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EDITOR:
F. J. CAMM

PRACTICAL WIRELESS

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PROGRESSIVE DEVELOPMENT OF THE SHORT-WAVE RECEIVER

Practical Wireless

EVERY MONTH
VOL. XXVII. No. 541 NOVEMBER, 1951

Editor F. J. CAMM

19th YEAR OF ISSUE

COMMENTS

By THE EDITOR

RADIO SHOW FOR THE NORTH

THE Radio Industry Council has decided to hold a Radio and Television Show in the City Hall, Manchester, in the spring, provisional dates being April 23rd to May 3rd, and the Council has received an assurance of B.B.C. co-operation.

The total attendance at the Show this year was 232,752, and this is considered a good result for the first Radio Show at Earl's Court. Next year's Show will be held at Earl's Court in September, 1952.

The great interest which the approach of television to the North of England has created justifies the Council in holding an additional exhibition in the North. This year at Earl's Court great interest was shown by Northerners in the Television Section of the Show. Although the total attendance was down on the 1949 figures (the last year in which a radio show was held in London; it was held in Birmingham in 1950), bearing in mind the counter-attractions of the Festival, the summer holidays, and the holding of other exhibitions contemporaneously the result was excellent.

Our inquiries amongst manufacturers showed that whilst export trade was good, home trade was slow. This is not to be wondered at when the large purchase tax figures appended to most of the exhibits were examined by the public. The policy of stating this instead of giving an all-in price was questioned by one or two, and a few manufacturers did not disclose the tax. We think, however, it was a fair policy so that the public could form its own opinion as to whom was really responsible for high prices.

IMPROVED HOME SERVICE

The B.B.C. intends to improve reception of the Home Service in certain areas where conditions have proved unsatisfactory and this is to be achieved by installing low-power transmitting stations in these areas.

The first of the twelve proposed stations came into operation on September 16th at Ramsgate, Hastings and Brighton. Ramsgate radiates the London Home Service on 202 metres (1,484 kc/s), and Hastings and Brighton the West of England Home Service on 206 metres (1,457 kc/s). There are technical reasons why these two latter transmitters cannot radiate the London Home Service. All three stations will ultimately have a power of 2 kW., but as the completion of the permanent installations will take some time the temporary transmitters will be used to provide a stop-gap service. The temporary station of Hastings will be replaced by a permanent station to be built near Bexhill so as to include Eastbourne in its service area.

The Brighton transmitter covers the Brighton, Hove, Shoreham and Worthing areas; Hastings the St. Leonards, Hastings and Bexhill areas; and Ramsgate the Ramsgate, Broadstairs and Margate areas.

All of these areas have complained for years of the poor quality of the standard service.

OUR NEW SERIES OF RECEIVERS

The component position has prevented us hitherto from publishing designs built and tested in our own laboratory. That position is now changing, and we shall during the next year publish a series of designs which will eventually replace those at present in our Blueprint List. Some of these designs, whilst still efficient, have presented difficulties to constructors because components are not readily available. This is a difficulty of which we have been aware for some time.

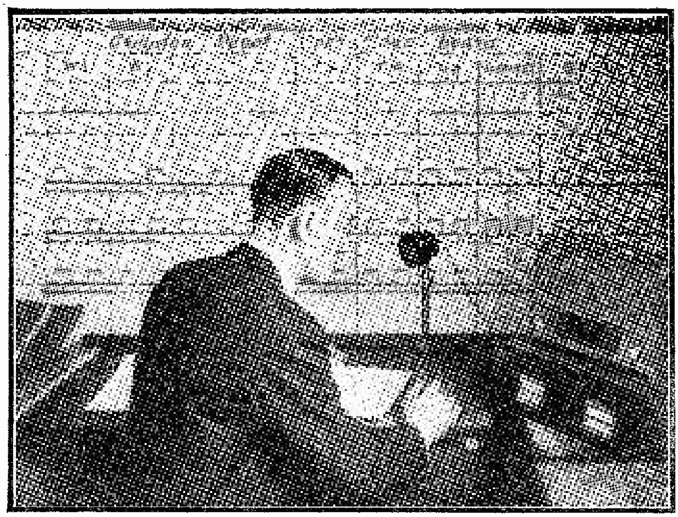
Our new series of receivers will be designed around components which are available even though they may be in short supply. Each will carry our usual guarantee.—F. J. C.

ROUND the WORLD of WIRELESS

Wireless Control for Ice-cream Vans

TWO-WAY radio communication is being used by T. Wall and Sons, Ltd., to control their ice-cream supply vans in the Croydon area. Six vans have been fitted with mobile transmitter-receiver equipment: the master transmitter, remotely controlled from the depot, is sited on a hilltop at Warlingham.

Shopkeepers who find themselves unexpectedly running out of ice-cream merely telephone the Croydon depot: a message is at once transmitted to the nearest van. Within 10 minutes, fresh supplies are at the door. Supply vans are radio-controlled within a radius of 15 miles.



The master transmitter employed by T. Wall and Sons, Ltd., at Warlingham.

Output Rise to £85 Million

EXPANSION, in the radio industry's total value of production is expected to rise this year to about £85 million, an increase of £10 million on last year.

Last year's output of television receivers (540,000) is expected to be increased by a figure of around 110,000. Effects of rearmament on civilian supplies are not expected to be realised until next spring.

Radio Industry Exports Increase

A CONSIDERABLE increase in exports is shown in the figure of £10,214,544, being the value attained for the first half of this year, compared with £7,537,468 for the same period last year and a 1950 total of £17,527,330. Exports for July of this year alone were £2,022,000 which, if taken as an average, would give an annual total of £24,250,000.

London to Brighton Walk

THE second half of the 25th London to Brighton walking race on September 8th was radio controlled.

A chain of short-wave radio stations, stretching from Crawley down to the finishing point at the Aquarium on Brighton front, enabled all the officials to be kept in touch with the walkers and at the finishing point loud-speakers kept the large crowd in touch with the progress of the race.

The equipment used was Pye P.T.C. 114 15-watt mobile sets with a fixed station at the Pycombe operations room.

Automatic Capacity Selector

DURING his visit on the opening day to the National Radio Exhibition, Lord Mountbatten inspected, at the T.C.C. stand, a completely automatic capacity selector, one of a chain of automatic machines designed, developed and manufactured by T.C.C. for the production of their silvered ceramic condensers.

In the demonstration, the silvered ceramic tubes were measured individually for capacity and graded into the values shown.

The electronic control gear is adjustable for the selection of any capacity between 10 pF. and 20,000 pF. and in tolerances from 0.5 per cent. upwards.

Photographic Exhibition

"ELECTRONICS—Profile of an Industry" was the title of a special photographic exhibition held at the Engineering Centre, Glasgow, from September 4th-15th.

The exhibition was organised by Mullard, Ltd., as an expression of the company's support of the scheme for promoting an electronics industry in Scotland. The photographs were taken in the Mullard laboratories and factories by the well-known industrial photographer, Walter Nurnberg, F.I.B.P., F.R.P.S.

Growth of Electronics

A FEATURE of the electronics exhibition was its showing, in an impressive manner, how numerous highly specialised techniques, and even industries, have grown up within the electronics industry in recent years. The tremendous scope of this rapidly expanding industry can be judged from the fact that the exhibition was divided into six separate, but closely inter-related, sections dealing with research, fine wire, magnetic materials, electronic valves and tubes and electronic equipment.

Communication with Canberra

THE wireless communication and navigational aid equipment installed in the English Electric "Canberra" for its recent Atlantic crossing was designed and manufactured by Marconi's Wireless Telegraph Co., Ltd.

This was the second such crossing but the flight was officially observed on this occasion in order to establish the new east-west record.

Not only the wireless equipment but also the radio officer was "Marconi" for the record attempt. He was Mr. R. H. T. Rylands, 29, of Bedford.

Interference Cure

A NEW cure has been devised by means of which, it is claimed, all interference with broadcast and television reception from electric sewing machines is eliminated.

A few condensers and chokes comprise the new form of suppression and are so small that they may be packed into a matchbox. The suppressors cost about ten shillings each.

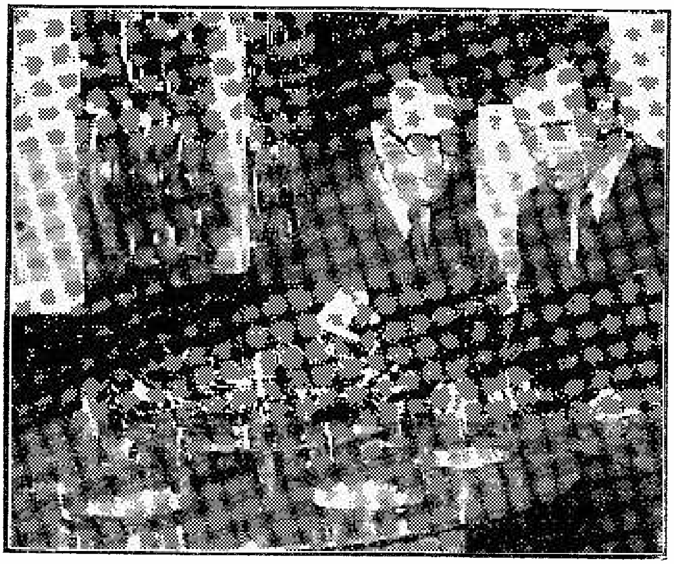
Broadcast Receiving Licences

THE following figures give the approximate numbers issued during the year ended 31st July, 1951.

Region	*Number*
London Postal ..	2,360,000
Home Counties ..	1,655,000
Midland	1,760,000
North Eastern ..	1,914,000
North Western ..	1,617,000
South Western ..	1,072,000
Welsh and Border Counties ..	732,000
Total England and Wales	11,110,000
Scotland	1,116,000
Northern Ireland ..	209,000
Grand Total ..	12,435,000

The above total includes 915,200 television licences.

The monthly increase in television licences (18,200) was the lowest in any month since July last year when the increase was nearly 17,000. The sales of licences usually decline in the midsummer months; this year there has been the additional effect of the increased purchase tax on receivers.



Lord Mountbatten's visit to the T.C.C. stand on the opening day of the Radio Exhibition.

Transmitters for Egypt

AN £80,000 order has been received by Marconi's Wireless Telegraph Co., Ltd., from the Egyptian Ministry of Communications—The Egyptian Broadcasting Authority—for one of the new 100 kW. Medium Frequency Air-cooled Broadcast Transmitters.

These transmitters have met with immediate success and two of them, operating in parallel, have been installed at Daventry for the B.B.C., to radiate the Third Programme. Other orders have been received from Argentine, Denmark, Finland and Norway.

The transmitter for the Egyptian State Broadcasting Authority is to be installed at Abu Zaabal, near Cairo, and will be housed in the same transmitter hall as the Marconi 100 kW. High Frequency Transmitter, now being delivered to the Egyptian Authorities. The complete mast radiator is also being supplied by Marconi's and will be erected by local labour under the supervision of British Engineers.

Two Shows Next Year

IT was recently decided by the British radio industry that two exhibitions will be held next year.

This is probably due to the approximate 40 per cent. drop in attendance at this year's Earls Court show as compared with the 1949 exhibition.

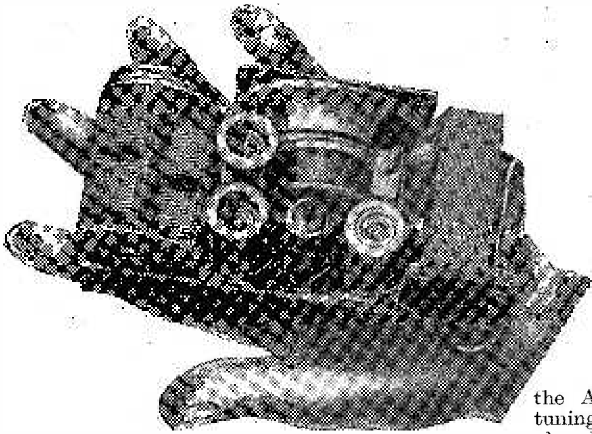
Earls Court will again play host to the industry next year and Manchester City Hall will be the setting of the second show (April 23rd to May 3rd.).

Ekco's Silver Jubilee Celebration

ON Friday, September 21st, 6,500 employees and friends of E. K. Cole, Ltd., of Southend-on-Sea, came from Southend, Malmesbury, Manchester, Glasgow, Birmingham and London to the Harringay Arena for the show "Rose Marie on Ice."

This marked the 25th anniversary of the founding of the company and the evening included the presentation by Mr. E. K. Cole, the firm's chairman and founder, of gold watches to four employees who have been with Mr. Cole since the founding of the company.

Mr. Cole was presented with a portrait of himself, painted by Frank O. Salisbury, C.V.O., for which the company's employees had subscribed. Mrs. E. K. Cole also received a souvenir of the occasion.



A.C. Mains Midget

A T.R.F. RECEIVER UTILISING MIDGET VALVES AND A 2½IN. SPEAKER

By K. Aked

(Concluded from the October issue)

IT is necessary to take precautions to prevent damage to the variable condenser. First, remove the Perspex dust cover, and pass the centre connecting lug through the chassis and solder the lug to the chassis, using a very hot iron. The condenser is held in the desired position during this operation. The lug will hold the condenser quite firmly with a slight resilient action to guard against microphony. Solder the R.F. screen in position with the 8 μF. smoothing condenser through the hole. The clip on V1 screen retainer will have to be filed to fit. Leave the speaker and coils on one side until the wiring is almost completed, for the coils are easily damaged whilst soldering other leads. Wire the heaters and rectifier circuit up first. Use the screen pin of V3 as a H.T. point to connect other components that require connecting to H.T. Keep all the small resistors except R4 and R5 close to the chassis and solder three leads for the detector coil to C4, H.T.+ and anode of V1 so that the detector coil can be soldered in later. C11, C9 and C7 are connected in after the wiring is completed. This will ensure plenty of room for soldering. Wiring should be checked carefully as the work proceeds to avoid mistakes—it saves trouble searching later.

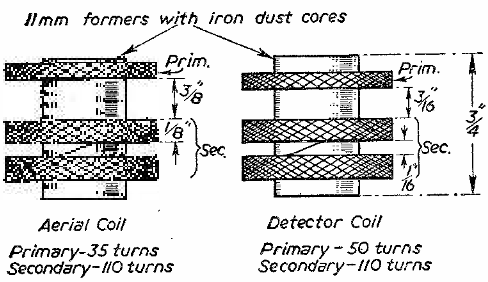


Fig. 10.—Details of the coil.

Coils

In the original model excellent results were obtained by using the B.F.O. coils of Command Receivers. These are wound on ⅜in. diameter powder iron cores and turns were removed until the Athlone programme was received with the tuning condenser at full mesh. Couplings were placed at 3/16in. and ⅛in. from the main windings for the detector and aerial coils respectively, number of turns as in table. However, the standard 11 m.m. formers may be used and details are given. Litz wire with strands of about 45 s.w.g. should be used as the "Q" drops sharply with single-strand wire. The cores will allow plenty of adjustment but will have to be shortened slightly to fit the length of former used.

Condenser Drive

The prototype is fitted with a miniature version of the normal drum type of drive. It is sweated to the condenser shaft as there is hardly room for other methods of fixing. Provision is made for a small horizontal scale, under the speaker, of clear plastic and calibrated from known stations. A cord from the drum is used to move a wire pointer and there is plenty of room for such a system. The scale is best countersunk in the cabinet rather than attached to the chassis. It may be illuminated by a lamp of the Post Office type, fed from the rectifier heater. No more than 100-150 mA. must be taken however, and the lamp will have to be carefully insulated as there will be full H.T. voltage on it with respect to chassis. The dial cord hole

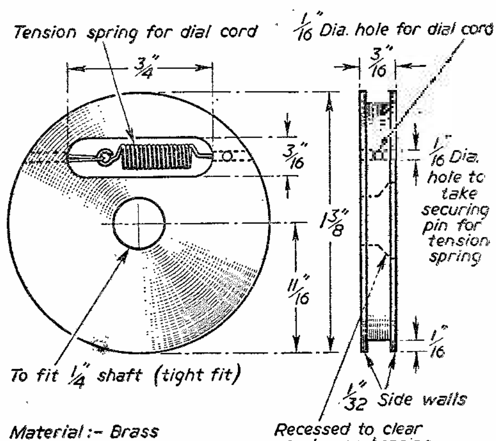


Fig. 11.—Drive and dial details.

nearest the speaker will have to be moved if a pointer system is not used. Naturally, the condenser may be used without a drive but this will spoil the symmetry of the front of the set and also it is difficult to tune the condenser directly, especially on weak stations. The drive specified will give a reduction of about 3 to 1.

Testing and Aligning

When satisfied the set is wired correctly connect to the mains. The H.T. voltage at the rectifier cathode should be approximately 230 volts and at the remote end of R8 190-210 volts, according to the position of the volume control. Bias voltage on V3 should be around 12.5 volts. Align at the L.F. end by the slugs in the coils and the trimmers at H.F. end of band. The trimmers are a bit awkward to get at but can be adjusted reasonably easy if they are eased before the condenser is fitted to the chassis. Finally, when the set is functioning satisfactorily do not turn up the volume control too far as the speaker is only rated at $\frac{1}{4}$ watt and the output stage will deliver approximately $1\frac{1}{2}$ watts at full output.

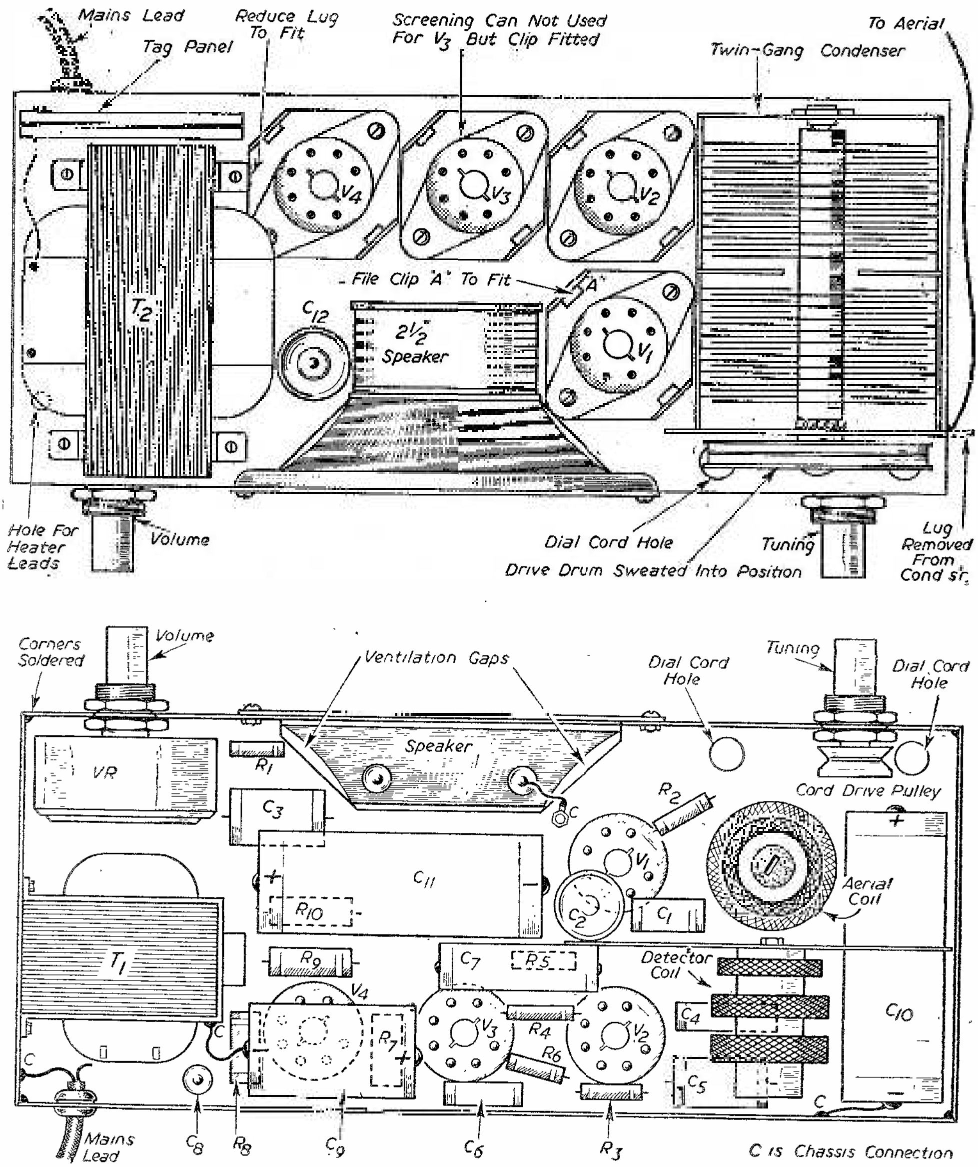
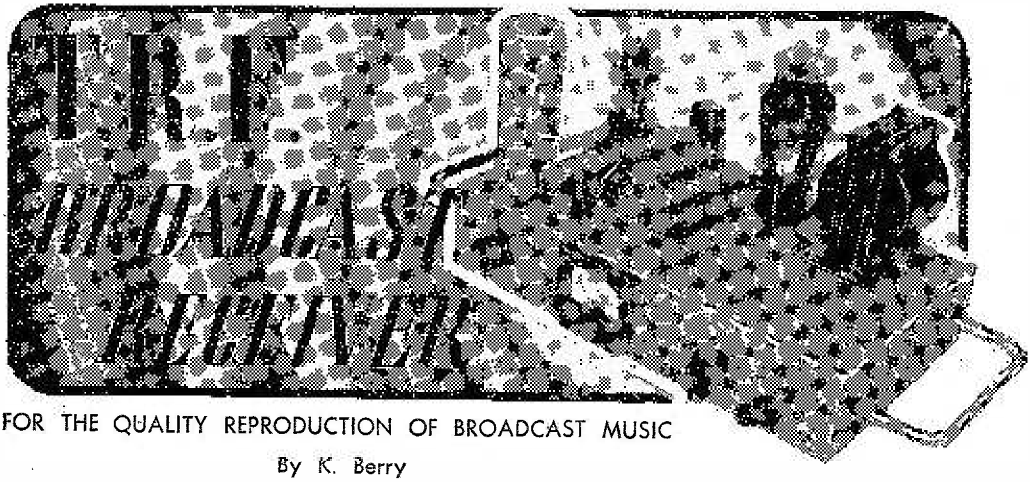


Fig. 12.—Above and below chassis layout.



FOR THE QUALITY REPRODUCTION OF BROADCAST MUSIC

By K. Berry

THE receiver described here was designed because good quality reproduction of broadcast music was required but at the same time the cost of a good push-pull output stage with its expensive output transformer and loudspeaker could not be entertained. A compromise was therefore effected; a good 8in. moving-coil energised speaker was used, and this was mounted on a baffle 32in. square and 1in. thick, which looked after the loudspeaker problem. At the same time the baffle would do service for a 12in. loudspeaker at a later date.

The output transformer used in the original receiver was a Ferranti OPM1, rewound to match a 3Ω speech coil to the output valve. This rewinding is quite easy as the winding consists of three formers each with the number of turns marked thereon, and it is a simple matter to wind the requisite number of turns on the old secondary transformers. However, any reasonable transformer should do bearing in mind the high standing current of the output valve and the consequent need to avoid magnetic saturation.

The rest of the components used in the amplifier are not critical.

The Circuit

V1A is a normal radio-frequency amplifier, R.F. gain control being effected by means of VR1 a 10KΩ rheostat. It is transformer coupled by L3, L4 to V2A.

V2A is an infinite-impedance detector which has a negligible damping effect on the tuned circuit L4, C6, and is comparatively distortionless. The rectified signal appears across the cathode load R6, the R.F. component being filtered by C8, R7 and C10.

A single-pole change-over switch has been placed in the input circuit of V1B to enable an external signal to be amplified, in particular a pick-up. V1B is a pentode L.F. amplifier giving a stage gain of approximately 140, decoupled by R10 and C13.

Negative feedback is introduced via the cathode circuit. The voltage across the secondary of the output transformer is divided between VR3 and R13, thus introducing negative feedback over

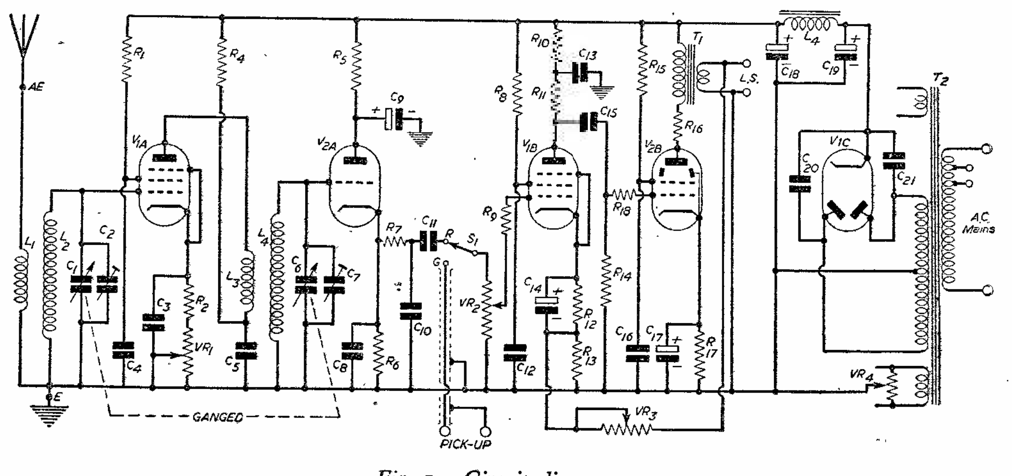


Fig. 1.—Circuit diagram.

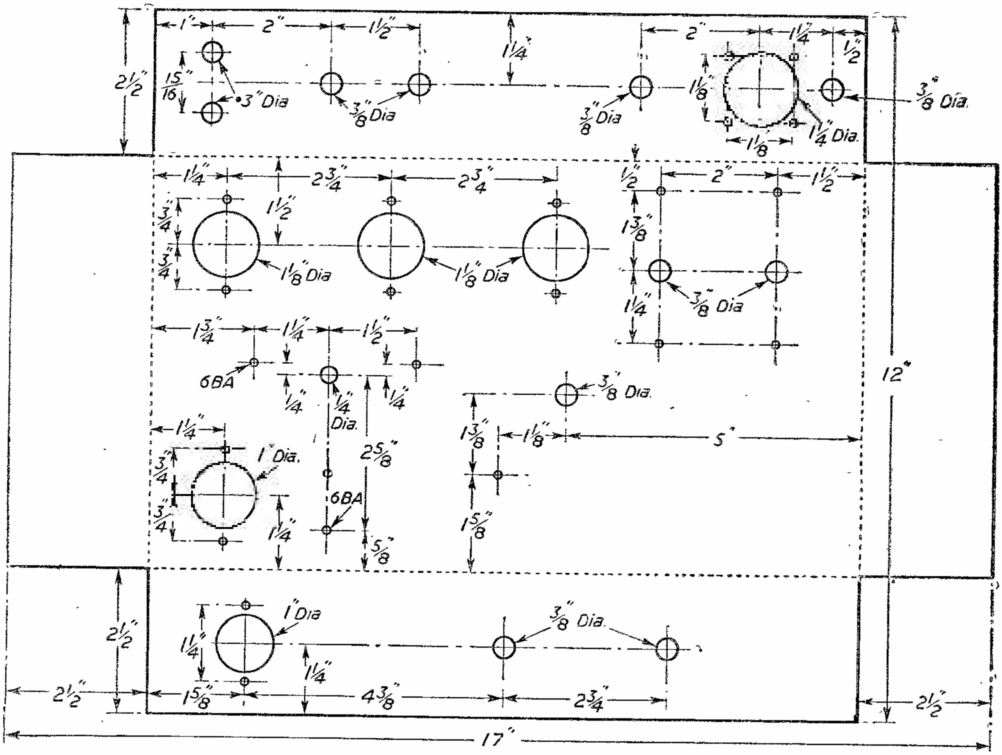


Fig. 2.—Chassis construction and drilling measurements. All holes are 4 B.A. unless otherwise stated.

V1B, V2B and the output transformer, consequently reducing distortion in these components. The amount of negative feedback applied depends on the setting of VR3. It will usually be found that there is a limit to the amount of feedback which can be applied, due to phase shift in the output transformer, and that beyond that oscillation will occur. The liberal use of negative feedback combined with the infinite-impedance detector and the baffle board and speaker are the salient points of this design.

V2B is a beam tetrode which can develop 11 watts output at 15 per cent. harmonic distortion, which is far too distorted to be of use in this circuit. However, by applying negative feedback, an output of some 2-3 watts *mean* is possible without any audible distortion on transients. The screen voltage is dropped and decoupled by R15 and C16.

The power supply is quite conventional; C18 and C19 are connected across the rectifier to prevent modulation hum. Balancing of the heater potential with regard to chassis is effected by VR4, although in the original receiver it made absolutely no difference as there was no hum in any position!

Construction

Views of the completed receiver are shown and the complete plan of the chassis is given in Fig. 2. The original chassis was 18-gauge bright mild steel, cadmium plated, but tin-plate or aluminium would be equally acceptable. The plan assumes soldered, brazed or welded corners, so that if a different construction is used the ends would best be made separately.

Little difficulty should be experienced in the wiring. It is to be recommended that the receiver

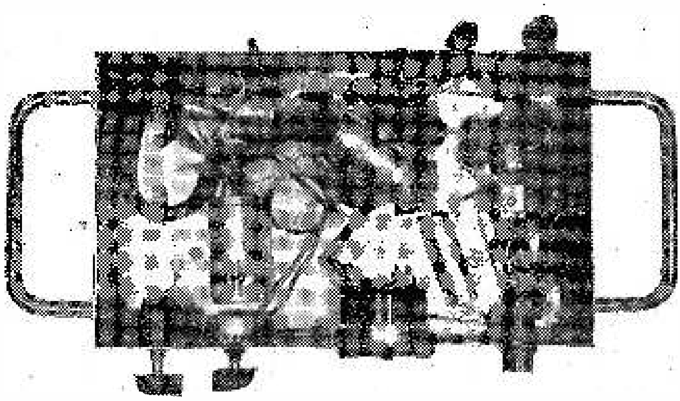


Fig. 3.—Underneath view of the receiver.

COMPONENTS LIST

Capacitors :
- C1, C6—500 pF. 2-gang variable.
- C2, C7—30 pF. trimmers.
- C3, C4, C5, C11, C15—.1 μF. 500 volts.
- C8—200 pF. mica.
- C10—100 pF. mica.
- C13, C16—.5 μF. 500 volts.
- C12—.25 μF. 500 volts.
- C20, C21—.01 μF. mica.
- C9—4 μF. 450 volts.
- C18, C19—16 μF. 450 volts.
- C14, C17—25 μF. 25 volts.

Resistors :
- R1—100 KΩ ½ watt.
- R4, R5, R7, R18—10 KΩ ½ watt.
- R2—300 Ω ½ watt.
- R6—50 KΩ ½ watt.
- R8, R14—220 KΩ ¼ watt.
- R9, R10—20 KΩ ¼ watt.
- R11—100 KΩ ¼ watt.
- R12—600 Ω ½ watt.
- R13—100 Ω ½ watt.
- R15—7.5 KΩ 2 watt.
- R17—300 Ω 1 watt.
- VR1, VR3—10 KΩ rheostat, L1 Wearite PA2 coil.
- VR2—½ MΩ potentiometer. L2 Wearite PHF2 coil.
- VR4—200 Ω potentiometer.
- L4—20H 100 mA. choke.
- T1—Output transformer. Ratio 37.5 : 1 for 3Ω speech coil, 16.7 : 1 for 15Ω speech coil.
- T2—Mains transformer. Pri. 0-220-240 volts.
  Sec. 1, 350-0-350, 100 mA.
  Sec. 2, 5 volts, 3 amps.
  Sec. 3, 6.3 volts, 3 amps.
- S1—Single-pole changeover switch.
- V1A—KTW61.
- V2A—6J5.
- V1B—6SH7.
- V2B—6L6.
- V1C—5Z4.

is first completed and tested before the negative feedback is applied.

It will be seen that one side of the secondary of the output transformer is earthed and the feedback voltage taken from the other side. Now it will be found there is a right and a wrong way to connect the negative feedback circuit and if it is connected the wrong way, positive feedback will ensue, so that if on connecting the feedback circuit oscillations occur (with VR3 at its maximum setting), then reverse the connections to the secondary of the output transformer.

Although the original receiver was intended for medium-wave reception there is no reason why it should not be built as a medium- and long-wave receiver.

Should a greater gain be desired on the L.F. side of the receiver, then if the following values are used instead of those specified a considerable increase in gain will result—R11 500KΩ, R8 1MΩ, R12 3KΩ. It is not advisable, however, to make this change unless the extra gain is really needed as the chances of instability and noise level are increased.

Finally, it should be said that top cut has had to be effected in the original receiver owing to heterodynes on the B.B.C. programmes in the evenings. Although this is undesirable it seems to be the only solution to the elimination of the heterodynes.

Records Lure Mosquitoes

DR. MORTON C. KAHN, Head of the Department of Parasitology of the Cornell Medical College in New York City, has recently described his extensive experiments in mass extermination of mosquitoes in a broadcast over "The Voice of America's Radio University" programme.

He discovered that mosquitoes make sounds other than the buzzing caused by their wing movements. Furthermore, the male and female sounds differ and that the female's call would lure the male mosquito over a wide area.

A study of the mosquito's flying habits revealed that the males would always fly as closely as possible to females. An examination of the mosquito's anatomy disclosed that the antennæ of the male were heavily haired, while those of the female were less so. Dr. Kahn concluded that the male heavily haired antennæ might act as a sound-receptor mechanism for sound vibrations emitted by the female.

By placing a microphone into a sound-proof, mosquito-filled chamber, Dr. Kahn heard an amazing variety of sounds through the loudspeaker. One female mosquito was then placed in the chamber, and when she began to call a recording of the noise was made. To test his theory, Dr. Kahn then opened a box of male mosquitoes in his laboratory. They flew about aimlessly, but when they heard the recorded sound, all the males flew towards the loudspeaker.

Further experiments revealed that the lowest-pitched female noises were most effective in attracting the males, and the radiation of the male call did not attract females. Another discovery was that different mosquito species make different sounds, which therefore require the recording of numerous female calls.

Dr. Kahn describes the sound of a mosquito love-call, greatly amplified, as "a horrendous noise, like that of a giant power saw gnawing its way through a hardwood plank, coupled with the roar of a hundred air-raid sirens."

Dr. Kahn amplified the mosquito call a billion times and broadcast it in a Cuban swamp recognised as a breeding-place for malaria-carrying mosquitoes. Males within the radius of a mile were lured to their deaths by high-voltage electrocution. The apparatus consisted of a large outdoor loudspeaker, recordings with an automatic player, and a 10,000-volt electrical grille that formed the background for the assembly.

Encouraged by results to date, Dr. Kahn hopes that a similar method for home use may be developed. Perhaps every domestic radio set could be fitted with an electric grille over the loudspeaker with sufficient power to kill the amorous mosquitoes, yet harmless to the listener adjusting the set. Also, the time may come when a master recording of the female call could be broadcast from some central location over a large area.

On Your Wavelength

By Thermion

P.D. or E.M.F.?

WHENEVER I shoot an arrow into the air I can be certain that it will drop with the accuracy of a guided missile plop into the laps of those for whom it was intended. So it turned out to be with my paragraph under the above heading in the October issue. I want to make it clear that I am not in need of any instruction as to what the two terms mean. I know the argument that E.M.F. is the *absolute* motive force in the circuit, and that the potential difference is the drop in potential across terminals in the network not necessarily containing a source of E.M.F.

Also I know that P.D.s can occur in closed meshes where no E.M.F. exists. Indeed, Kirchoff's Second Law makes it clear. Also P.D. and E.M.F. (in volts) can be numerically equal to each other in the circuit; for example, in a cell without external wiring, but when the cell is delivering current to an external load, the E.M.F. constant, even when the cell is normally considered flat, is always greater then the terminal P.D.

One of my critics on this matter, in a didactic outburst, endeavours to explain all this in a quagmire of tangled verbiage extending to nearly 2,000 words, condescendingly expounding all of these well-known arguments. Indeed, I anticipated all this when I wrote: "I have no doubt that I shall receive a crop of letters from teachers and others carefully explaining the old argument why P.D. is not equal to E.M.F."

One of the critics to whom I am referring, in an effort to set my steps on the paths of rectitude from which he thinks I have in my technical juvenescence strayed, tries to explain that if we detach a piece off a magnet, that piece will try to attach itself to any other pieces of iron, steel, cobalt, *nickel*, etc. I do so hope that he is now fully aware that nickel is a non-magnetic material. This shows how careful critics should be.

On the other hand, I have received letters agreeing with the point of view expressed in my paragraph!

One critic thinks my remarks are crassly misleading, and in a letter to the Editor expresses the view that he will not permit me to be publicly shown to have made an ass of myself.

Well, he wishes to preserve his anonymity, otherwise I could show where the ass resides.

Incidentally, I have received a long letter from an instructor, fully qualified, who agrees with my point of view and thinks that academic distinctions, including the misuse of the term "volt," should give way to practical applications and ideas. Perhaps readers from this point would like to debate the matter amongst themselves in the correspondence pages.

The Radio Show

I LIKED the roominess of the Earls Court Show, and although attendances were very much down and trade on the whole not so brisk as hitherto, I do not think that matters would have been improved if, as some thought, the Show had been held at Olympia. Next year, I learn, the organisers are to hold a show in the City Hall, Manchester, in the spring, probably during April and May. This decision, I think, was taken because of the great interest evinced by Northerners in the Earls Court Show.

Although the attendances were down, great credit attaches to the organisers, and particularly to Andrew Reid, the Radio Industry Council's publicity chief. The exhibition secured excellent publicity in the daily and periodical Press throughout the country, and but for his efforts attendances would undoubtedly have been worse. It was his job to look after journalists, and answer their questions, and Andrew Reid had all the facts and figures at his finger-tips. In my view it was the best-organised show of the whole series. How fickle, however, is public opinion! At Olympia there were complaints that the gangways were too narrow, a criticism with which I agree, and yet there were critics at Earls Court who thought that the wider gangways destroyed the intimacy which was apparent at Olympia.

So far as the trade drop is concerned various reasons were given. Some thought that the Government policy of making prices prohibitive, by purchase tax, etc., and reducing the public spending power in other ways by high taxation was succeeding. In other words, the Government doesn't *want* you to buy radio and television sets. Judging by the shortage of materials it doesn't want you to have old ones repaired either. The fact is that the public now has less money to spend, and now that basic prices are higher and purchase tax has been increased to 66⅔ per cent., the prices of even modest receivers which used to cost £15 or so are now in the £40 class. What the position will be next year no one can forecast. Perhaps there will be a general election and a new Government which has different ideas on taxation. The industry itself is, of course, busy with Government orders, otherwise the decline in the public purchasing power would be a serious thing for them.

I noted that most interest was shown in television. My forecast that within 10 years there would be more lookers than listeners will, I believe, turn out to be accurate. Perhaps by that time it will not be necessary to have a broadcast as well as a television receiver. It is also quite possible that all-in television receivers will have been produced. Projection television demonstrations were most impressive. There is one thing about television—you can *see* what you are getting for your money!

A Ribbon

AN IDEAL INSTRUMENT FOR ..

By W. P.

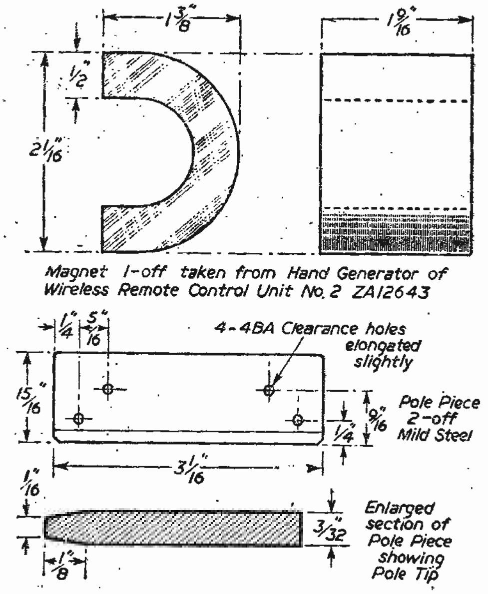


Fig. 1.—Dimensions of the pole pieces.

A RIBBON microphone differs from all other types in that it is operated by the velocity of the sound waves and not by the pressure. Hence it is sometimes called a velocity microphone.

It is capable of extremely good quality owing to the low inertia of the ribbon, which consists of a strip of very thin aluminium foil that is able to follow faithfully the movement of the air around it. It might be said that the foil actually forms part of the medium through which the sound waves travel.

Its main fault is low output, but it will usually be found that the better the quality of a microphone the lower will be its output. Very roughly, a ribbon microphone will develop about half the voltage of a moving-coil type. Also, its impedance is very low, being only that of a single conductor a few inches long. This necessitates the use of a line transformer placed as close as possible to the microphone.

The construction is not difficult though the fitting of the ribbon calls for considerable care. In the microphone here to be described the method adopted makes it a straightforward job.

This microphone has been in use for over a year and has given consistently good results with a wire recorder for which it was built. Top response is excellent and gives a naturalness of reproduction lacking when other types of microphone are used. On the other hand, if it is used too close to the mouth the lower frequencies are accentuated. This is an inherent fault of the ribbon microphone but it disappears when speech takes place at about 12in. distance.

Sensitivity is good, normal speech being very clear and distinct at from 12ft. to 14ft. in the room in which it is used.

The Magnet

The permanent magnet used is taken from the hand generator of a Wireless Remote Control Unit No. 2, ZA12643. Dimensions are given in Fig. 1.

Construction

Begin by making the blocks and clamping bolts, Fig. 2. The sectional view shows how the tapering slots are cut. The shallow slot 5/16in. wide is to give air-space immediately behind the ribbon and the deep slot 1-1/16in. wide is to ensure that no "box effect" takes place between the back of the ribbon and the inside of the magnet. These blocks may be made of any insulating material capable of being tapped. Only the bottom block requires the two tapped holes for the terminal screws.

The magnet is clamped between these blocks.

Use sub-standard (small across flats) 2BA nuts on the clamping bolts. Rivet over one nut on each bolt.

The pole-pieces, Fig. 1, should be flat and care given to forming the tips so that they are smooth and straight with a very small radius along each edge of the 1/16in. flat tip.

Do not elongate the holes until assembly.

Fig. 3 shows the tensioning and spring plates. Cut and drill as shown, then bend as indicated in the enlarged view.

To solder on the 5BA nuts on the top of the

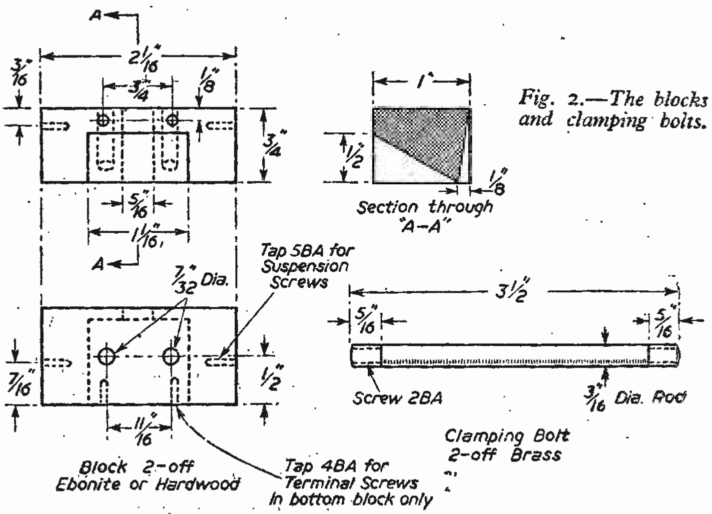


Fig. 2.—The blocks and clamping bolts.

Microphone

USE WITH A WAVE RECORDER

Halket

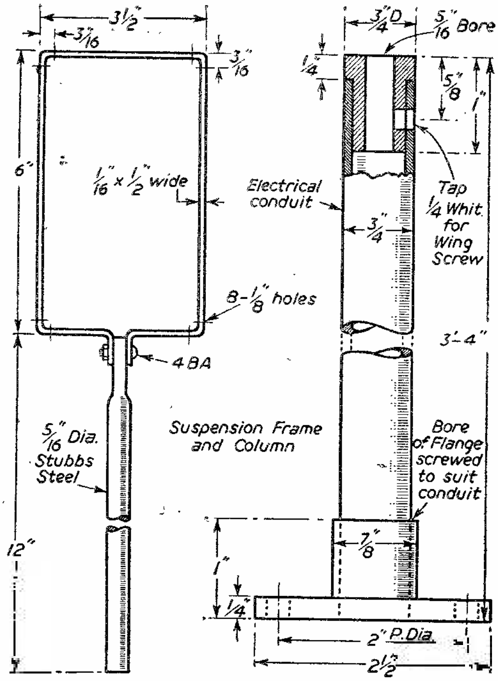


Fig. 4.—Details of the adjustable stand.

tensioning plate, blacken two 5BA screws in a candle flame then pass them through the holes and screw the nuts hard on. The carbon will prevent the solder sticking to the screws. When the nuts are soldered, remove the screws and with a fine file dress and radius the front (bent) edge of both plates. Radius also the inside edges since the ribbon passes over these and down to the clamps and will break on an edge that is in any way sharp.

Next make the clamps and little suspension eyes, Fig. 3.

Figs. 4 and 5 show the details of the adjustable stand which is quite straightforward.

Do not make the bush on the top of the column too tight a fit or the conduit may split.

The hardwood cross-members forming the base are tapped to correspond with the four ¼in. holes in the flange at the bottom of the column.

The rubber pads may be lady's size circular rubber heels.

Assembly

Scribe a centre line across the top of each block and mark the blocks "top" and "bottom."

Position the small brass clamps shown in Fig. 3 on the blocks so that they are exactly central and have their back edges flush with the back of the blocks. Mark through and drill and tap.

Position the tensioning plate on the top block so that its bent edge stands out 3/64in. over the front of the block. Drill and tap and do the same with the spring plate on the bottom block.

Lightly gum two layers of lint around the inside of the magnet, then clamp the magnet between the blocks which have no components attached to them yet. Set the front faces of the blocks flush with the front face of the magnet and tighten the clamping bolts lightly. Lay the magnet on its side on a flat surface and with a surface-gauge adjust each block until the centre lines are central with the magnet and in line with each other. Tighten up.

Lay a piece of 3/16in. wide non-magnetic material central with the centre line, from block to block and clamp on with toolmaker's clamps.

Place the pole-pieces, having marked them "top" and "bottom," against the 3/16in. distance piece and mark through and drill and tap the eight holes.

Elongate the holes in the pole-pieces until each pole-tip can be withdrawn 1/16in. from the distance piece. Remove the pole-pieces and distance piece. Elongate slightly the holes in the tensioning and spring plates and fix in position using a piece of flat 3/64in. steel laid on the faces of the blocks and magnet. When the bent edges of the plates are flush with the steel plate tighten up the screws permanently.

Now see that the bent edges are lying parallel with the tops

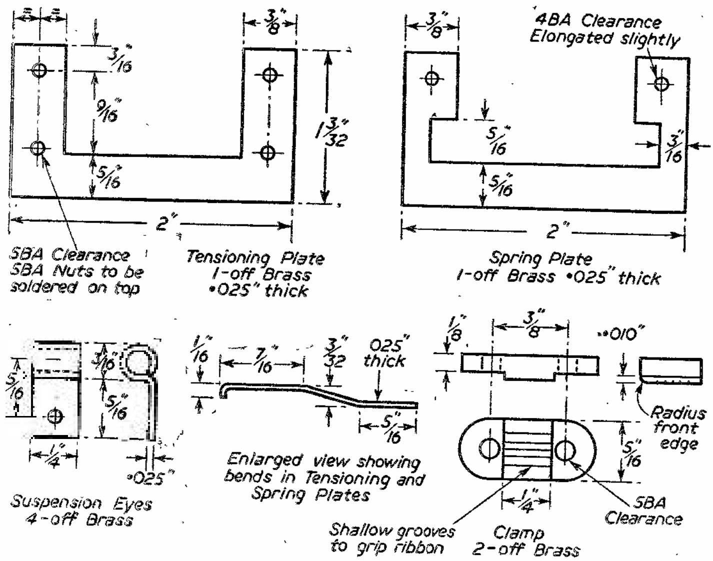


Fig. 3.—The tensioning and spring plates.

of the blocks. Twist them if necessary until they are. Put in the two 5BA screws in the tensioning plate and screw down until they just touch the top of the block.

Fix on pole-pieces, using *brass* screws, and make sure that everything is central, in line and fitting properly. The tensioning and spring plates should be 1/32in. clear of the ends of the pole-pieces. Remove the pole-pieces.

Fitting the Ribbon

Cut off about 12in. of foil and paper from a large fixed condenser and steep in hot water until the foil and paper separate easily.

Measure the thickness of the foil to make sure it is thin enough. Its thickness should be a quarter of a thou. (.00025in.), or less. To measure this size fold a piece of foil until four layers are obtained which should measure .001in. in a micrometer.

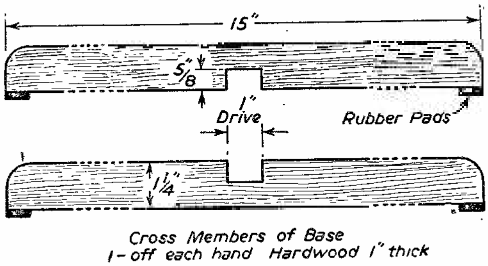


Fig. 5.—Further details of the stand.

Lay a length of the foil on a clean, medium thick magazine and carefully clean off any remaining grease with a soft rag dipped in petrol or other solvent. Clean both sides.

With a steel 12in. rule laid along the foil make a cut with a razor blade running ½in. from one end to the other. Move the rule back 3/16in. and cut the ribbon this width. Begin the cut ½in. from one end. This prevents the foil from wrinkling. Lay the ribbon aside until needed.

It is advisable to fit the ribbon where the magnet has little chance of picking up steel dust or filings.

Clamp the magnet, face upwards, in a small vice so that there is a clear drop from the top face of each insulating block and laying a spirit level across the magnet, adjust until it is horizontal.

Screw in the adjusting screws in the tensioning plate a quarter of a turn so that the plate just rises and put a dab of gum on the blocks between the tapped holes for the small brass clamps, and leave it to become tacky.

The ribbon may now be put on.

Fold over the ribbon for ½in. from each end and attach a crocodile clip over each folded portion.

Lift both clips with the ribbon hanging between and lay the ribbon along the centre line from tensioning plate to spring plate and allow the crocodile clips to hang freely.

Adjust the ribbon until it is exactly central between the holes for the clamps and when certain that it is lying without any twist or uneveness, press it against the tacky gum.

Put the clamp on the bottom block and tighten down the screws alternately until the ribbon is firmly held.

Put the clamp on the top block but, before tightening the screws, screw back the tensioning screws so that the ribbon will be released from strain. Now tighten down the clamp and cut off the excess ribbon.

Clean the pole-pieces very carefully to make sure that there are no steel filings sticking to them.

Lay one on the magnet and slide inwards until the tip is 1/16in. from the ribbon. Put in the two outside screws and bind lightly, then the two inside screws but leave them loose. Do the same with the other pole-piece, taking great care, for it will tend to jump across and destroy the ribbon.

Remove the microphone from the vice and with a small brass bar, holding the microphone up to the light, tap the outside edge of a pole-piece until the tip is about .005in. from the ribbon. Do not attempt to make this gap any smaller. If the tip does go too close grip the projecting edge of the pole-piece with pliers and draw it back. The pole-pieces on the arrangement drawing, Fig. 6, are shown flush with the outside of the magnet, but if they have been made as in the detail drawing they will stand out for this purpose.

When both pole-pieces are set and firmly screwed down, paint a coating of nail varnish across the ribbon where it crosses over the tensioning and spring plates. This anchors the ribbon to the plates. Leave to dry then put on another coating.

When the second coating is dry lay the microphone on its back and, with a 2-volt cell and small flash-lamp in series, send a current through the ribbon by touching a screw on the tensioning and spring plate with the connecting wires. If the ribbon goes down, reverse the connections. Now remove the small lamp and connect the cell straight across the ribbon. It will bulge upwards, grow warm, send off a little smoke and make scratchy sounds. Hold it thus for a few seconds then disconnect.

This treatment will even out any small wrinkles.

The microphone can now be left aside, face downwards on a flat surface.

The Line Transformer

The core of the line transformer should be about ⅝in. square and the primary winding, that is, the winding which carries the ribbon current, is two layers of 16 turns each, 20 or 22 s.w.g. enamelled copper wire. The secondary must be wound to suit the amplifier with which the microphone is to be used.

LIST OF COMPONENTS

MICROPHONE
1 permanent magnet, as specified. Item 1.
2 pieces mild steel, 3 1/8 x 1 x 3/32. Item 2.
2 pieces ebonite, 2 1/8 x 1 x ¾. Item 3.
2 pieces brass rod, 3½ x 3/16 dia. Item 4.
2 pieces brass sheet, 2 x 1 1/8 x .025. Items 5 & 6.
2 pieces brass bar, ¾ x 5/16 x 1/8. Item 7.
4 pieces brass strip, 1 x ¼ x .025. Item 8.

STAND
1 piece brass strip, 20 x ½ x 1/16.
1 piece Stubbs steel, 12 x 5/16 dia.
1 piece electric conduit, 40 x ¾ dia.
1 bush metal, 1 x ¾ dia.
1 flange metal, 1 x 2 dia.
2 pieces hardwood, 15 x 1¼ x 1.

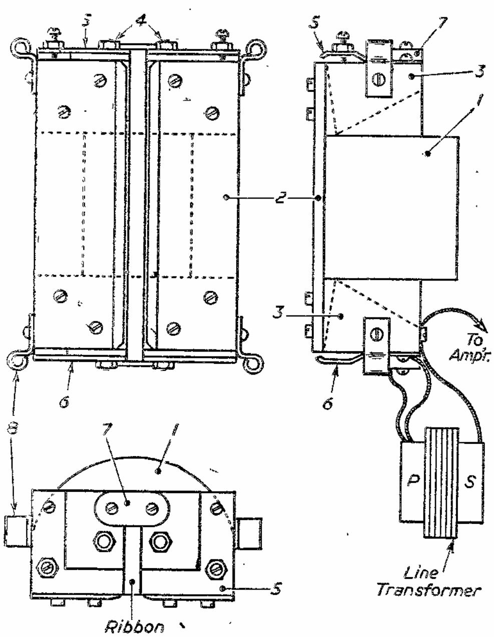


Fig. 6.—The arrangement of the pole pieces.

The line transformer used with the microphone described was a step-down transformer with a 5-ohm winding. Since this 5-ohm winding matched the input transformer of the amplifier, the high resistance winding was stripped off and the primary wound over the 5-ohm winding.

It would be more efficient to wind the primary next to the core, but the voltage output of the microphone proving to be more than ample, maximum efficiency was not required.

Some experiment with the line transformer is well worth while, but the core area and the primary winding as described give very satisfactory results.

Final Assembly

The side elevation, Fig. 6, shows how the line transformer is slung from the microphone.

Two 16 s.w.g. wires go from the secondary to the terminal screws.

Keep the leads to the primary as short as possible, about 1in. long. Solder one to the extreme rear of one side of the spring plate. The other is soldered to the end of one of the clamping bolts, Fig. 2, Item 4, which is used as the conductor from the tensioning plate. Solder a short 16 s.w.g. piece of wire from the extreme rear of one side of the tensioning plate to the top of the same clamping bolt.

Now mount the microphone in the frame, supporting it with thin, strong cord from the holes drilled in the frame to the small suspension eyes.

Ribbon Tensioning

Adjust the microphone to a suitable height and blow gently and directly on the ribbon. If it appears to tremble more freely on one side screw down the screw on the tensioning plate on that side. Only give the screw the merest fraction of a turn, otherwise the ribbon may break. This adjustment could be made less critical if the spring plate were made thinner and more springy, but it was found that when this was done undesirable resonance peaks appeared. Keep blowing gently on the ribbon and adjusting the tension until the ribbon trembles evenly.

Testing

Now connect up to the amplifier and test.

If the reproduction sounds tinny the ribbon is too slack.

Tighten up until a natural quality is obtained. The tension should be such that a very light breath on the ribbon causes it to tremble just perceptibly.

Dab a spot of nail varnish round the tensioning screws and nuts to lock them.

Since the ribbon microphone is susceptible to magnetic dust and to draughts, make a thin silk envelope and slip it over the frame and microphone, tying it below.

Remarks

There is no great difficulty in fitting the ribbon, but it calls for a light and sure touch.

Ribbons $\frac{1}{8}$in. and $\frac{1}{4}$in. were tried and also, somewhat thicker, but the ribbon 3/16in. wide and .00025in. thick proved superior to any other.

Book Review

THE first edition of "R.S.G.B. Amateur Radio Call Book" is now on sale at 3s. 6d. per copy (3s. 9d., post free) from the headquarters of the Society at New Ruskin House, Little Russell Street, London, W.C.1.

It contains up-to-date names and addresses of some 6,000 licensed amateur transmitting stations in the British Isles and Irish Republic and it is believed to be as accurate a record of amateur activity in these isles as has yet been produced. Copies may be obtained in the Irish Republic from the honorary secretary of the Irish Radio Transmitters' Society, Captain A. C. Woods, 17, Butterfield Crescent, Rathfarnham, Dublin. If a call sign does not appear in the book the licensee should notify the Call Book Editor direct and non-members of the society are asked to advise the Call Book Editor of any changes of address. Members of the R.S.G.B., when changing their address, need only advise the general secretary in the ordinary way, but should ensure that their full call sign is shown. The address of the Call Book Editor is: Mr. J. P. P. Tyndall, G2QI, 174, The Drive, Ilford, Essex.

Alkaline Dry Cell Battery

A NEW COMPACT ELECTRICAL DRY BATTERY FOR PORTABLE DEVICES

By "Technicus"

THE field of small engineering and electrical patents is strewn down the years with ideas which have not been developed, either because they did not fit into the existing scheme of things, there was no means of economical production or perhaps they proved too great a tax on the imagination of the day. Thus have many excellent ideas laid fallow, to find themselves suddenly developed and exploited on a world-wide scale as though they were a creation of the hour.

The use of mercuric oxide as the positive element is not new, for several Germans suggested it in patents 25 years or more ago. It took, however, a Second World War with its multiplicity of small, portable electrical devices to show how useful was this original German idea. But to describe the matter in that way may be misleading, for in the interval between the original idea and the mass production of the Ruben cell great strides had been made in methods of manufacturing alkaline dry batteries. One essential requirement of the recent war was that the production of any electronic idea had to be on a massive scale or not at all. The battery people in the United States had accumulated some experience in dealing with large numbers, so that they were capable of coping with requirements.

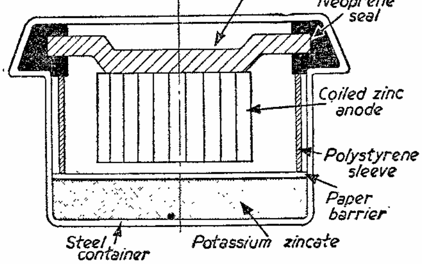


Fig. 1.—Rolled zinc anode.

The Principle

The anode of the Ruben cell can be either a roll of zinc or zinc powder. The electrolyte is a solution of potassium zincate in caustic potash, while the depolarising cathode material is the mercury oxide referred to above. This is mixed with graphite powder, which provides the required conductivity for the oxide. A feature is the use of a polystyrene sleeve to insulate the anode from the steel outer container, which is chemically resistant cold rolled metal. The barrier consists of a specially treated paper that resists attack by the alkali, enabling a wet depolarising surface to be maintained without permitting the passage of depolariser to the anode.

The above description covers the general chemical aspects, but no less important is the method of putting together the various components. Originally, a rolled zinc anode was preferred, this being made up of a spirally wound corrugated strip of zinc about two thousandths of an inch thick, interwoven with special paper. But this design of anode is now replaced by a pressed powder, made up of zinc which is pelleted after the powder particles are amalgamated.

The two arrangements are shown in Figs. 1 and 2, from which it will be seen that the powder pattern enables a flat cell to be made, an obvious advantage with certain portable electrical devices. A zinc disc on the top constitutes the external negative terminal of the battery, while sealing of both the rolled zinc or pressed powder anode types is done with neoprene, which introduces the second of modern synthetic materials to the dry battery.

Performance

High efficiency is obviously desirable in a dry cell used in, for example, a portable radio set, both to save weight and to maintain electronic efficiency. The Ruben cell is claimed to utilise 80-90 per cent. of its constituents, and yield about five times the service of the conventional dry cell. With an open circuit voltage of 1.34, and closed circuit value of between 1.24 and 1.31 volts, the discharge curve is sensibly flat, as shown in Fig. 3, where its performance is compared with a conventional dry cell. This flat curve is a valuable feature and means, obviously, that an optimum working efficiency is maintained over longer periods with electronic equipment.

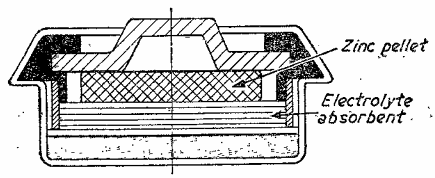


Fig. 2.—Pressed powder anode.

One of the essential requirements of a dry battery is that it stores well. Without this property a battery is of little value, for to maintain supplies to users in war-time the manufacturer must work a year or two ahead of demand, which may fluctuate violently. A shelf life of at least two years is desirable, although in peace-time this may not be necessary. Fig. 4 illustrates how this new alkaline dry cell behaves in comparison with an ordinary

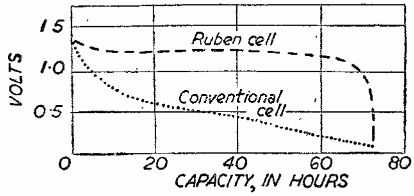


Fig. 3.—Discharge curve of Ruben cell compared with that of conventional cell.

cell, from which it is evident that it marks a distinct improvement in battery design.

The operating characteristics of the Ruben cell

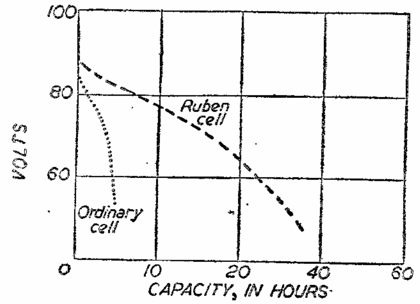


Fig. 4—Capacities of Ruben cell compared with ordinary cell after 18 months' storage.

have been evaluated thoroughly and it may be said to be a commercial proposition; despite its higher cost of manufacture compared with the conventional dry cell. There appear to be no obvious disadvantages, and on technical grounds one can expect steady progress. It is to be remarked that much of the development work, prior to its full-scale production for the American armed forces during the recent war, was telescoped from years to months, in which the possibilities of intense electro-chemical research was graphically demonstrated.

Uses for the Cell

One of the obvious uses for the new alkaline cell is in deaf aids, where compactness and high capacity is essential. Here the pressed powder anode type, with its flat form, would be handy. Since the war there has been a world-wide growth in the use of portable radio, not only by Service personnel but by the public. For this compactness, long life and a flat discharge curve are highly desirable. New ideas continue to come on to the market, such as miniature flashlights or torches, for which an alkaline cell of the Ruben type is well suited. Altogether one might say that the demand for lighter, higher capacity cells is growing, spelling the expansion of such batteries as this.

L.S. Crystal Valve Receiver

AN EXPERIMENTAL SET USING GERMANIUM TRIODES

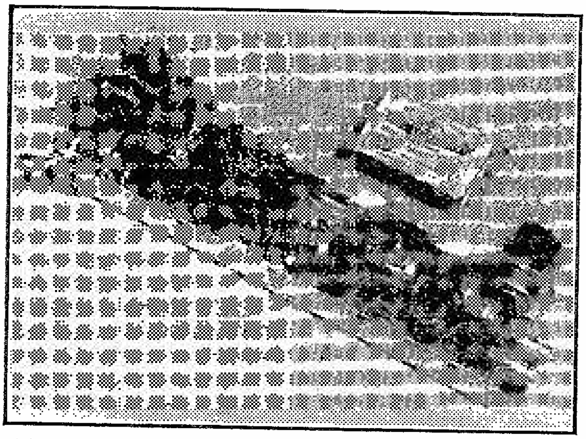


Fig. 1.—The G.E.C. experimental crystal valve midget receiver. Comparison with the matchbox gives a good idea of its size.

As an illustration of the capabilities and possible future applications of the germanium triode, the G.E.C. has built a simple experimental radio receiver which gives acceptable loudspeaker output using germanium triodes instead of the usual thermionic valves.

Germanium triodes, as most readers know, are descendants of the crystal detectors used in the early days of radio, and have the same essential feature of a metallic crystal to which contact is made by means of points. The early crystal detectors were very unstable and erratic and have been completely superseded by the development of germanium crystal diodes, which the G.E.C. produces for television receivers, modern crystal receivers and other technical applications.

Experimental work in connection with these diodes has led to the development of the G.E.C. germanium triode and it is now possible to design a radio receiver which is stable, capable of withstanding severe mechanical shock and at the same time able to produce loudspeaker output with a low power consumption.

Experimental Only

Three points must, however, be borne in mind in connection with the present receiver: (1) it is only experimental and the industrial production of such a set is unlikely for some time; (2) although no filament heating power is required for the set, it is not independent of electrical supplies and it still needs an H.T. battery (or an equivalent mains unit, which may utilise germanium diodes as rectifiers); (3) the crystal triode is not likely to replace the existing thermionic valves of an ordinary radio receiver at present. Nevertheless, the germanium triode is an important development in the field of electronics and it seems likely that the first applications will include electronic computing machines and lightweight radio sets.

To the question "What is the advantage of a crystal triode if an H.T. battery is still necessary?" there is a fourfold answer: there is no filament or cathode to be heated; the unit is extremely robust; it is very compact and also very long-lived. Filament or cathode heating may not seem of great

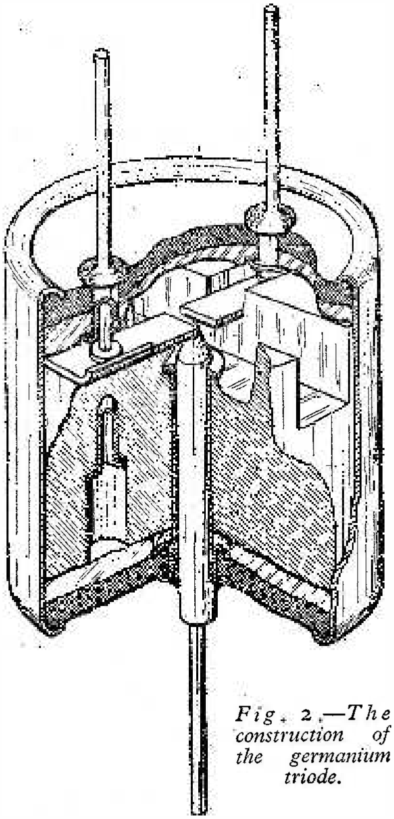


Fig. 2.—The construction of the germanium triode.

importance to the layman, but in some receivers—for instance, portables—the necessary equipment for it can add appreciably to the weight of the set. In apparatus where thousands of valves are employed, e.g. computing machines, the amount of power required for filament heating and the corresponding amount of useless heat developed may be very substantial.

A battery is necessary in an "all-crystal" receiver because it is impossible (at least, in the realm of science) to obtain "something for nothing." If power, in the form of a large volume of sound, is to be obtained from the loudspeaker, at least an equal amount of power must be supplied to the apparatus. In practice more must always be supplied on account of internal losses, but this wastage, because there is no filament to heat, is relatively low.

Technical Notes

The experimental receiver (see Fig. 1) is of comparatively simple design and uses a two-circuit tuner to obtain reasonable selectivity and five G.E.C. germanium triodes in the R.F. amplifying, detector and push-pull A.F. output stages, which results in a receiver of sensitivity suitable for local station reception and an audio output of about 50 milliwatts. A more sensitive and selective receiver can of course be made by using more germanium triodes, for example in a superheterodyne circuit, where a germanium triode oscillator would be employed.

The total power consumption of the present receiver is about 10 mA. at 50 volts, from which it will be seen that about 10 per cent. of the total power input is utilised as loudspeaker output.

The design of the germanium triode is illustrated in Fig. 2 and is of a form which can be manufactured relatively easily. It consists of two phosphor-bronze blades 0.003in. thick and 0.04in. wide, supported in a moulded insulator. The gap between the blades is very critical, and is obtained by means of a manufacturing technique which involves mounting a single strip across a channel in the moulding and subsequently shearing a gap a few thousandths of an inch wide with a specially designed cutter. The germanium is soldered to the tip of a metal stub and is ground to a point, with an angle of 60 deg. Then by inserting the apex of the resulting cone into the gap between the blades, the essential two-point contact is made with the germanium and with a spacing which can be very accurately controlled. The three electrodes are then the two blades and the stub.

In simple terms, the electrical operation of the triode depends on the fact that if a negative potential is applied to one of the blades (called the "collector") then the current to it can be varied by altering the positive voltage applied to the other blade (called the "emitter"). See Fig. 3. The "emitter" draws appreciable current when positive voltages are applied to it, in contrast to the thermionic valve, in which grid *voltage* is the important factor controlling the anode current. In the germanium triode the "emitter" *current* controls the "collector" current, i.e. it is a current-operated device rather than a voltage-operated.

The characteristics of the germanium triode result in a device of low input impedance (of the order of 500 ohms) and of relatively high output impedance (of the order of 30,000 ohms), and of course the associated circuits have to be designed with this in mind.

For an amplifier, a typical operating condition would be: collector, 1.5 mA. at —30 volts; emitter, 0.5 mA. at $+\frac{1}{4}$ volt, and with proper impedance matching such an amplifier stage will give a power gain of 20-30 dB.

Due to the limited safe collector current, the power output of a single germanium triode of the present design is about 20 milliwatts, for a tolerable degree of distortion. Oscillators, however, may be made with outputs up to about 100 milliwatts. There is an inherent upper frequency limit for operating the germanium triode, which arises from transit time effects in the germanium. At present this limit is about 10 Mc/s.

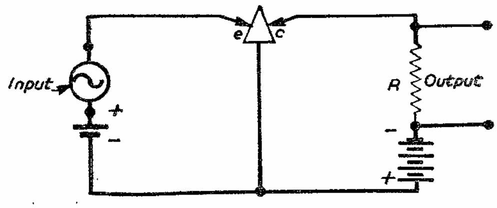


Fig. 3.—A triode amplifier circuit.

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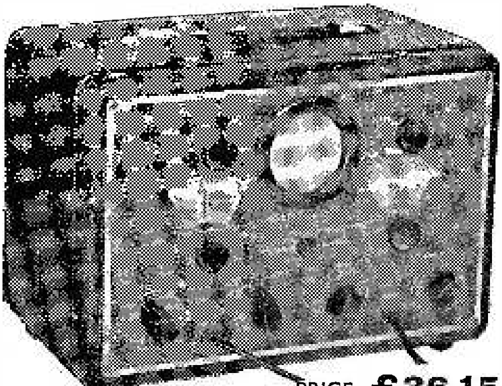
MODEL 260A TELEVISION WOBBULATOR · MODEL 260

MODEL 260A



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★ **THE "SUMMER ALLDRY" BATTERY PORTABLE,** as published in the June issue of "Practical Wireless." We can supply from stock all of the Components to build this Midget 3-Valve Receiver. A reprint of the complete article and circuits, including Practical Layout and Component Price List is available for **1/-.**

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D.C. Supplies—2

THE A.C. VERSION OF THE SUPPLY PANEL

By W. Nimmons

LAST month details were given of the D.C. version, and it is now proposed to describe the A.C. arrangement of H.T. eliminator and battery charger. For those new to the mains (though skilled in the construction of battery receivers), this should be excellent practice.

The A.C. version differs from the D.C. in several important particulars. In the first place, while there is a "through" circuit from mains to receiver in the D.C. arrangement this is not the case in the A.C. version. Instead we have a transformer which, in a sense, isolates the mains from the rest of the apparatus. Then there is a rectifier, which is unnecessary in the D.C. version and, there is an absence of moving parts—the rotary transformer, which is essential with D.C. if the voltage is to be stepped down and the current stepped up.

In actual fact there are two transformers and two rectifiers, one for H.T. and one for charging purposes. Fig. 1 shows the theoretical circuit which, after the transformers and rectifiers, is very similar to the D.C. arrangement. The same method of selecting the appropriate current ratings is used, the resistors being slightly different.

The mains transformers, H.T. and L.T., can be made at home, using an old transformer or choke for the core, if this is of substantial proportions. Otherwise No. 4 stampings can be used; these will provide $1\frac{1}{2}$ sq. in. winding area, and should be large enough.

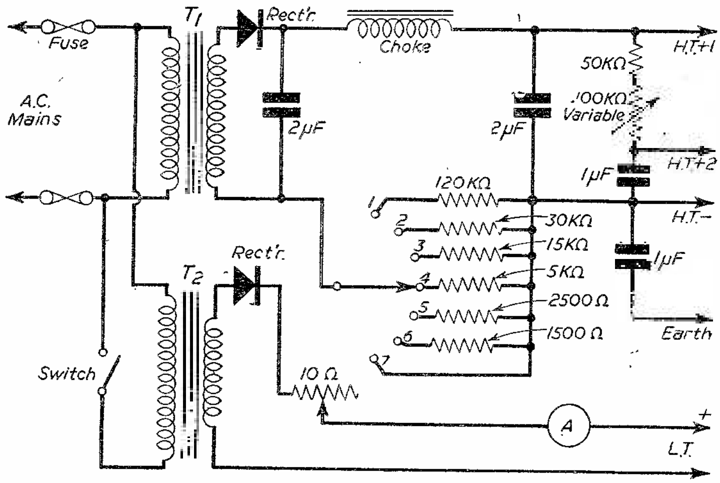


Fig. 1.—Circuit of A.C. eliminator.

Wind 1,800 turns of No. 30 gauge enamelled wire for the primary. Insulate with two or three layers of tape. Then wind the secondary, which in the case of the H.T. transformer will consist of the same number of turns of the same gauge wire, and in the case of the L.T. transformer 100 turns of No. 20 gauge D.C.C. wire. This will provide approximately the same output as the rotary transformer used in the D.C. version, i.e., 14 volts on no load, dropping to around 6 or 7 volts at the maximum current of 4 or 5 amperes, with an average of 10 volts at 2 amperes, which is ample for most wireless accumulators. The excess voltage is, of course, dissipated in the rheostat.

If the constructor does not wish to go to the trouble of winding his own transformers he can use a commercial transformer with an output of 250-0-250v. In this case, as we are using half-wave rectification, only one half of the secondary will be used. There will, in addition, probably be an L.T. secondary which can be utilised to charge the accumulator. In this case only one transformer is required, the L.T. secondary of this taking the place of the L.T. secondary of T_2 of Fig. 1. The only difficulty with this arrangement is that if the voltage is low to begin with there will not be much in reserve, after rectification. This could be overcome by removing the old winding and putting in one with double the turns with wire a gauge smaller; or, if there is more than one L.T. winding, by connecting them in series. For example, if the specification shows two L.T. windings of, say, 6.3v. 2-3a. and 4v. 2a., by connecting these in series we should obtain over 10 volts, which should be ample to overcome rectifier resistance.

Rectifier

Selenium rectifiers are employed, which have smaller physical proportions than rectifiers of the old oxide-coated type. If the mains transformer (H.T.) is made as directed, or one giving 250 volts is employed, there should be around 200 volts after rectification. This is further dropped to a value suitable for any type of battery set by the network of resistors numbered 1 to 6, ranging from 120,000 ohms to 1,500 ohms. These are selected by a flying lead on the panel, as shown in Fig. 2. The highest resistance gives the smallest voltage and current, and is suitable for operating a single detector valve, while the lowest resistance will operate a large multi-valve set.

Note that there are seven sockets in the case of the A.C. version, as against six in the D.C. The extra socket arises because, as will be seen from Fig. 1, the end socket has no resistance connected; this enables the full voltage of the transformer secondary to be carried forward, and should only be used when operating a large receiver. The current then drawn will bring down the voltage to a value suitable for a battery receiver—say, to around 150 volts.

This could not be done in the D.C. version without grave risk to the life of the valves because the mains would sustain a constant voltage quite independent of the current drawn. Thus the valves would be receiving the full mains voltage, whereas their maximum voltage is 150. In the D.C. version, therefore, the lowest resistance is 2,300 ohms, which with a current of 30 milliamps flowing would cause a voltage drop of around 70 volts, which brings the mains voltage down to 150.

Fig. 1 shows also a choke and two 2-μF condensers as a smoothing system. The choke should be of really adequate inductance, if complete smoothing is to be obtained, 40 henries being the minimum. If desired, the 2-μF paper condensers may be replaced by 8-μF electrolytic condensers if hum persists, taking care to connect them the right way round. Two separate condensers must be used, the type having two condensers in the one pack, with the common negative terminal, being unsuitable. If such were used it would short-circuit the resistor network and render it inoperative; this would mean that the arrangement could only be used with the large type of receiver.

It should be made clear that the L.T. arrangements for charging are in no sense a trickle charger, but is capable of giving a full charge to any normal wireless accumulator. A trickle charger operates on the low amperage of from $\frac{1}{4}$ to $\frac{1}{2}$ ampere, and must be kept running more or less continuously. With this arrangement, however, it is intended that the cell should be charged up properly at the requisite intervals. This avoids the hum which sometimes occurs with a trickle charger.

It may be opportune at this place to indicate the right and the wrong way to switch on and off, in case some readers may be using a mains unit for the first time. The invariable rule is: Switch on the set *first*, and switch off the set *last*. If the mains unit is switched on first, with the valve filaments cold, then the full voltage of the mains will appear at the mains unit terminals, and consequently at the anode circuits of the valves. During the time the valves are heating up, if they are switched on after the mains, the filaments will be subjected to an excessive voltage strain which will damage them. When, however, the filaments are fully alight before any H.T. voltage appears at their anodes the cushioning effect of the condensers and choke prevents any voltage surge as far as the anode current is concerned.

This will apply even with the greatest resistance in circuit, since when there is no current being drawn the resistance behaves as if it were non-existent. The effect of switching on the mains before the set can be seen in a dark room as a momentary blue glow in the valves when their filaments are lighted, indicating that they are being overrun while warming up. This is particularly the case with D.C. mains.

The value of the tappings as an aid to trouble-free reception was well illustrated by the case of a short-wave converter being run off a conventional eliminator. The dial was rife with parasitic oscillation which all but drowned the signals. It was discovered that the eliminator had a resistance of 5,000 ohms. As the triode-hexode valve of the converter consumed only 2 milliamps, this caused a voltage drop of 10 volts only. Thus the valve was being supplied with a voltage in excess of 200.

As regards safety precautions, the rule is to switch off at the mains when making any adjustments to the apparatus. This applies equally well to the set as to the mains unit. An experienced operator can work at the receiver with the mains on but the inexperienced should switch off. The earth connection should be made to the earth provided on the mains unit, and *not* to the earth terminal on the receiver.

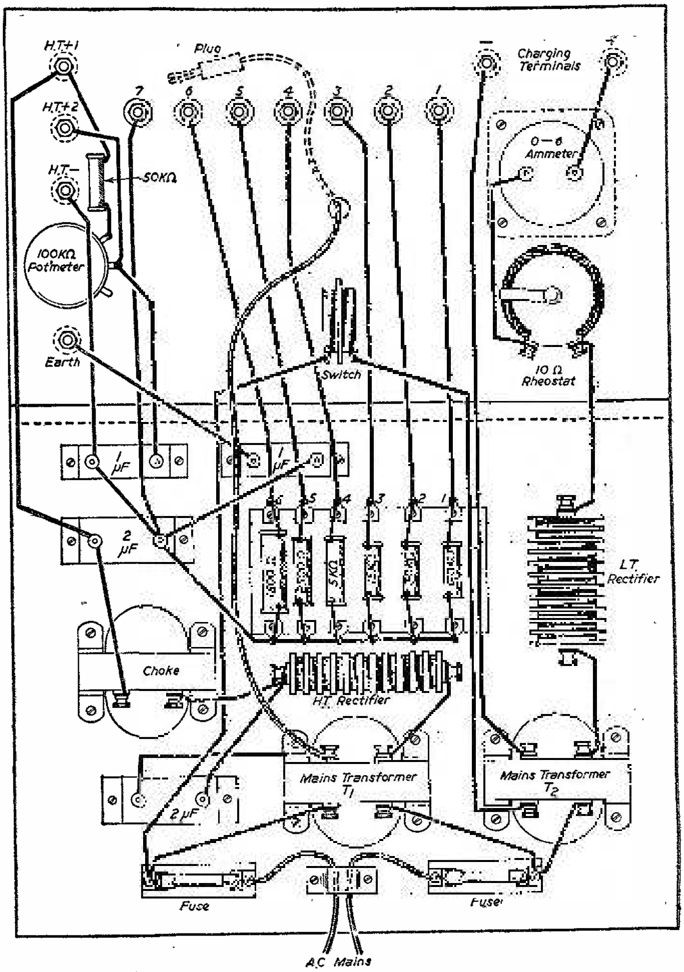


Fig. 2.—Wiring plan of the circuit shown in Fig. 1.

For the Transmitter

Clamp Modulation

BRIEF DETAILS OF THE PRINCIPLES OF THIS INCREASINGLY POPULAR ARRANGEMENT

By Wm. A. Hope

LIKE super-modulation, clamp modulation bears certain advantages over the usual amplitude modulation systems, as applied to amateur telecommunication. Briefly, these advantages are:

A. Simplicity of circuit.
B. No costly modulation transformers.
C. About 90 per cent. modulation of transmitter carrier; and
D. Moderate constructional costs.

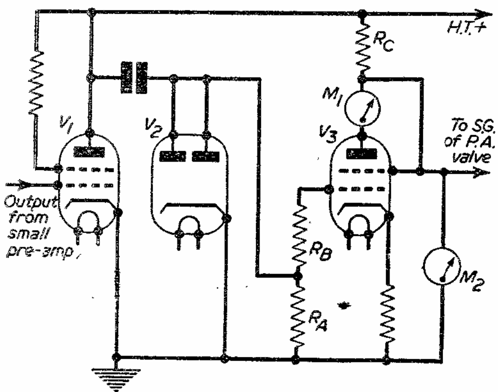


Fig. 1.—Basic circuit for clamp modulator.

Clamp Modulation Theory

Fig. 1 shows the basic "clamp modulator" where the output from a small microphone pre-amplifier is fed into the control grid of V1, and is thus amplified. V2, a double-diode, supplies a negative voltage to the control grid of valve V3, which can be either a tetrode or a pentode. From Fig. 1 it will be seen that the screen grid of the "final" is connected in parallel with the screen grid of V3, thus any variation in the H.T. potential on the screen grid electrode of V3 will also appear on the "final" screen grid.

When the microphone pre-amplifier is switched off there is a fixed bias potential on the control grid of V3. This is determined by the value of the resistors R_A and R_B, which will enable V3 to draw a fairly big current as indicated by meter M1. This large current causes a large potential difference to exist across the resistor R_C, thus showing a decrease in the voltage reading on M2. When this potential drop occurs, the valve, V3, is under-run and the input power to the "final" is reduced.

With the pre-amplifier switched on, V2, the D.C. restorer, supplies a further negative potential to the standing potential on the control grid of V3. Thus the valve is driven towards its "cut-off" point and there is a decrease in anode current. As the anode current is small, the drop in potential across resistor R_C is not as great as before and the input power to the "final" is increased. That is, briefly, the principle of the "Clamp" system.

Recommended Circuit

Fig. 2 shows a recommended circuit for such a modulator. The valve heaters should be allowed to warm up, while the cathode bias resistor should be switched into circuit by means of switch S1. H.T. can now be supplied to the modulator. The bias resistor, in the cathode circuit of V3, should be adjusted until the reading on the voltmeter corresponds to the maximum permissible screen grid potential for the valve in question. When this is the case, the transmitter proper can be used for C.W. transmission by means of a relay in the cathode circuit of the P.A. valve. By switching out the cathode bias resistor the potential on the screen grid of the P.A. valve will drop, thus enabling the operator to use "phone."

On speaking into the mike, the potential on the screen grid of the valve, V3, will fluctuate and the modulator gain control should be adjusted until the voltmeter reads the correct screen potential.

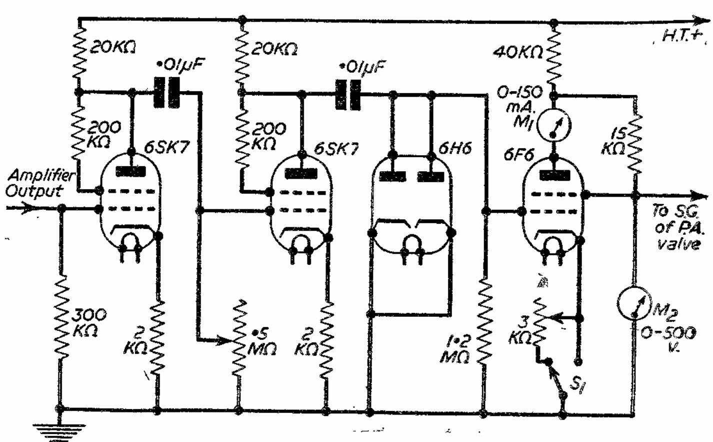
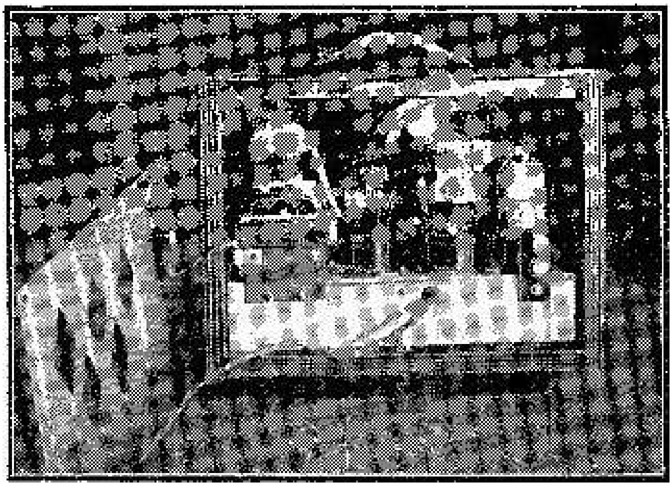


Fig. 2.—Suggested clamp modulator circuit.

The A.C. I

AN EFFICIENT TRA

By Eric



A rear view of the set, showing the compact arrangement of the components.

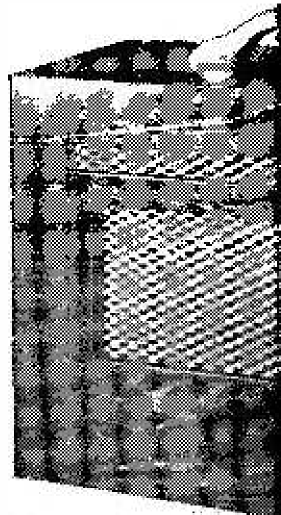
THIS receiver was designed for use in a bedroom for occasional listening to the Home (434 m.) and Light (1,500 m.) programmes. A third station, in the writer's case Hilversum (402), was also provided. The present trend to have a subsidiary receiver such as this is rapidly becoming popular and it was built, unlike most midget receivers, at extremely low cost. The valves and nearly all of the parts were obtained from Government surplus stores, the total cost being less than £3.

Circuit

This is a simple, but efficient, straight arrangement, using a high-gain pentode (SP41) as a leaky-grid detector. Reaction is provided by a small 100 pF condenser. It was found with the coil used that an extra fixed reaction condenser had to be switched in parallel for long-wave reception.

The audio amplifier chosen is a general-purpose triode (MH4), as the anode current available is low. Extra gain is obtained by giving the valve a smaller bias value than is usual. This did not, however, affect the reproduction noticeably.

The rectifier is a small diode detector valve (D41). This worked very well, supplying the 20 mA. or so required without difficulty. It was fed from a 5 volt winding on the mains transformer, a 1 ohm series resistor being



The attractive appearance of the finished receiver.

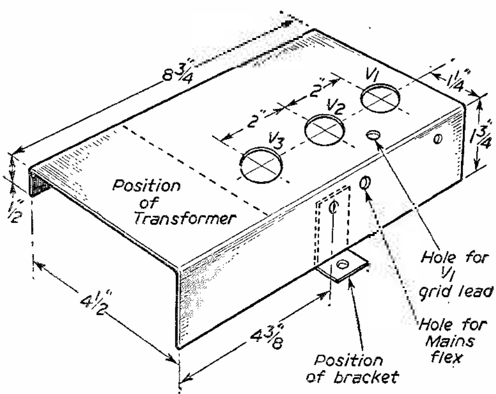


Fig. 2.—Chassis construction showing measurements and drilling details.

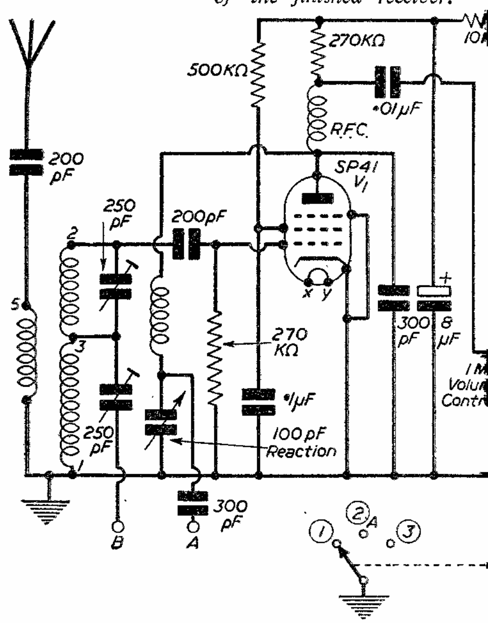


Fig. 1.—Circuit of

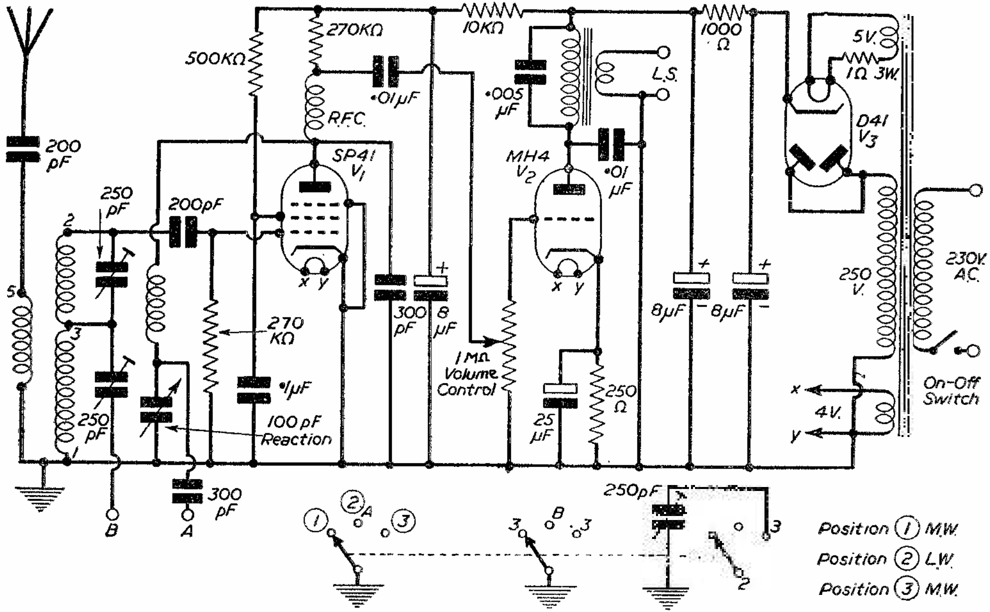


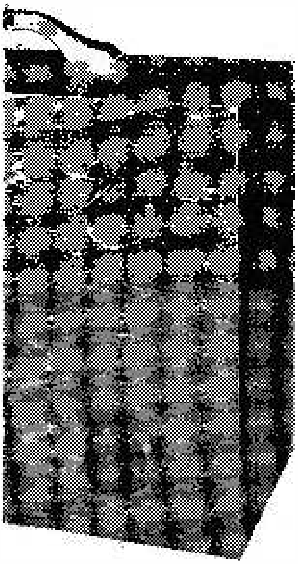
Fig. 1.—Circuit of the A.C. Preset Two.

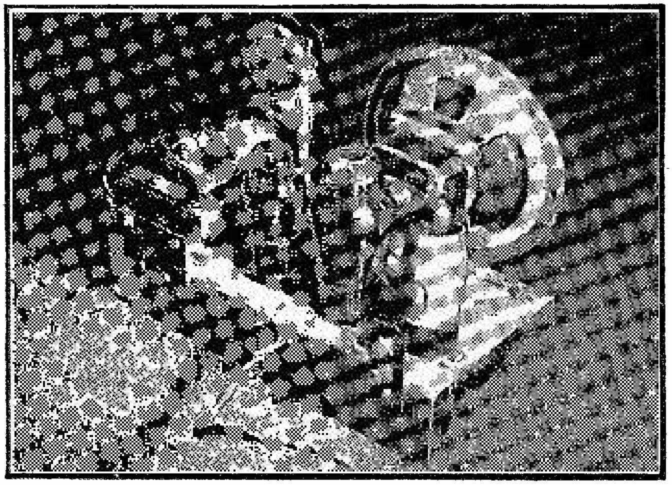
›reset Two

SPORTABLE RECEIVER

.Larnarch

included to drop the extra volt. An extra 4 volt winding obviates the use of this resistor.





Three-quarter view of the receiver ready for insertion in the cabinet.

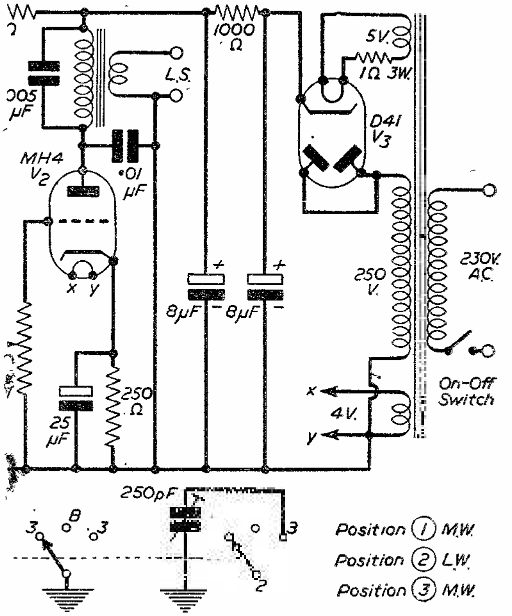
The .005 μF condenser across the output transformer secondary and .01 μF by-passing anode to earth were found, together, to give the tone required in the prototype. One of them may, of course, be omitted to give more treble.

Chassis and Construction

The chassis was bent from a piece of 16 s.w.g. aluminium (6¾in. x 8¾in.) as shown in Fig. 2.

Small brackets made from aluminium were used to support the volume control, station switch and variable condenser (Fig. 3). The valve and spindle holes were cut out with a fretsaw.

The positioning of the fixed condensers, etc., under the chassis is left to the reader, there being plenty of space to suit varying sizes of components. The coil former, however, originally about 3in. long, was cut down by the writer so that it could be mounted upright underneath. A piece of screwed rod together with a large washer was used to keep it in position. The trimmer condensers should be mounted rigidly. Grommets were fitted where wires pass through the chassis and a bracket was fixed to the rear of the chassis to hold the receiver in the cabinet. The on-off toggle switch was mounted on the back of the completed receiver—this was fitted with a small length of flex as shown in the photograph. A small paxalin strip (1in. x 2in.)



ʼhe A.C. Preset Two.

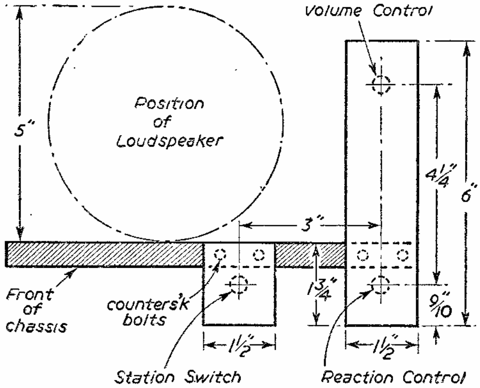


Fig. 3.—Details of the brackets.

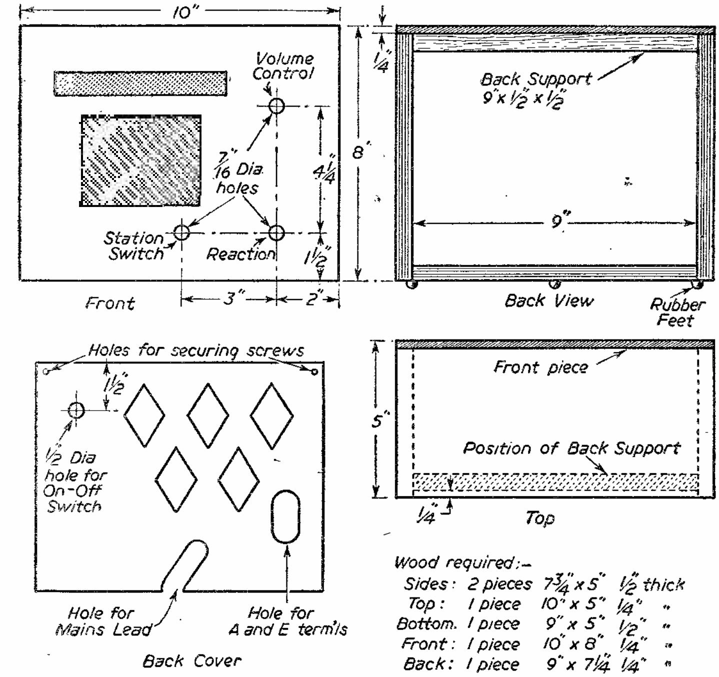


Fig. 4.—Constructional details of the cabinet.

was used for aerial and earth connections, being fitted with terminals.

Alignment

The aerial (preferably an outdoor one, but this is not essential) and earth are connected to the receiver and the switch is turned to position 1, the reaction being at maximum and volume about half-way. As the associated trimmer is unscrewed, stations will be heard (probably as whistles—if so, the reaction control will need turning down a little). A station is selected and the switch turned to position 2. The Light programme (1,500 m.) will be found when the trimmer is practically fully screwed up. Position 3 should give the Home service (434 m.), the capacity needed depending on the station chosen for position 1. Other stations may of course be substituted for these by altering the trimmer condensers to the values required. The range is approximately:

Position 1: 250-450 m.
,, 2: 1,000-1,600 m.
,, 3: 300-500 m. (depending on the setting of 1).

When listening the reaction should be turned down as much as possible and the volume turned up.

Cabinet

The cabinet was constructed from ½in. and ¼in. plywood. The component parts can be seen in Fig. 4. These were glued and fastened by means of small panel pins. A fretsaw was used to cut out the holes in the front before it was fixed on. The speaker fret may, of course, be cut to any size or design. The edges of the cabinet should be sand-papered thoroughly with a medium-grade sandpaper and finally the wood should be carefully smoothed by rubbing a fine-grade paper in the direction of the grain.

The grille was gold-painted aluminium which is fitted to many modern commercial receivers and is fairly easy to obtain. This contrasted well against the wood, which was oak-stained and then French polished. It was found necessary to put a piece of black material behind the grille to prevent light from the valves shining through to the front. A light brown plastic carrying handle was fitted as can be seen from the photograph.

The back, fretted as shown in Fig. 4, was painted with blackboard paint; alternatively it may be stained. It was fixed in position by two small wood screws.

Three small rubber feet, two in front and one behind, were fitted to the completed cabinet, the back one being secured by the screw which holds the chassis in position.

It was found that the cabinet improved the bass response of the set immensely.

LIST OF COMPONENTS

Small 100 pF variable condenser.
3 x 250 pF trimmer type condensers.

FIXED CONDENSERS:
2 x 300 pF (mica).
2 x 200 pF (mica).
.005 μF (350 v. paper).
2 x .01 μF (350 v. paper).
0.1 μF (350 v. paper).
3 x 8 μF (electrolytics).
25 μF (25 v. electrolytic).

FIXED RESISTORS:
500 kΩ (½ watt).
270 kΩ (½ watt).

Fixed Resistors: (Continued)
240 kΩ (½ watt).
10 kΩ (½ watt).
250 Ω (½ watt).
1,000 Ω (1 watt).
1 Ω (3 watts).
1 megohm volume control.
Small R.F. choke.
M. and L.W. coil (Weymouth C.T.W.2).
L.S.—5in. Celestion, with transformer.
Small mains transformer (250 v.—30 mA. 4 v.—2A, 5 v.—1A.).
Mains toggle switch.
3-pole 3-way wafer type switch.
Valves—SP41, MH4, D41.

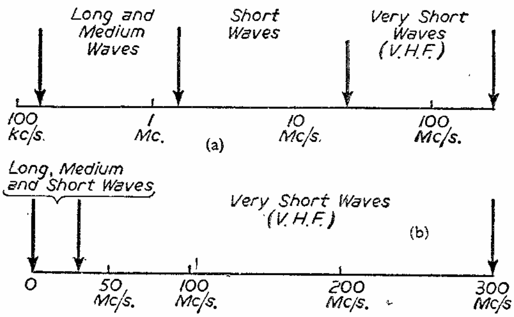
Radio Receiver Design at V.H.F.—1

INCREASED ETHER SPACE : OPTICAL RANGE : DIELECTRIC LOSSES

By G. P. Lowther

V.H.F. (very high frequencies) is used to designate the band of radio waves between 30 and 300 megacycles (10 and 1 m.).

The first question that may well be asked is, of what use are these frequencies when satisfactory service is already obtained from the long-, medium- and short-wave broadcast stations at present in use ? The answer is that, while it is true that many services will operate satisfactorily on these lower frequencies, there are other types of transmission that cannot be conveniently adapted to frequencies below about 40 mc/s or 50 mc/s. Also, the popularity of these lower frequencies has resulted in gross overcrowding of the ether.



Figs. 1 (a) and (b).—Illustrating the increased ether space.

Increased Ether Space

Fig. 1a, drawn on a logarithmic scale, as is frequently done, illustrates the increased ether space made available by extending the broadcasting range up to 300 mc/s, but does not give a true picture of the vastly greater number of transmissions that can be allocated to the V.H.F. In Fig. 1b the same frequency spectrum is drawn on a linear scale and it will be seen that if 9 kc/s were allocated to each channel, some 30,000 additional broadcast channels would be made available.

In actual practice it is found more useful to use the large band-widths available at V.H.F. to accommodate wide-band transmissions rather than narrow-band broadcast services which can be radiated at lower frequencies. Examples of such wide-band transmissions are: (a) television, the modulation frequency of which covers about 2.5 mc/s, which means that 5 mc/s are required for double side-band A.M. transmission and several times this band-width if frequency modulation is employed. Colour television also demands a considerably greater band-width than that at present used. (b) Radar, which operates on various carrier frequencies and also necessitates a band-width of several mc/s. (c) Commercial broadcasts employing frequency modulation (as in the U.S.A.) demand a band-width of some 75 kc/s, which clearly could not be allowed to encroach upon the lower frequency bands.

Since amateur transmitting frequencies extend up to 10,500 mc/s and include 28 mc/s-30 mc/s, 144 mc/s-146 mc/s, and 420 mc/s-460 mc/s bands, and television is being steadily extended, the technique of radio design at V.H.F. is of more than merely theoretical interest.

Transmitter Power

Due to the higher radiation resistance and aerial efficiency at these frequencies, the transmitter power required is lower than that with longer wavelengths. Thus the radiation resistance of a $\lambda/2$ dipole is about 72Ω in comparison with which the D.C. resistance is negligible. In the case of a long-wave aerial, the D.C. resistance is of far greater significance, e.g., the radiation resistance of the 16 kc/s Rugby transmitter$=0.055\Omega$ and the aerial efficiency$=11$ per cent. Over optical range, the field strength at V.H.F.,

$$E = \frac{88\sqrt{P}\, h_t\, h_r}{\lambda d^2} \text{ volts/metre}$$

where P=Transmitter power, in watts.
h_t=Height of transmitting aerial above the ground, in metres.

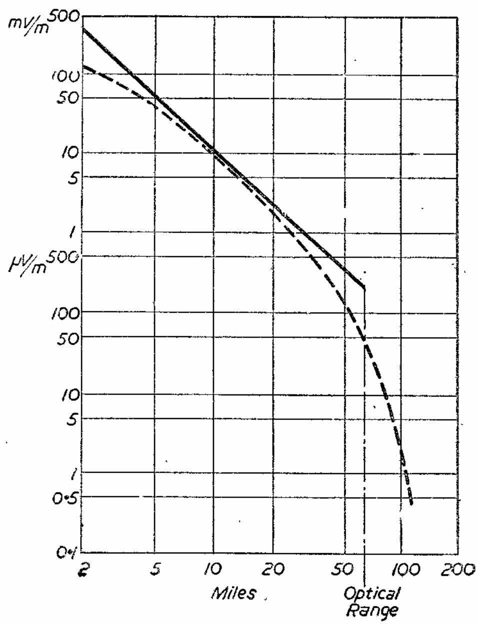


Fig. 2.—Graph showing field strength obtained.

h_r=Height of receiving aerial above the ground, in metres.

d=Distance between transmitting and receiving aerials, in metres.

λ=Wavelength, in metres.

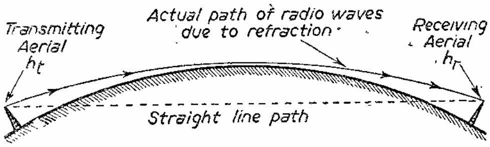


Fig. 3.—How the range of signals is limited by the curvature of the earth.

This assumes that both aerials are $\lambda/2$ dipoles; that h_t and h_r are each not less than $\lambda/2$; and that h_t h_r is much less than λd.

The full line curve in Fig. 2 is obtained from this formula.

The dotted curve indicates the approximate field strength obtained in practice.

h_t=1,000ft., h_r=30ft., Frequency=100 mc/s, Power=1,000 watts.

Over urban territory a decrease in field strength of from 10 db-20db may be expected owing to the scattering required to produce signals at street level in the presence of buildings. Where transmission is over water, an increase of from 20 db-26 db may be expected.

Another advantage of V.H.F. transmission is the small size of aerial that is required. For instance, a half-wave dipole has a length of approximately 1 yd. at a frequency of 150 mc/s and therefore directional arrays are comparatively easy to construct. This increases the signal strength, as does increasing the aerial height, to a very marked degree. The use of highly directive arrays and the fact that transmission is almost entirely confined to optical distances enables a considerable degree of secrecy to be obtained should this be desired. Also, it is possible to operate many stations on a common frequency provided that their geographical separation is sufficient. There are, however, a few disadvantages attendant upon the use of very high frequencies.

Optical Range

The range is almost entirely optical. As is well known, frequencies above about 30 mc/s. to 40 mc/s. during the day, and 15 mc/s. at night, are not reflected back to earth by the ionosphere, but pass into outer space and are lost. Satisfactory communication over appreciable distances with very high frequency waves is hence obtained only by utilising the ground wave, and even when the transmitting and receiving antennae are placed at the highest possible elevation, the range of the signals is limited to moderate distances by the curvature of the earth. This is illustrated in Fig. 3.

It may be shown that the maximum optical range of signals, $S=1.42(\sqrt{h_t}+\sqrt{h_r})$ miles, where h_r and h_t are in feet. The refraction of the earth's atmosphere causes slight bending of the radio waves, and this enables communication to be carried on over somewhat greater than optical distances. (Fig. 3 shows this bending in exaggerated form for the sake of greater clarity.) Thus, in practice, $S=1.6(\sqrt{h_r}+\sqrt{h_t})$ miles.

The following table based upon $S=1.42\sqrt{h}$ gives the horizon distance for various heights of aerial above ground level. For maximum reception range, the sum of the horizon distances for transmitting and receiving aerials should be multiplied by the factor 1.13.

Height of Aerial Above Ground	Limit of Optical Range	Height of Aerial Above Ground	Limit of Optical Range
FEET	MILES	FEET	MILES
5	3.2	1,000	45.0
20	6.4	2,000	63.5
50	10.0	3,000	78.0
100	14.2	4,000	90.0
500	32.0	5,000	100.0

Reception of V.H.F. signals at distances considerably greater than optical has frequently been reported, but such signals are almost entirely confined to frequencies below 100 mc/s. and are very unreliable, depending upon unusual ionospheric conditions.

Dielectric Losses

Dielectric and other losses are of much greater significance than at lower frequencies and therefore only high-grade components must be used. The following table gives some idea of the dielectric losses at 50 mc/s.

Component	Bakelite	Ceramic
Tuning condenser (max.)	10,000Ω	40,000Ω
,, ,, (min.)	50,000Ω	200,000Ω
Valve holder	200,000Ω	1 MΩ
Valve base	200,000Ω	1 MΩ

All condensers should have air or high-grade mica dielectric, particularly if passing signal frequency currents, while all insulation should be of ceramic or other high frequency material such as distrene, etc. Insulating sleeving should be avoided on wires carrying R.F. currents as also should shellac of other coil varnish. Every insulating material coming in contact with wires or components carrying high frequency currents should be regarded as a possible source of dielectric loss, and must be of the best possible quality.

Drop in Overall Gain

Since losses at V.H.F. are considerable, the impedance of tuned circuits is correspondingly reduced and so the overall gain drops. This reduction in gain can be partially offset by employing high slope valves, but unfortunately a high mutual conductance implies close grid-cathode spacing and therefore high input capacity. In order to tune circuits to frequencies of the order of several hundred megacycles, it is necessary to keep input and output capacities down to the absolute minimum and so a compromise has to be made. Also, for reasons to be explained later, the physical dimensions of the valves must be kept as small as possible. It is thus to be expected that such valves will be somewhat more expensive than normal receiving types.

(To be continued)

The Progressive Development of the Short-wave Receiver

AN INTERESTING REVIEW OF THE AMATEUR'S PROGRESS SINCE THE "EARLY DAYS"

By A. W. MANN

WHEN writing on matters of short-wave interest it is, in the author's opinion, wiser to err on the side of understatement than to allow one's imagination full play. This applies especially to short-wave listening and the performance to be expected from various types of short-wave receivers.

I mention those things because I realise that short-wave listening, far from being the pastime of the select few, is now an international one. Also that its progress was retarded considerably during the initial stage by overstatement.

With that I am sure that many old-timers will agree. Re-reading articles of short-wave interest to be found in a number of radio publications dating back to the early days of the pastime, one finds much of interest and usefulness, together with a considerable amount of overstatement. The idea in the latter instance being, one would imagine, to get the home-constructor of broadcast receivers interested in short-wave listening and receiver construction. The recognised authoritative writers stuck to facts and avoided the mistake of painting a too glowing picture. To them I and others owe quite a lot.

Receivers

Simple regenerative receivers were in common use and these consisted for the most part of broadcast-type components, large diameter home-made coils, built on baseboard lines, and totally devoid of screening.

Stations were few and of low power, many of an experimental nature. There were very few scheduled transmissions. So far as Europeans were concerned, the results were fairly good. One reads much about the thrills of short-wave reception, the spirit of adventure and such like. The claims made, so far as American and Antipodian reception were concerned, were true, the proof of this being found in the fact that the writer managed to do the same, but not with the ease one was led to believe it could be done.

Better Designs

A well-known writer, who is still actively engaged along the same lines, described during the period under discussion a new method of receiver construction which enabled one to obtain stability in operation. The underside of the baseboard was screened with tin foil, and the panel backed with the same material. A very stable receiver was the result, and DX reception became an accomplished fact.

At a later date he applied the metal panel and chassis method of construction to short-wave receivers. This has proved to be a far-reaching development. The metal chassis and panel was first introduced by Mr. F. J. CAMM.

The number of transmitters on the air was increasing, but, even so, to hear transmissions from all continents was an accomplishment which required consistent and patient listening, and sometimes covered a period of weeks before it was achieved.

S.W. in U.S.A.

Apart from the amateurs, short-wave interest in the British Isles could not be said to be other than luke-warm. It was, however, very popular in America.

Special components, kit receivers, and complete factory-designed and produced models were available. The newly introduced screened-grid valve was incorporated as an untuned buffer by free-lance designers and commercial interests. The Pilot company, however, was the first to design a receiver which included a tuned R.F. stage for short-wave reception. This was named the Super Wasp.

Other firms did likewise. Amongst the best were those in the range produced by National, such as the S.W.5 and others.

Selectivity Problems

At this time the problem of selectivity was an acute one, especially on the amateur bands. Naturally, attention was turned to the manufacture of short-wave superheterodynes. Some of these were reported as very good.

Commercial air transport lines and others required something to meet their special requirements. Co-operation with receiver manufacturers resulted in the production of the National AGS, Hammerland Comet Pro, etc. These were known as commercial receivers. Some of them were put to amateur use, and were among the forerunners of the present-day communications receiver.

More Enthusiasm

At home, designers were incorporating the S.G. valve in designs for home construction. At first as an untuned buffer, and later in the form of a tuned radio-frequency stage. The tuned radio-frequency type receiver was responsible for an increasing interest in short-wave reception, and was followed by the autodyne type superhet, and later the modern frequency-changer types.

American communication-type receivers were imported into this country in considerable numbers, mostly for amateur use, and a few of British manufacture were available.

Now, the British-designed and produced communication-type receiver has come into its own on sheer merit. The same applies to British components, which enable the home constructor to build home-constructed receivers of high efficiency.

The Beginner

The beginner should not imagine that a communication receiver is absolutely necessary in order to enjoy satisfactory reception. If one's inclinations centre on listening alone, a commercially-produced, or ex-service type communications receiver will provide many hours of enjoyment.

Whatever type of receiver is chosen, he should avoid becoming a mere collector of call signs. This applies especially to amateur band listening. It is the surest way of growing tired of a pastime, which, if tackled in a rational manner, might retain one's interest for a lifetime.

Flitting from one station to another on any band, and constant dial twirling results in much that might otherwise be of interest being missed.

The most simple short-wave receiver will prove to be well worth the outlay, for the educational and news items one is able to receive. In addition to the short-wave broadcast bands the amateur 'phone bands offer, as a rule, something of interest. While there is, it must be admitted, a minority who obviously play to the gallery and are more foolish than funny, there are, on the other hand, a considerable number of well-informed and most experienced amateurs on 40 and 80 metres, to whom it is a pleasure to listen.

Systematic Listening

The systematic short-wave listener soon begins to find that geography can be an interesting subject. An atlas, great circle map, and a small world globe will all prove to be worth while. In addition there are available two booklets, between the covers of which are complete lists of frequency allocations and call signs. Short-wave radio publications feature news and time schedules, all of which means that one knows when and where to listen.

Receiver Calibration

An accurately-calibrated frequency meter is an expensive piece of apparatus. The listener can, however, calibrate his receiver dials on known transmitter frequencies.

Experimental Work

Experimental work is a means whereby one can try out in practical form the ideas of others, and a few original ones. The time has not been wasted if one finds that an original idea of one's own will not work.

The writer has found quite a number of ideas which did not turn out as it was hoped. As a result the idea was discarded or modified. If you have an idea in mind the best thing is to try it out. One can learn quite a lot that way.

The first thing which is required is a receiver on which to listen. Once having decided that it meets one's present requirements, use it. In the meantime set out to get together sufficient components to build anything from a single-valve to a four-valve receiver.

Once having done so you will be in a position to try out various circuits, layouts, reaction schemes, bandspread, L.F. coupling arrangements, and many more besides.

To the new hand this may seem to be a little too ambitious. It is, however, the way to learn radio, and short-wave radio in particular, if combined with selected reading. One can collect an amazing amount of apparatus in time even though it is obtained the hard way. The pleasure and interest it provides will far outweigh the initial cost.

News from the Clubs

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

THE Junior Section (London Centre), Radio Group, is holding a Radio, Television and Models Exhibition at Waterloo Bridge House, Waterloo Road, S.E.1, on October 26th and 27th, 1951. In addition to the exhibits there will be films on radio and allied subjects.

Admission is by programme, which includes entrance to the cinema. Secretaries of radio societies are invited to write for copies of the programme, a limited number of which are available at threepence each, post free, to: The Hon. Group Secretary, 28, Orchard Avenue, Heston, Middlesex.

WARRINGTON AND DISTRICT RADIO SOCIETY

Press Officer: Mr. Frank E. Loxham, "Fulwood," 104, Heath Road, Penketh, Near Warrington, Lancashire.

INTEREST in the society has been maintained during the summer months by lecturettes by members, demonstrations of home-built equipment, etc. A sale of radio and electronic equipment—which had been left by a "silent key"—realised over £7, which was handed over to the widow.

LOTHIANS RADIO SOCIETY

Hon. Sec.: J. Harris, 24, Braid Hills Road, Edinburgh, 10.

MEETINGS will be held at the Edinburgh Chambers of Commerce, 25, Charlotte Square, twice monthly, commencing as from Sept. 20th and continuing fortnightly, at 7.30 p.m. All comers welcomed.

WORCESTER AND DISTRICT AMATEUR RADIO CLUB

THE club hon. secretary, having found it impossible to continue with the work of the club, has resigned. Mr. P. Sealey, of 1, Sandys Road, Worcester, has taken his place. Readers living in the district are cordially invited to come along any Thursday evening and meet the members. Meeting place: The Rainbow Club, Rainbow Hill, Worcester.

BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: R. T. Parsons, 14, Carlyle Avenue, Brighton, 7.

CLUB meetings continue every Tuesday evening. Several well-known manufacturers are coming along in the near future to give talks and demonstrations of their equipments. These include Messrs. Belling Lee and Marconi Instruments. The club TX is active on 80-metre C.W. during informal meetings and does get Q.S.O.s! The dance arranged for October 17th promises to be a highlight of the club's social activities. The hon. sec. will be pleased to supply details of programmes and membership upon request.

SLADE RADIO SOCIETY

THE following meetings will be held at 7.45 at headquarters: Parochial Hall, Broomfield Road, Slade Road, Erdington, Birmingham, 23.

Oct. 12th.—Talk and demonstration "Home-made Pickups," by Mr. E. Walcot.

Oct. 26th.—Talk, "Measuring Instruments," by Mr. Collinge (Ferranti, Ltd.).

Nov. 9th.—Annual dinner.

Nov. 23rd.—Annual general meeting.

Dec. 7th.—Talk, "Manufacture of Cathode Ray Tubes," by Mr. G. P. Thwaites (Standard Telephones and Cables).

ROMFORD AND DISTRICT RADIO SOCIETY

Hon. Sec.: D. L. K. Coppendale, 9, Morden Road, Chadwell Heath, Essex.

THE above club is anxious to obtain new members. Anybody interested should write to the hon. sec.

HAMMERSMITH (MEN'S INSTITUTE) RADIO CLUB

Hon. Sec.: H. Perriss, 76, Carthew Road, W.6.

THE club announces with regret the resignation of their secretary, Mr. A. E. White, owing to pressure of professional work, and welcomes the appointment of Mr. H. Perriss as hon. sec.

The next session has commenced and an invitation is extended to all intending members. The classes are held at the L.C.C. Institute, Brackenbury Road, Hammersmith, London, W.6, on Mondays, Wednesdays and Fridays.

FREQUENCY MODULATION

A NEW SERIES

2.—THE GENERAL TECHNIQUE EXPLAINED

By J. F. Golding

(*Continued from page 469 October issue.*)

A POWER ratio of 45 db. is obtained by taking advantage of the improved signal-to-noise ratio at the quiet end of the range and, for loud tones, by virtue of the fact that there is really no such thing as 100 per cent. modulation in F.M., maximum deviation being an arbitrary figure chosen to give maximum fidelity within the limits set by a workable bandwidth.

The fourth advantage, the reduced interference between stations having adjacent wavelengths, is due to the type of detection used for frequency modulation.

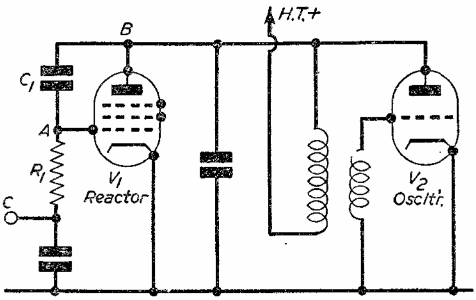


Fig. 1.—Basic circuit of a frequency-modulated oscillator using a capacitive reactor valve.

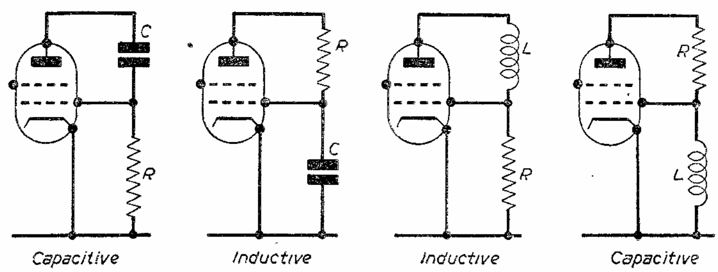
If the frequency separation between two carriers received by an A.M. receiver is within the audio band, the beat note is heard in the output, causing serious interference with the desired programme unless there is a voltage ratio at the receiver input of at least 20 db. between the wanted and unwanted carriers. Interference can also be caused by beats between the wanted and unwanted sidebands, resulting in the characteristic frequency-inverted "monkey chatter." This type of interference is probably even more objectionable than the continuous whistle caused by a beat between two carriers. If interference of this nature is to be completely avoided, powerful amplitude-modulated transmitters need to be separated by at least 30 kc/s.

The effect on a frequency-modulated receiver is quite different because, as mentioned earlier in connection with noise, the type of demodulator used will not detect these beat notes, which are, in any case, largely eliminated by the amplitude limiter.

Interference

However, interference does occur to a certain degree due to phase modulation of the desired by the undesired signal. This results, as with noise interference, in an output of *frequency* equal to an *amplitude* directly proportional to the mean frequency separation. It will be seen, therefore, that interference is small for small carrier spacing. It is actually most noticeable at about 5 kc/s separation because, although a larger separation gives more equivalent modulation, the resultant output becomes less audible. This is particularly so when pre-emphasis is employed.

It is found in practice that interference of this type is negligible provided the desired to undesired carrier ratio at the receiver input is not less than two to one. In most receivers it is usually found that if two stations are very close together in frequency the more powerful completely "captures" the receiver so that the lower-powered transmitter is not audible in the receiver output. This may be so marked that, if the separation is



$$C_E = \frac{g^m RC}{1+(R\omega C)^2} \qquad L_E = \frac{1+(R\omega C)^2}{g^m RC\omega^2} \qquad L_E = \frac{R^2+\omega^2L^2}{g^m R\omega^2 L} \qquad C_E = \frac{g^m RL}{R^2+\omega^2L^2}$$

Fig. 2.—Four commonly used phase-changing networks. CE and LE are the effective capacitance or inductance of the reactor valve.

less than the deviation, it is quite impossible to tune in the lower-powered of the two. This is known as the capture effect and will be explained more fully in a later article dealing with F.M. receivers.

General Technique

In many respects frequency-modulation transmitters and receivers differ but little from their amplitude modulation counterparts, the R.F. and A.F. stages being similar in every way except for the values chosen for the circuit elements. This is to be expected, and the questions immediately arise :

(a) How is the frequency of the carrier modulated at the transmitter ?

(b) Having received the frequency-modulated signal, how is it converted to an audio output?

In the simplest possible form of frequency-modulated oscillator, one of the tuning elements is varied mechanically by means of an electric motor or a moving-coil "loudspeaker-type" mechanism. Both of these methods are used in certain test instruments where a fixed deviation and fixed low-value modulation frequency are required, e.g., wobulator circuits for examining response characteristics, but a frequency-modulated transmitter obviously requires a much more flexible device capable of following the facsimile of the modulation waveform and reproducing it as a proportional change in inductance or capacitance.

This can be accomplished electronically by means of a "reactor valve" circuit in parallel with the tuned circuit of the oscillator. As its name implies, this is a pentode valve which, by virtue of its method of connection, behaves like a reactance—inductive or capacitive—the value of which is proportional to the mutual conductance of the valve.

Basic Circuit

The diagram Fig. 1 shows the basic circuit of a frequency-modulated oscillator of this type. It consists of a simple anode-tuned oscillator with a reactor valve, V1, connected across the tuned circuit. The control grid of this valve is connected to a phase-changing network, consisting of a capacitor and resistor, in such a way that the voltage at point A is lagging by 90 deg. on the voltage at point B. Since the anode current is directly proportional to, and is in phase with, the grid voltage, we have the condition where the R.F. current passed by the valve lags on the R.F. voltage by an angle of 90 deg. The valve, therefore, appears as a capacitance across the tuned circuit, its effective reactance being proportional to the product of the mutual conductance and the R.F. voltage at point A. It is, of course, essential that valve V1 shall be a pentode or tetrode with a high internal resistance in order to prevent losses due to the anode current varying with anode voltage.

It will readily be seen that by varying the gm (mutual conductance) of valve V1 to follow the modulating voltage, the effective shunt capacitance can be made to vary in value by an equivalent amount, producing a percentage change in frequency equal to half the percentage change in total capacitance. This may be expressed as :

$$\frac{\text{Deviation freq.}}{\text{Carrier freq.}} = \frac{1}{2}\,\frac{\text{Change in capacitance}}{\text{Total capacitance}}$$

or

$$\frac{\Delta f}{f} = \frac{\Delta C}{2C}$$

In order that the gm of valve V1 shall vary linearly with the modulating voltage, it must be a valve of the variable-mu type, the A.F. signal being injected at point C, and sufficient grid bias applied to cause the valve to operate over that portion of the characteristic where the gm/Eg curve is linear.

The frequency-modulated oscillator described is one in which the reactor valve is made to behave as a variable capacitance using a capacitance/resistance phase-changing network. The principle may be applied equally well, however, by causing the valve

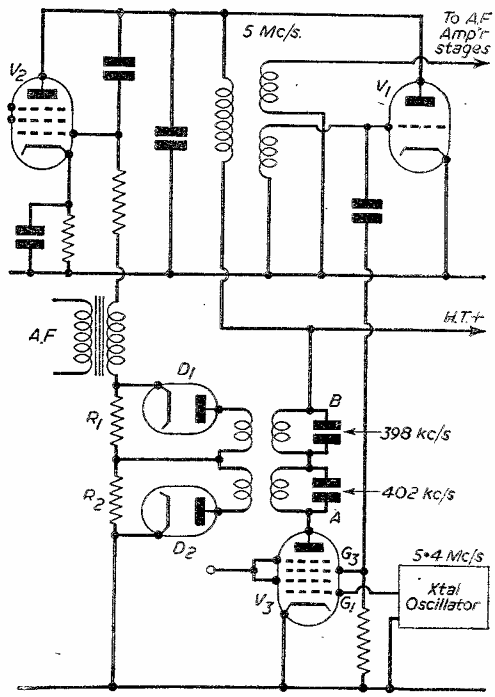


Fig. 3.—Diagram showing a common method of applying indirect crystal control to an F.M. oscillator.

to behave as an inductance, and using phase-changing networks comprising inductance or capacitance and resistance. The diagrams and formulæ in Fig. 2 show the four common types of phase-changing network, together with the methods of calculating the effective reactance of the reactor valve circuit.

Indirect Control

Since the oscillator frequency is varied by the reactor valve, it is obviously impossible to use the circuit as a directly crystal-controlled master oscillator of a transmitter. However, as any reader who is familiar with automatic frequency control of A.M. receivers will readily appreciate, the circuit

(*continued on page* 517)

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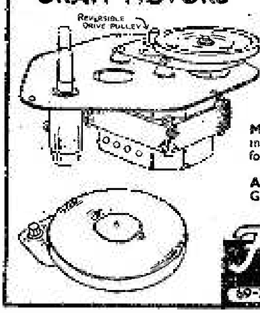

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(*Continued from page* 514)

lends itself admirably to the principle of indirect control as shown in Fig. 3.

In this circuit, V1 is a triode oscillator, operating at a mean frequency of 5 Mc/s, V2 is the variable-mu reactor valve, and V3 is a hexode mixer which we will call the frequency stabiliser valve. The output of a crystal oscillator is connected to one of the control grids of V3, while the output of the F.M. oscillator is applied to the other. Assuming that the crystal oscillator is operating at 5.4 Mc/s, its output will beat with the mean carrier frequency to give a signal of 400 kc/s in the anode circuit of the stabiliser valve. This consists of two tuned transformers A and B which resonate at 398 kc/s and 402 kc/s respectively.

When the F.M. oscillator is operating at exactly 5 Mc/s, the potential differences across transformers A and B are equal, and since these voltages are rectified by diodes D1 and D2, equal and opposite D.C. voltages appear across resistors R1 and R2. If, however, the mean carrier frequency wanders high, the beat frequency falls and circuit A approaches resonance, increasing the D.C. voltage drop across resistor R1. This applies a positive voltage to the grid of the reactor valve, increasing its mutual conductance and, by increasing its effective capacitance, brings the mean carrier frequency back to normal. If, on the other hand, the mean carrier frequency wanders low, transformer B approaches resonance, causing a greater voltage drop across resistor R2 with a corresponding correcting effect.

There are, of course, variations on the basic circuit shown in Fig. 3. For example, some transmitters do not utilise the reactor valve for frequency stability control. Instead a small motor operating a variable capacitor forms the load for diodes D1 and D2, the method of connection being such that when the out-of-balance voltage becomes positive, the motor rotates in the appropriate direction to increase the capacitance and, when it becomes negative the rotation is in the opposite direction. In other transmitters the feed to grid 3 of the stabiliser valve is taken from some later stage in the transmitter instead of directly from the oscillator output. For reasons which will be apparent later this second variation results in greater discrimination and, therefore, a closer control on the carrier frequency.

The master oscillator usually operates at a centre frequency between 5 and 10 Mc/s, harmonic multipliers being used in the subsequent stages to produce a final output in the V.H.F. band. For example, an 8 Mc/s master oscillator may be followed by two frequency doubler and one tripler stage giving:

$8 \text{ Mc/s} \times 2 \times 2 \times 3 = 96$ Mc/s output frequency.

This practice is commonly adopted for both A.M. and F.M. transmitters operating at high radio frequencies because of the difficulties in producing a sufficiently stable V.H.F. oscillator. In the case of an F.M. transmitter, the deviation is, of course, multiplied by the same factor as the carrier frequency so that, using the multipliers already described, a 6 kc/s deviation of the master oscillator frequency results in a 72 kc/s deviation of the output frequency.

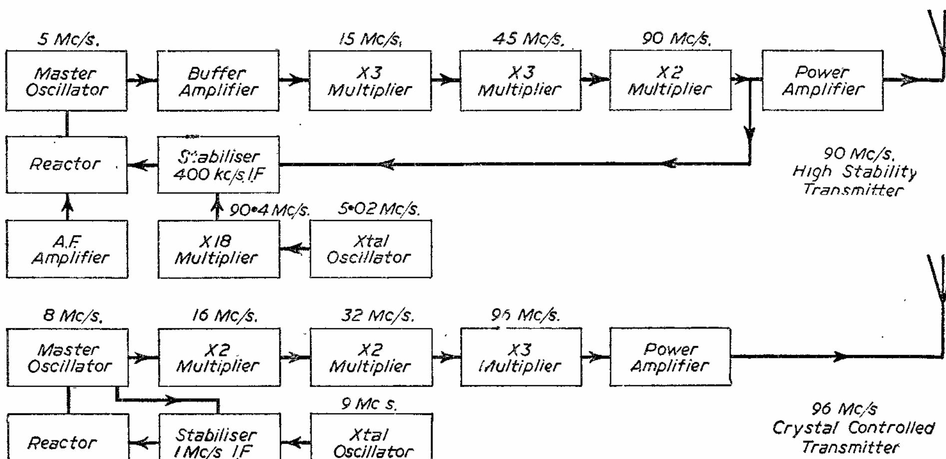


Fig. 4.—Block schematic diagrams of two frequency - modulated transmitters.

Transmitters

Block schematic diagrams of two typical transmitters are given at Fig. 4. The first of the two utilises the output frequency signal to operate the stabiliser valve. This means that, as crystal controlled oscillators do not operate at V.H.F., a system of multipliers must also follow the reference oscillator. The advantage of this method of control is now apparent. Let us assume that the stabiliser valve anode load circuits balance out at 400 kc/s and that a variation of mean carrier frequency of 500 c/s at grid 3 applies a correcting voltage of 0.5 volts to the reactor valve grid. Then, if the stabiliser valve is operating directly from the 5 Mc/s master oscillator, a frequency variation of $\frac{5 \times 10^2}{5 \times 10^6} \times 100 = .01$ per cent. causes a correcting voltage of 0.5 volts. If, however, the stabiliser is connected as shown in the lower diagram, it is operating from a 90 Mc/s signal so that a variation for 0.5 volts correcting voltage is about .0005 per cent.

(*To be continued*)

Programme Pointers

THIS MONTH MAURICE REEVE DEALS WITH SOME RECENT PROGRAMMES

THIS is a repetitious age. Wherever we go and in whichever direction we happen to turn, multitudes of signs, indications, requests and suggestions confront us on the land, over the land and under the land. Our roads are decorated with them throughout their length and breadth. Arrows point blandly right in to a shop window and say "Portsmouth," or ridiculously up into the sky indicating "Glasgow"; whilst at our feet, or rather, our wheel, studs and whitewash tell us a whole heap more.

But we have to go to the B.B.C. for the quintessence of repetitiousness. I think that every word that is in the *Radio Times* is repeated from the studio at the actual broadcast plus all the little bits about Beethoven's Second Concerto having been written before his first, etc., etc., etc. Even in items of ten or fifteen minutes duration, a lengthy cast will be read and followed by the producer, the arranger, the narrator, the musical accompaniment and other participants; everyone, in fact, who has had the smallest part of their finger in the pie. Then we are told that Mr. So and So is now appearing at the Theatre Royal, Newcastle, whilst Miss Such and Such appears by kind permission of Messrs. This, That and the Other. Every word of which is in the *Radio Times*. Then, to crown the proceedings, and just in case we would like yet one more piece of information to make us all a bit jollier and more contented even than we were, an entirely new voice steals up to the microphone to inform us that "Have a Bash" was recorded, or that "you have just heard a repeat of last Friday's broadcast."

The Weather and Cricket!

The weather forecast, or that part of it which alone interests you and I, is in the 8 a.m., 1 p.m. and 6 p.m. news, actually repeated three times in fifteen minutes (twenty minutes in the case of the 6 p.m. news): once, at five minutes to, when we are told in detail; a second time, at the hour, in the headlines, and yet a third time, towards the end of the bulletin proper.

As to cricket, space, and my own shortage of adjectives, prevent my commenting. And so it goes on.

Not only is the amount of entertainment time lost enormous, but the whole thing has a "clogging" effect on all types of show. None of it is in the least bit necessary and it should be scrapped forthwith. It is the brightest red tape. Programmes and artists should be freed from these shackles immediately, and audiences be allowed to breathe freely and to listen without announcers' constrictions.

The G.W.R.

"The Little Giant," the story of Brunel, builder of the Great Western Railway, etc., made an interesting and effective programme, which could well be followed by others of a similar character. Looking back, it seems that there was little, if anything, to justify the choice of a 7ft. gauge—for the once famous railway line out of Paddington. Not one other single line in Great Britain followed suit, and it must have been at enormous cost that, towards the end of the century, conversion to 4ft. 8½in., in conformity with all other systems, was decided upon. To pass on to the Great Western of those days from other lines, and, for the first time, confront the broad-beamed monsters of Gooch and others, must have been a weird experience.

Drama

There were two dramatic productions last month of unusual quality. One was of one of the world's masterpieces. Molière's "Tartuffe," freely adapted into English by Miles Malleson, who also played the part of Monsieur Orgon. Here, Molière drew the greatest portrait of an arch hypocrite, probably in all literature, greater than any in Dickens, whose pages are full of these contemptible unworthies, drowning himself in self pity and pompous humbuggery. The climax of the play is reached in one of the greatest scenes in all dramatic literature, where Madame Orgon, who cannot convince her dolt of a husband that she is receiving the old reprobate's unwanted lecherous advances, hides him under the table for him to see and hear for himself. Like most plays which set out to tell the truth to those who would rather not hear it, "Tartuffe," first performed before the "Grand Monarch" and his court, was reviled and banned. To-day it stands, on its merits,

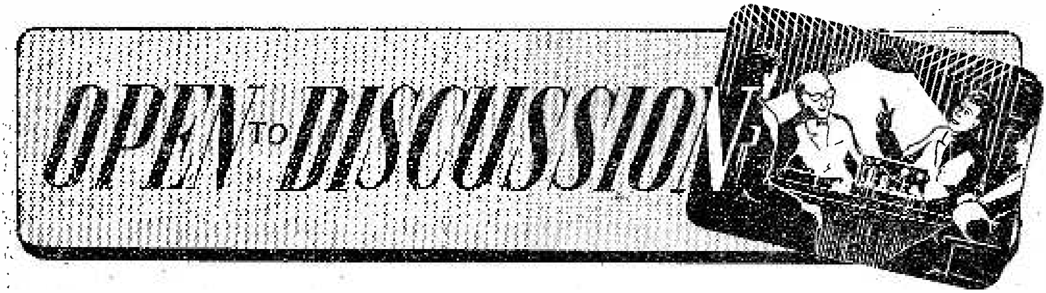
Mr. Donald Wolfit lived the old humbug to the life and brought out all his most loathsome oiliness. Mr. Malleson was excellent as the rich merchant Orgon who, until the famous "under the table" scene, incredibly swallows all Tartuffe's blandishments hook, line and sinker. His adaptation also seemed to me to be well worthy of the original. And the ladies of the cast, Violet Loxley, May Agate, Frances Rowe, etc., played very attractively.

"Return to Tyassi"

The other play was Mr. Ben Levy's "Return to Tyassi." In spite of having received a staggeringly good press upon its recent West End production, the theatre-going public exercised its well-known lack of critical judgment and compelled its early demise by stopping away.

The story concerns the reactions of a woman, "comfortably" married to a second husband, on learning of the death, in Tyassi, of her first. She is to "fall in love" with the brother-in-law, in order, largely, to keep up the illusion. On realising that her present husband won't divorce her and that she seems to have greatly incommoded many other people, she brings the drama to a summary conclusion by walking off the balcony. Romeo and Juliet came to an end just as suddenly, and for much the same reason, no drama, apparently, being able to exist without a heroine.

I thought it a very powerful and moving play, done in first-class style by Yvonne Mitchell, Robert Harris, Rachel Kempson, Kathleen Nesbitt and others.

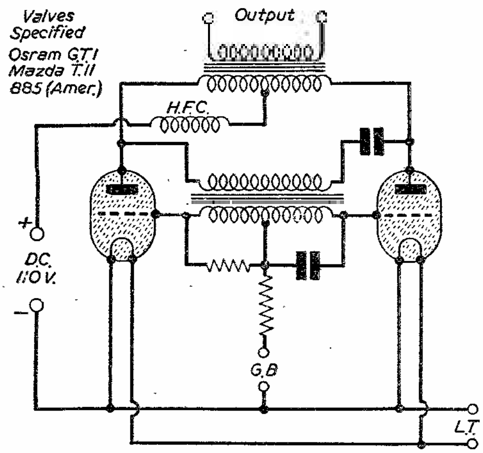


The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

A.C. from D.C.

SIR,—During the war, whilst aboard ship, I occasionally looked through a book belonging to the chief radio operator, in which the accompanying circuit appeared.

It was claimed by the author that, because of the restricted voltage aboard ship, usually 110 v. D.C., the circuit could be used to give an A.C. voltage from 110 v. D.C. Now, unfortunately, I cannot remember the name of the author



The circuit referred to in J. van Niekerk's letter.

or the title of the book, but I take it that it was reliable, as the radio operator was using it in his studies for, I believe, the City and Guilds examination.

No component values were given, but, according to the author, it seems the grid bias is varied until the valves start to conduct, and the condenser in the anode circuit then charges up and discharges alternately, thus setting up an A.C. voltage in the transformer. Perhaps some of your readers may have come across it before, and may be able to help me. I am therefore appending the circuit herewith, so that readers may see it, and perhaps write to me. It would appear to be the ideal power pack for aboard ship, as there are no moving parts to cause interference with others as in the case with rotary converters, vibrators, etc. The particular valves are expensive I know, but I think it would justify the expense.—J. VAN NIEKERK (2nd Engineer), M.V. *Regent Jaguar*, c/o C. T. Bowring and Co., Ltd., 52, Leadenhall Street, London, E.C.3.

"Measuring Small Condensers"

SIR,—In the article in your September issue under the above title, Mr. Kendall says: "... 1.887 has been taken as equal to 2. Therefore for more accurate results the answer should be multiplied by 1.059." That he differentiates between 1.059 and 1.06 implies he considers the apparatus accurate at least to 1 per cent. But let us consider just the mathematics. Quite apart from the practical side, $f=\frac{1}{2\pi\sqrt{LC}}$ is itself only an approximation. We neglect R.F. resistance; we consider "L" and "C" to be lumped elements; we neglect the effect of the circuit on this L, C combination; we do not draw power off from the circuit ... and so on. Yet in the oscillator in point not one of these assumptions is valid—in fact at 100 mc/s we cannot hope for anything like an exact analysis of what is happening and shouldn't hope to rely on the formula to better than 10 per cent. Even his "1.887" is an approximation which doesn't justify that extra decimal place. It comes from using $f=\frac{1}{2\pi\sqrt{LC}}$ and deducing that $\lambda=2\pi C\sqrt{LC}$, where "C" is the speed of the radiation and units are consistent. With the units of the article, $2\pi C$ comes to about 1.887, but it is only "about," for the speed of the radiation is not 3×10^8 metres/sec.—a better approximation is 299.8×10^8 m/s. and that alone will cause a 1 per cent. error, to be disregarded.

Let us now consider the practical side. It would be hard to choose a less accurate way of detecting voltage anti-nodes than a bulb (1.5v. to be preferred to 2.5v., by the way). When it warms up the resistance rises and so if one tries to get the bulb just glowing it is very tricky. Either it won't light, or it starts glowing brightly and one can move the slide several centimetres and detect no difference. It is also sluggish and unless a lot of coupling is provided with the oscillator one can miss the current nodes altogether. Then when one couples too closely, either the wretched oscillator ceases to live up to its name or subsidiary nodes are set up (due to reflection at the free end).

I have not tried a 7193 or CV6, but a 955 is inadequate and even the Mullard EC53 won't light a torch bulb (nominally of ½ watt consumption) in the circuit shown. Readers who have trouble might be interested (and surprised!) to find a 6V6 will supply easily enough output at frequencies at least to 150 mc/s. off 200 volts or so of H.T. I do not suggest so high a frequency, though. For one thing, battery leads, etc., are apt to absorb strongly, being in critical relation with the wavelength. For another, the result will be meaningless—even an extra centimetre in the test leads compared with working conditions for the capacitor will be enough to make it seemingly gain in capacitance in the circuit.

The circuit is interesting theoretically and novel in application. But it is certainly not "accurate." —M. BAMFORD (Macclesfield).

The Author's reply to the above criticism is:

The object of the appendix was not to "prove" that the device could be used to a few parts in a million but to show how the formula relating wavelength to capacity was derived $(LC=\frac{\lambda^2}{4})$ from the full equation $\lambda=1.885\sqrt{LC}$ (note here my error, as in the article I used 1.887 instead of 1.885). This formula is still very well known, although it has during the late war been proved slightly in error by N.P.L., Teddington. The correct formula is now recognised as 1.8837, a difference of just over 0.01 per cent., and not over 1 per cent. as stated by your correspondent.

The normal person does not try to work to a higher accuracy than his instruments, consequently the approximation formula $LC=\frac{\lambda^2}{4}$ was used instead of $LC=\frac{\lambda^2}{(1885)^2}$, but as is explained in the Appendix this introduces an error.

Again Mr. Bamford appears to have the incorrect idea of the use of the formulæ for oscillatory circuits and seems to consider that it is incorrect to take the value of a valve-driven circuit as $f=\frac{1}{2\sqrt{LC}}$ as there is resistance present in the circuit; this is the case with the self-oscillatory or "ringing" circuit, but not with the driven circuit, as the negative resistance of the valve cancels out the positive resistance of the circuit. Under favourable conditions the 7193 will go down to just under −400 ohms.

I admit that a bulb is not the absolute ideal means of measuring the nodes but if the measurements are made over several wavelengths a good accuracy can be obtained (1 per cent. or better, but owing to line loss more power is required than the 7193 will supply). The 7193 will, with the aid of an American G.E. 1.5 volt 0.05 amp. bulb, indicate four nodes with ease, i.e., $1\frac{1}{2}$ wavelengths. A point to note here is that the wire should be bright copper and as thick as possible. As the resistance of the bulb varies from about 10 ohms when cold to 30 when hot there will also be an amount of shift of the position of the current node when measuring due to the variation of the load drawn by the bulb. The best way to find the position of the node is not to find the point of max. brilliance, but find two points of equal brilliance one each side of the node and then take the average of the two distances (this can be done to give 5 per cent. over two wavelengths with ease).

The choice of valve depends on individual taste and, as Mr. Bamford stated, it is surprising what can be used, and I have used such valves as the ML4 and PX4 with very good results up to 60 to 100 mc/s.!

At all frequencies over about 5 mc/s the inductance and capacity of wiring and components has a very large effect, but this distributed reactance can be measured and regarded for calculations as so much "lumped" reactance. Take, for example, the impedance of a pair of wires, this can be given as $Z_0=276 \; \mathrm{Log}_{10}\frac{D}{R}$ (where D is spacing and R radius of the wires), whilst the formula $Z_0=\sqrt{\frac{L}{C}}$ is just as good and accurate although it takes the two reactances as "lumped" quantities per unit length of feeder!

There are other small inaccuracies that occur, and they are the inductance and capacitance of condenser leads, so leads should be thick and short.

As a point of interest the formulæ concerned for L and C of single wires are:

$$L=2\left\{\mathrm{LOG}_{\varepsilon}\left(\frac{2l}{d}\right)-\right\}\times 10^{-3} \text{ microhenries.}$$

$$C=\frac{10^{-5}}{18\left\{\mathrm{LOG}_{\varepsilon}\left(\frac{2l}{d}\right)-1\right\}} \text{ microfarads.}$$

where l is the length d the wire diameter and ε the base of the Naperian log.

In spite of all the small inaccuracies of this method of measuring capacity it is still possible to use it to an accuracy of 5 per cent. with the measurements being made at V.H.F., and such measurements are a far better guide than 1 per cent. accuracy made at 1 mc/s owing to the difference in condenser impedance due to plate inductance and R.R.resistance. This last point was the gravamen of the article and the one that Mr. Bamford appears to have missed. —JAMES S. KENDALL.

Old Sets Disowned

SIR,—In fairness to the radio manufacturers, I felt I could not let A. Whetton's (St. Austell) letter in the October issue of PRACTICAL WIRELESS go by unchallenged. During the past 25 years I have been employed by many of the big radio concerns on testing and inspection of radio equipment, and I have yet to see any radio sets coming from assembly being packed without test for the customer. I think it is A. Whetton who is the one who is likely to give the public a false sense of security and he is certainly not doing the industry any good.

Point No. 1. He mentions receiving a set with the mains primary open circuit. Does he know it is possible for any transformer in a radio set to become internally "open circuit" at any time?

Point No. 2. Sets do not leave the factories with noisy volume controls. There are many reasons why volume controls are noisy and in many cases they develop noise when left in one position.

No, Mr. Whetton, I am not asking you to believe me, I am telling you all radio sets are tested before the customer gets them. So get your facts right, then you will find that the majority of employees not only worry about pay packets and clock watching, they also do their job.—G. H. PURKISS (Essex).

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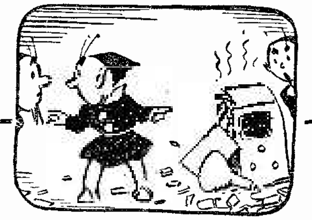

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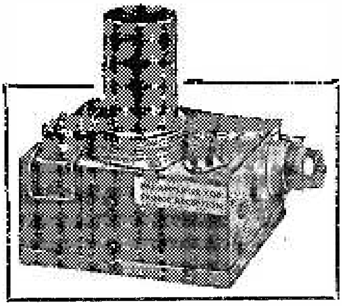

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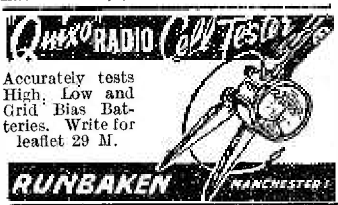

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Review of the Latest Gramophone Records

MOZART'S "Concerto No. 21 in C" is the latest addition to the Columbia Masterworks Series. It features the French pianist Robert Casadesus who, together with Charles Munch conducting the Philharmonic Symphony Orchestra, produces a memorable recording on *Columbia LX*1412/5. It is an extremely festive work with trumpets and drums setting the atmosphere.

The brilliant piano playing of Malcuzynski is well substantiated by his performance of the Chopin "Polonaise No. 2 in E Flat Minor" on *Columbia LX*1416. This work, which is sometimes known as the "Siberian" or "Revolt" polonaise, is remarkable for its constantly changing expression marks, particularly in relationship to time.

The music of Vieuxtemps holds much the same challenge for violinists as the works of Liszt for pianists, so it is not surprising that Yehudi Menuhin has chosen Vieuxtemps' "Concerto No. 4 in D Minor, bp. 31" for his latest recording on *H.M.V. DB*21307/9. This No. 4 is considered the finest of his six violin concertos. Menuhin's performance is masterly, and the result will have as much appeal for general listeners as for those with a particular interest in the violin.

Nicolai Malko has been guest conductor of the Danish Radio Symphony Orchestra since 1930, and this month he conducts the orchestra in two of Tchaikovsky's famous waltzes. They are "The Sleeping Beauty Ballet, op. 66," and "Serenade in C, op. 48," recorded on *H.M.V. C*4104.

The discovery of a hitherto unpublished work by Beethoven is an event of considerable musical interest. This month the Columbia Company issue the first recording of Beethoven's "Rondo in B Flat," played by the famous pianist Louis Kentner, who gave the work its first broadcast. The MS. was recently discovered by Jack Werner in the British Museum and published by Ascherberg in 1950. On the reverse side of this record, *Columbia DX*1775, is Beethoven's "Bagatelle in A Minor." For most pianists, this latter piece has proved to be a popular inclusion in recital programmes.

Vocal

The film "Taxi di Notte," which is to be exhibited in Great Britain under the title of "Bambino," was inspired by the real-life story of Armondo Scavolini, a famous Roman taxi-driver, whose part is played by Gigli. The picture opens with Gigli singing "Cetta Silente" (Silent City), which he follows with "Con la poggia o con la luna" (In the Rain or in the Moonlight), both of which he has recorded on *H.M.V. DA*11324.

If you like opera then you should hear the latest recording of Jussi Björling, the popular tenor, with songs from Puccini's "La Bohème" and Verdi's "La Forza Del Destino," on *H.M.V. DB*21311.

Lily Pons makes a welcome appearance in the new lists with a recording from Act 2 of Verdi's "Rigoletto" (On Every Festal Morning) and from Act 1 of Donizetti's "Linda di Chamounix" (O Guiding Star of Love), on *Columbia LX*1418. For this record she is accompanied by her husband, Andre Kostelanetz, conducting the Columbia Symphony Orchestra.

Variety

"Rose of the Mountain" and "Lonely Little Roben" are the two titles chosen by Ronny Ronalde for his latest recording on *Columbia DB*2916. The first tune is the latest to come to us from Germany (though the song has already made its mark in the United States). The latter title is a new American song with a folk flavour about it.

The Radio Revellers have taken the novelty song "Music Man" and given it the broad type of comedy treatment they gave "Grandfather's Clock" on *Columbia DB*2922. Everything happens in the song. Boisterous laughter, whistling in harmony, hurdy-gurdy, fairground effects, and even a burlesque of "Memory Man" (Leslie Welch). On the reverse they present a melodious vocal styling of "Sweet Violets."

Well established as a purveyor of organ interpretations of popular songs, Ken Griffin presents two numbers that are revivals on *Columbia DB*2911. They are "Wonderful One" and "Together."

"Down in the Forest" and "Song of the Thankful Heart," by the Luton Girls Choir under the leadership of Arthur E. Davies on *Parlophone R*3431, is the result of a novel recording experiment. In order to present these two fine ballads in the most effective manner, and to enhance the outdoor atmosphere of the songs themselves, they were actually recorded in the open air. The spot chosen was Black Park, Iver, Bucks.

Dance Music

Correct tempo dance music is supplied by Joe Loss and his Orchestra with "I Apologise" (Foxtrot) and "Riot in Rio" (Quickstep) on *H.M.V. DB*6104, and Victor Silvester and his Ballroom Orchestra with "Too Young" (Quickstep) and "None But the Weary Heart" (Waltz) on *Columbia FB*3616. Harry Davidson and his Orchestra add to their old-time dance series with "Princess Ena Quadrille" on *Columbia DX*1776.

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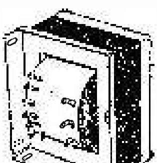

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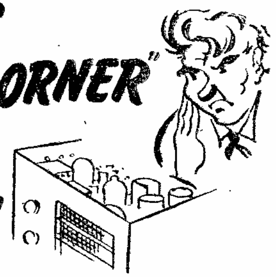

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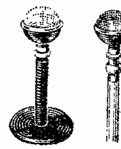

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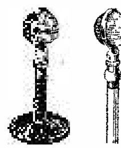

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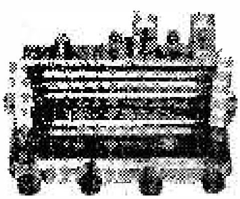

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