—"Ekco" portable radio stolen Lower Hutt 1st–4th February, 1952.

Proceedings of the New Zealand Electronics Institute Incorporated.

HEADQUARTERS NOTES

Compilation of the annual report and balance sheet for the year ended 31st May 1952, is now being undertaken, and it is hoped to have these documents published in the next issue of the Institute proceedings.

A Council meeting was arranged for a date towards the end of May and further information respecting business transacted at this meeting will also be published in the next issue.

BRANCH ACTIVITIES

Christchurch

A meeting of the Christchurch branch was held on 28th April, 1952, and was attended by 15 members and two visitors. The speaker for the evening was Mr. T. R. Pollard, who spoke on places, people, and trends overseas in connection with industry and electronics. He first outlined and compared research organizations in New Zealand, Australia, England, and America. Mr. Pollard then described the rain-making experiments in Australia and moon reflection experiments. He gave an account of frequency standards at the National Physical Laboratory.

In the course of his talk, Mr. Pollard described the English and American methods of testing the acoustic properties of walls. In England, a cement room with a high-gloss finish was taken as a standard and a standard noise was measured after a certain small interval. The material to be tested then replaced one of the standard walls and the measurement was repeated. In America, a totally dead room was used and the inside noise was measured having been transmitted through the wall by a battery of 256 loudspeakers (256 matched speakers chosen by testing a batch of ten thousand loudspeakers). The standard wall was then replaced by the one to be tested and the experiment repeated.

Mr. Pollard described a visit to Ferranti's research organization in Edinburgh where Mr. Williamson (of amplifier fame) demonstrated a high-speed recorder devised to operate electronically and record on paper up to 1,000 cycles per second. He also described a wire-wound potentiometer having a linearity with accuracy of 1/10th of 1 per cent.

Mr. Pollard described a visit to the S.T.C. Laboratory near London where he saw 8-ball microphones being made and the coils being wound with 8 x 1 mil. aluminium ribbon, wound on edge. This microphone is used as their standard test microphone. He also mentioned visits to Holland, Switzerland, and the U.S.A.

In America, Mr. Pollard was told of a high-speed camera shutter consisting of a tube with a polaroid at each end in opposition to cut off the light. Around the tube was a coil through which a short duration pulse of thousands of amps was sent, thus twisting the beam of light between the polaroids and giving an exposure of one-millionth of a second.

The meeting closed at 10.30 p.m. with a vote of thanks moved by Mr. A. V. Butcher.

Wellington

Wellington Branch has been holding regular monthly committee meetings. At one of these meetings recently it was agreed that a social evening should be held but subsequently this was altered and took the form of a visit to Radio Corporation, covering an inspection of equipment there commencing at 6 p.m. This visit was enjoyed by all members.

In addition, an evening lecture was held, the speaker being Mr. A. H. Browne. Mr. Browne briefly explained a few of the problems associated with transmission from jet aircraft, because they fly higher and faster than conventional aircraft. The speaker said that in order to increase the payload of the aircraft the radio operator is dispensed with, and the duty is performed by the pilot. Hence the use of radio telephone, but at the same time increased radiated power is required. This introduces further problems, aerial insulation, for example, hence single side-band transmission. Mr. Browne spoke then on the fundamentals of S.S.B. transmission, and the double balance modulator, a system to avoid the use of a crystal filter with its associated problems, was treated in full detail.

Mr. Browne used prepared block diagrams to assist members in obtaining a clear picture of the whole system, and with the aid of the diagrams, was able to give much detail in his paper. The schematics of the various stages of the S.S.B. transmitter were similarly explained. The operation of the selective double demodulator was described in principle before passing on to the complete S.S.B. receiver. The details of the relay-operated motor-controlled carrier frequency of the receiver were of interest to the meeting, and the speaker, in throwing open the meeting for discussion replied to a number of questions which were indicative of the general interest in the subject.

Mr. Browne pointed out that the system described was only in the experimental stage at the time and the chairman, in proposing a vote of thanks, remarked that it was gratifying to have a paper given at a Institute meeting describing equipment which had not as yet been put into production. The president of the Institute (Mr. W. L. Harrison) expressed pleasure at the attendance, and extended to the visitors, especially mentioning the technical trainees of the Broadcasting Service who were present, an invitation to attend future meetings.

At a recent meeting of the Dunedin branch, Mr. H. E. Symmons gave a lecture on "Starvation Circuits."

Mr. Symmons commenced by pointing out that under normal operating conditions the gain realized in a circuit comprising a pentode with resistive anode load and 500 volts H.T. is about 100 to 150. In the often used "semi-starved" circuit with about half megohm anode load and two megohm screen dropping resistor, gains of from 250 to 500 are realized. In truly starved circuits, in which the anode current is limited to about 10 microamps by means of very low screen voltages, and using an anode load of 30 megohms, gains of 2890 with an EF50 and 1450 with a 6SJ7 were obtained in a single stage.

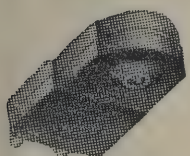
(Continued on Page 48.)

Audio Men

who want the best will want

PICKERING COMPONENTS

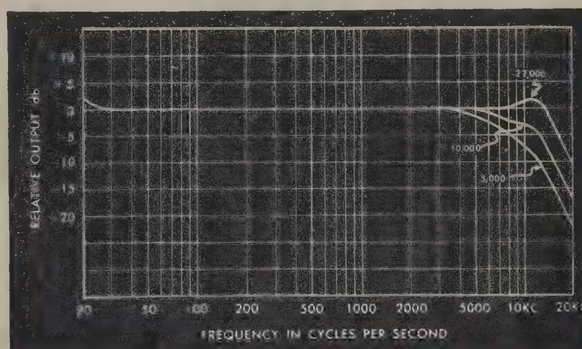
when they are available in New Zealand

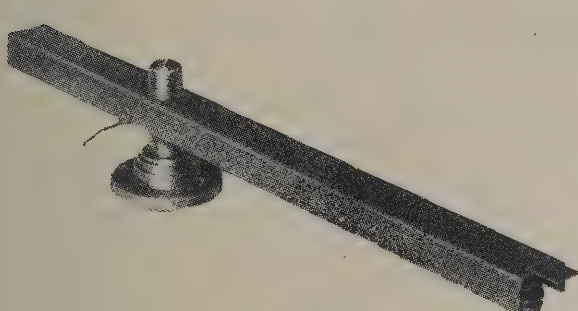


Pickering Cartridges

With diamond or sapphire stylus, for standard or microgroove records, are the first choice of America's professional audio engineers for high-quality reproduction.

Each cartridge is carefully tested at the factory for frequency response, waveform distortion, output level, and tracking pressure. Optical parts and electrical inspection of the pick-up coil are made on each unit. Users report absolute stability, amazing ruggedness, and complete insensitivity to effects of temperature and humidity.





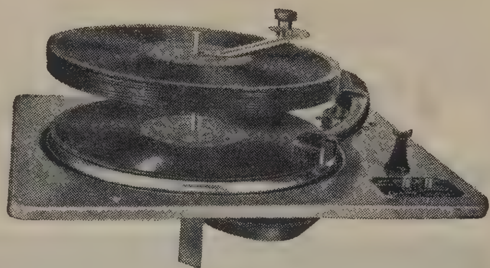
190 Pick-up Arm

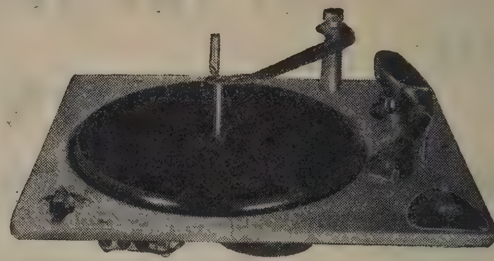
The Pickering is the only arm capable of optimum performance on both microgroove and standard records. Investigation by Pickering engineers showed that arms which perform well on standard records will not necessarily do so on microgroove. In fact, no commercially available arm was found which would meet all requirements. The Pickering arm embodies all the features determined as significant and important to enable a high-quality cartridge to play microgroove records without distortion or record or stylus wear. (1) The ratio of vertical-to-lateral moment of inertia is as low as possible. (2) The vertical mass has been minimized in order to track any record without imposing extra vertical load on grooves; it plays badly warped records just as well as flat ones. (3) There is no spurious arm resonance at any frequency. (4) Pivot friction is lower than 3 gram centimetres and the bearings are rugged and trouble-free. (5) The arm is statically balanced about the vertical axis to eliminate tendency to jump grooves when subjected to bumping or jarring. (6) Offset head reduces tracking error to less than plus or minus 2½%. (7) Stylus point is protected against contact with anything but the record grooves; it cannot strike the turntable mat or centre pin; it plays all sizes of records up to 17¼ in. O.D. In addition, the 190 Pick-up Arm features: Sensitive tracking force adjustment; height adjustment for turntables from ½ in. to 2 in. high; one-hole mounting and self-contained levelling screws; plug-in cartridge-holder; magnetic arm rest; stylus point completely visible for starting and cueing records; 16¾ in. long. Pickering Cartridges used with the 190 Arm require 50% less vertical tracking force than is required when using conventional arms.

PICKERING

Those interested will be invited later to hear — this equipment demonstrated. —

AND COMPANY, INC., OCEANSIDE, LONG ISLAND, NEW YORK





N.Z. Radio Traders' Federation

As *Radio and Electronics* goes to press before the Radio Traders' Conference has concluded, we must defer a full report of the proceedings until the July issue. In the meantime, however, we are pleased to publish extracts from the Annual Report of the President, Mr. J. Fairclough.

"One can safely say that radio traders and service shops have together, with all sections of the business community, experienced encouraging trading conditions during the year under review. Sales of new sets, as shown by the increase in licenses of over 17,000, have been most encouraging despite increased prices, and the holding back of the public's purchasing, that occurred early in 1951, due to somewhat ambiguous information published regarding television. Incidentally, the question of television is being carefully watched by your Executive, and every endeavour is being maintained to keep members up-to-date with both private and Government action that will affect the trade.

"Difficulties in securing necessary parts for new radio sets, and particularly replacement parts for service and maintenance of sets, have been frequent, and representations in an endeavour to secure a continuity of necessary spares to give the public service, have been made to manufacturers and the Import Control Department on several occasions.

"Increased prices, increased costs of selling, higher rates of pay for servicemen and staff, the necessity today of having to seek business which in the past came to us automatically, the tendency for more and more hire-purchase business, may be matters easily overlooked, due to the past seasons of prosperity giving us a false sense of security. These matters indicate a hard future, which, however, can be eased considerably by the co-operation of all Associations, the rounding up of all dealers and servicemen as members of your local Associations, and a confidence in your Executive to look after your interests, providing you wish them to do so.

"As a Federation the interests of the radio traders are being continually watched, and attention given to matters that are of benefit to the members and trade in general and in this respect my thanks are due to the Federation's Secretary, Mr. P. J. Luxford, for his keenness and willingness to follow various matters up.

"On several matters of importance, so far as we are concerned, which have also been associated with Government Departments, we have found these Departments slow to follow up with information and action which we have sought, and, unfortunately, criticism has been levelled at the Secretary and Executive for delays over which we have had no control.

"At the last Annual Meeting, I stated my willingness to attend the Annual Meetings of the different Associations, and wish to express my gratitude to both Wellington and Auckland Associations for inviting me to their meetings and giving me an opportunity to address their members.

"The year has seen several Executive meetings, dealing with matters of importance, and also on various occasions, when visiting Wellington, the Secretary has made himself available, and we have discussed together, at some length, matters of importance to the trade in general.

"The future has wonderful prospects, with the rapid advancement of radio, radio gramophones, and the approach of television, but with it all will come more difficulties, which can only be overcome by increased membership, and a greater co-operation between Associations and the Federation, and a confidence in your new President and Executive for 1952/53.

"I have already mentioned the Secretary and his office staff, who have given willingly of their time and advice, and I wish to extend to my Vice-President, Mr. Dudley Billing, and to the members of the Executive, my sincere thanks for their assistance and for the time they have given towards the running of the Federation during the past year, which was not by any means an easy period. To the Editor and Technical Editor of *Radio and Electronics,* I would express very sincere thanks for the amount of publicity they have given the Federation and the courtesy they have shown me on my repeated calls during the past year.

Statistics

"At the last Annual Meeting, a resolution was passed regarding the inclusion of certain customs statistical information in annual reports. These statistics are being procured by the Federation (at a fee) and have been circulated as received.

"Recently the Reserve Bank has commenced compilation of statistics relating to retail sales and stocks of radios. Arrangements have been made to procure these statistics monthly and associations have been sent circulars showing the information available. At the present time these figures should be of particular value to members.

Conference

"This year, for the first time, the Federation's Annual Conference is to be held at Dunedin. I wish to express my thanks to the Otago Association for their offer to act as host, and also for the considerable amount of work it has done to organize the Conference. I sincerely hope that the result of our deliberations will be strengthening of the Federation and that the radio trade throughout the Dominion will also benefit.

Finance

"Although a satisfactory bank balance is disclosed in the financial statement, the Annual Meeting should consider the financial position of the Federation as a result of the anticipated reduced income due to the resignation of the Auckland Association. Arrears of subscription owing by several Associations is also a matter requiring attention."

TRADE WINDS

Messrs. C. R. Peoples and Co., Auckland, advise their appointment as sole New Zealand agents for Hydra condensers.

* * *

Messrs. J. C. Laird and Sons, Ltd., Hawera, are again looking very spick and span after the severe fire of January last, which destroyed the showroom and office. Lost records and important data have created rather a problem, says Noel, but helpful co-operation from the clientele has considerably eased the burden, for which Lairds are very grateful.

* * *

Congratulations to "Brack" of Miles Nelson, Ltd., who is now the proud father of a son.

Doug. Barrett has resigned from the costing department of Radio (1936) Ltd. to take up residence in Napier.

* * *

Messrs. S.O.S. of Auckland have taken extra premises at No. 15 Grey's Avenue, about 100 yards from the Town Hall. These premises will house the workshop and administration sections, where Jim Eckford will be glad to welcome visitors.

* * *

Messrs. Electronic Navigation announce their successful tendering for Decca Marine Radar Equipment for the Royal New Zealand Navy.

THE RADIO INDUSTRY COUNCIL (LONDON)

Amendments to specifications issued by the above, and as mentioned by "Radio and Electronics" in specific issues, are now to hand, and may be seen at our offices, 46 Mercer Street, Wellington.

The amendments cover specifications set out hereunder, and comprise only amendment No. 1 except where otherwise indicated.

RIC/113, Issue No. 1, June, 1950 (Amdmts. 1 and 2)
RIC/111, Issue No. 1—July, 1950
RIC/112, Issue No. 1—May, 1950
Amendments 1 and 2
RIC/113, Issue No. 1—June, 1950
Amendments 1 and 2
RIC/122, Issue No. 1—February, 1950
RIC/131, Issue No. 1—July, 1950
RIC/132, Issue No. 1—July, 1950
RIC/133, Issue No. 1—April, 1951
RIC/134, Issue No. 1—April, 1951
RIC/136, Issue No. 1—February, 1951
RIC/137, Issue No. 1—April, 1951
RIC/141, Issue No. 1—February, 1951
RIC/142, Issue No. 1—September, 1951
RIC/143, Issue No. 1—September, 1951
RIC/214, Issue No. 1—February, 1951
RIC/321, Issue No. 1—February, 1951
RIC/322, Issue No. 1—February, 1951
RIC/1000/C, Issue No. 1—April, 1951

* * *

During 1951, radio exports from Great Britain were 144 per cent. up on 1949, says Pye Ltd., of Cambridge. This is just one example of the tremendous effort which is being made by British industry to expand overseas business.

* * *

The end of 1951 saw an addition to the Pye group of companies with the opening of TV Manufacturing

Limited at Oulton Broad, near Lowestoft, in Suffolk. This factory, formerly owned by the Admiralty, had fallen into disuse since the war and was taken over by Pye Limited only six months ago. Reconditioning has been partially completed, and the present floor space is approximately 28,000 square feet, with another 12,000 square feet under preparation. Furthermore, an additional 50,000 square feet can be developed in a fairly short space of time. Today, four assembly lines are in operation producing marine communication and radar equipment and radio and TV receivers.

PUBLICATIONS RECEIVED

Osram Valve Manual, Part I—General Electrical Co., Ltd. (England). British General Electric Co., Ltd., Wellington.

Philips Wall Charts on Receiving and Special Valves—Philips Electrical Industries of N.Z. Ltd.

Dial, Vol. 8, No. 3, International General Electric Co., (U.S.A.)—National Electrical and Engineering Co., Ltd.

Brochures from G.E.C. (England); Major Products Telephone and Television; Miniature Relays; "Telephones are made in Coventry."—British General Electric Co., Ltd. (N.Z.).

"Valves and Their Applications," by Mullard Electronic Research Laboratories, England—C. and A. Odlin Timber and Hardware Co., Ltd.

National Electric Review, March, 1952—National Electrical and Engineering Co., Ltd.

B.I.C.C. Bulletin, No. 5, British Insulated Callender's Cables Ltd.—National Electrical and Engineering Co., Ltd.

"Radiotronics," April, 1952.—Amalgamated Wireless Valve Co. Pty., Ltd.

Pye Television Newsletter, April, 1952, "Pye in America," Pye Ltd., England.—Green and Cooper, Ltd.

Brochure, Pye TV Cameras, Pye Ltd., England—Green and Cooper, Ltd.

Philips Technical Review June, 1951; N. V. Philips Gloeilampenfabrieken, The Netherlands.—Philips Electical Industries of New Zealand, Ltd.

1952 Calender: N. V. Philips Gloeilampenfabrieken, The Netherlands.—Philips Electrical Industries of New Zealand, Ltd.

Wholesale Price List for May.—Ducon (N.Z.), Ltd.

The Scanner, February, 1952: Decca Radar, Ltd.—Electronic Navigation, Ltd.

Sylvania News, February, 1952: Sylvania Electric Products, Inc., U.S.A.—G. A. Wooller and Co., Ltd.

Latest Record Releases

(Supplied through the courtesy of Messrs. H.M.V. (N.Z.) Ltd.)

Columbia

Troubadour Song, Burl Ives with Guitar; High Barbaree, Burl Ives with Inst. Trio—DO3482.

Old Paint: I've Got no Use for Women, Burl Ives with Guitar—DO3483.

Little Mohee, Burl Ives with Guitar accompaniment; John Henry, Burl Ives with Guitar—DO3484.

Got the World by the Tail; My Mommo Told Me, Burl Ives with Inst. Accompaniment—DO3485.

Be My Life's Companion, Rosemary Clooney with Orchestra; If Teardrops were Pennies, Rosemary Clooney with Inst. Accompaniment—DO3487.

Nola; Twelfth Street Rag, Morton Gould and His Orchestra—DB2524.

Melody of the Stars; Humpty Dumpty, Peter Yorke and His Orchestra—DB2569.

Humoresque; Moonlight and Roses, Ken Griffin, organ—DB2798.

His Master's Voice

Marechiare; A'Vucchella, Mario Lanza with Orchestra —EC188.

A Mother as Lovely as You; I Hope You have a Happy Birthday, Donald Peers with Orchestra—EA4016.

Let Me In, The Fontane Sisters with Texas Jim Robertson; Castle Rock, The Fontane Sisters with Orchestra—EA4017.

Never; California Moon, Denis Day with Orchestra—EA4018.

Domino; Over a Bottle of Wine, Tony Martin with Orchestra—EA4019.

And So To Sleep Again; Put Me In Your Pocket, April Stevens with Orchestra—EA4020.

Tiger Rag; Everybody Loves my Baby, Glenn Miller and His Orchestra—EA4023.

Regal Zonophone

Teardrop Waltz; Little Darlin' I'm Sick and Tired of You, Tommy Mack and His Overlanders—G25321.

Decca

J'Attendrai (Au Revoir); Wabash Blues, Roland Peachey's Hawaiians—F8506.

There's Nothing Else to do in Makla-Ka-Mo-Ka-Lu; Gentle Evening Breeze; Roland Peachey's Hawaiians—F9063.

Show Me the Way to Go Home; Dreaming, Prima Scala and his Band—F9052.

1952 Radio-gram

(Continued from Page 33.)

causes the high frequencies to become distorted, in the usual way.

If you have never tried a set with band-expanding I.F.s this one will give you a new conception of the quality that is to be had from our own broadcast stations, given a little effort, devoted to building the set. Of course, if you have a good amplifier and would like to build the tuner section only of this receiver, there is no reason at all why you should not do this. All that is necessary is to build the circuit up to and including the volume control and three-position switch. Then a cathode follower can be installed, as an output tube, and the whole thing gives you the switching facilities from radio to gram, as well as the tuner itself.

N.Z.E.I. Proceedings

(Continued from Page 40.)

It was pointed out by Volkers (*Electronics,* March, 1951) that a 6SJ7 increases from its normal value of 1650 at 3 ma. anode curent to a maximum of 9000 at about 11 ma. anode current, while the internal impedance varied from 1 megohm at 3 ma. anode current to a maximum of 100 megohm at about 3 ma. anode current.

A circuit was shown by which the gain could be obtained directly, and curves were shown giving the performance of several types of valve under starvation conditions.

Mr. Symmons pointed out that there were several drawbacks to the starved amplifier: (1) It has a very high output impedance, and so far has only been successfully coupled by means of direct coupling to a semi-starved cathode follower, having a megohm cathode load; (2) Starved amplifiers have a self-biasing effect so that grid leaks returned to earth must be small (about 100k.) or returned to H.T., where they should be about 80 megohms; (3) Owing to the very high value of the anode load (about 30 megohms) the band width of a starved amplifier is only about 1.5 c/sec., but this could be improved by sacrificing gain in using negative feedback.

Several applications were mentioned. A D.C. millivoltmeter was demonstrated which will handle without attenuators a maximum of 100 millivolts and has a sensitivity of 20 μvolts. This comprised a single EF50 starved amplifier followed by an EF50 semi-starved cathode follower, and an electronic voltmeter.

Also shown was an A.C. amplifier comprising two stages of starved amplifiers coupled via a cathode follower and having a gain of about four million.

This brought Mr. Symmons's most interesting lecture to its end and Mr. Andersen moved that Mr. Symmons be accorded a hearty vote of thanks. This was carried with acclamation.

Supper was then served and thus ended a most enjoyable evening.