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Popular Wireless

and Wireless Review

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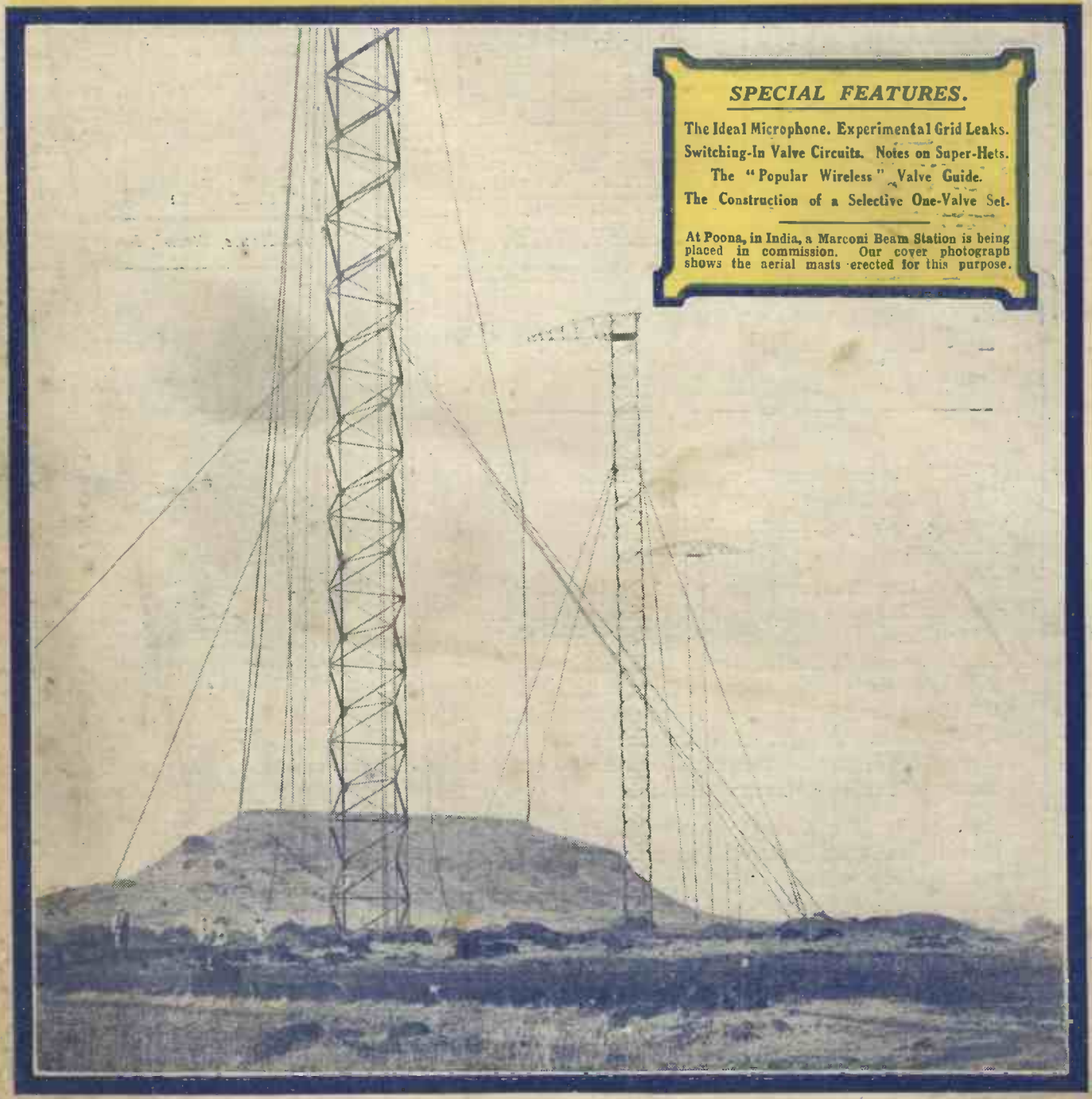
Scientific Adviser: SIR OLIVER LODGE, F.R.S., D.Sc.



SPECIAL FEATURES.

The Ideal Microphone. Experimental Grid Leaks.
Switching-In Valve Circuits. Notes on Super-Hets.
The "Popular Wireless" Valve Guide.
The Construction of a Selective One-Valve Set.

At Poona, in India, a Marconi Beam Station is being placed in commission. Our cover photograph shows the aerial masts erected for this purpose.

Exide

THE LONG-LIFE BATTERY

The New H-T Battery TYPE WJ

9d PER VOLT

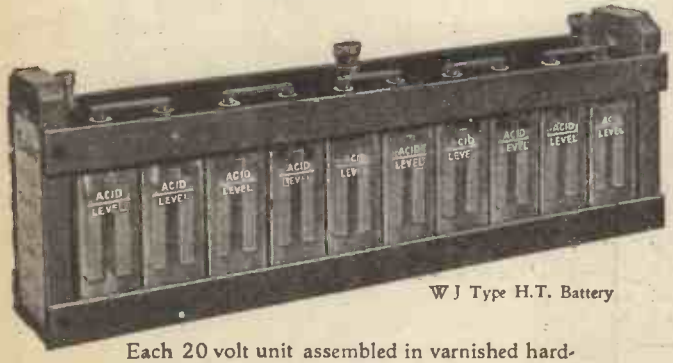
"ATMOSPHERICS" ELIMINATED

Only by using Accumulator high tension can you realise the purity of reception attained by cutting out the noises, due to partly run down dry batteries.

The silent background given by Exide H.T. batteries is almost uncanny, giving a freedom from the distortion due to "dry battery atmospherics," that is a revelation and a delight.

Accumulator H.T. means music instead of noise and every word distinct.

The W J type has a capacity of 2,500 mili-ampere hours, needs recharging only every six months and will last a lifetime.



W J Type H.T. Battery

Each 20 volt unit assembled in varnished hard-wood container.
Internal resistance negligible.
Voltage practically constant.
A third terminal gives 10 volt tappings.
Supplied ready charged, it can be used immediately on addition of "Accumulator" acid.

PRICE—

20-volt battery (without acid) - 15/-

9d. per volt

Any required voltage can be obtained by coupling, in series, the appropriate number of 20-volt units.

Order from your usual dealer at once to ensure early delivery

Advertisement of THE CHLORIDE ELECTRICAL STORAGE CO. LTD., Clifton Junction, nr. Manchester

A Triple-Coated Filament that resists the ravages of Time

CLEVER advertising can sell anything once—but if the commodity does not live up to its advertised reputation then the manufacturer gets no repeat orders. His business is built upon shifting sands, the product declines in popularity and eventually disappears. On the other hand, if the article is a good one users are only too glad, not merely to keep on buying but also to testify to its merits and further its sales.

When the Cossor Valve was first introduced its novel constructional features created great interest. The sceptically-minded bought Cossor Valves deliberately to prove to their own satisfaction the fact that an arched filament almost totally surrounded by a hood-shaped Grid and Anode could make no material improvement in sensitiveness or volume.

But those who came to scoff remained to praise. Throughout the length and breadth of the land you'll find Cossor users enthusiastically acclaiming the superiority of their valves. Not merely because actual experience proves them to possess a longer life—not merely because comparative tests show them to be more sensitive to weak signals—not merely because they are entirely free from annoying microphonic noises—not merely because they yield a much purer tone. Their popularity cannot be ascribed to any one of these features but to the rare combination of them all.

And now comes the Wuncell—the first really *long life* Dull Emitter. Dull Emitters are no new discovery. They have been in existence for several years—but there is a vast difference between the laboratory specimen and the valve produced under modern manufacturing conditions in mass production. Two bugbears have always been present in the evolution of the perfect dull emitter. One the difficulty of obtaining absolute uniformity of performance, and the other, of producing a robust valve.

Not until these difficulties were definitely overcome was the Wuncell placed upon the market. The wonderful reputation enjoyed by the Cossor Bright Emitter valve could not be prejudiced by the hasty manufacture of a dull emitter merely to meet a clamorous demand.

Uniformity of performance and exceptional sturdiness are the two outstanding features of the new Wuncell. These are no idle platitudes as many thousands of Wuncell users can already testify. They are due solely to its unique filament.

Instead of whittling down the filament to secure low current consumption at the risk of fragility, that used in the Wuncell, by reason of a most elaborate process is *built up layer upon layer.* The result is a filament quite as stout as that used in any bright emitter valve. Its electron emission, however, is so vastly increased that only very little electrical energy is required to operate it. In daylight, for example, its glow is practically invisible, while at night it can only be compared to the luminous figures on a watch.

With such a filament mounted in arch formation and further secured at its centre by a third support, it is small wonder that the Wuncell was described by *Amateur Wireless* as being "almost everlasting." Valve users would do well to note that this type of filament is not obtainable in any other make of valve.

Uniformity of construction is safeguarded in the big Cossor factory through the provision of the most accurate machinery that human ingenuity can devise. Gauges accurate to one ten-thousandth part of an inch—workers long skilled in the most delicate operations—systematic tests taken during every process—the courage to discard every valve which does not reach the pre-determined standard of excellence—these are some of the reasons why the Wuncell is rapidly supplanting all bright emitter valves.

For 2-volt Accumulators.

W.1. For Detector and L.F. use. Consumption: .3 amp.	14/-
W.2. (With red top) For H.F. use. Consumption: .3 amp.	14/-
W 3. The Loud Speaker Valve. Consumption: .5 amp.	18/6

Cossor
DULL EMITTER VALVES

For 2, 4 or 6 Volts.

W.R.1. Similar to W.1 but with special resistance which can be short-circuited when not required	16/-
W.R.2. Similar to W.2 but with resistance as above	16/-

Popular Wireless

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RADIO NOTES AND NEWS.

Who told the Police?—Candour at 6 BM—Receiving California Direct—Prince of Wales to Broadcast—Europe's New Wave Length Scheme.

Who Told the Police?

AMONGST my letters this week was one from a Dutch Ham! Over in Holland, you know, they follow the American fashion of calling an amateur radio transmitter a "ham"; and lately the police have been on the track of these hams, for they have been transmitting without licences from the Government. Over a dozen prosecutions have taken place, and nobody knows how the police get hold of the names and addresses. My correspondent urges me to warn British experimenters not to give the Dutch police any addresses they may have picked up, and he goes on to say:

Dutch Hams.

"IT is rather a bore that the Dutch authorities are so backward on this point, and don't meet in any way our wishes. However, we go on, if possible even more than we have done of late."

If they are all animated by this spirit, the Dutch police will have great difficulty in curing those hams, won't they?

Candour at 6 B M.

"JUST One Thing After Another" is the title of Saturday's programme at Bournemouth. Some of the other stations have that kind of programme, too, though generally they are not so candid about it!

European Ups and Downs.

HAVE you noticed the falling-off in the strength of Radio-Berne since that station changed its wave-length? Several readers have reported that the Swiss station is now only coming in at about half-strength, but my own aerial is evidently not favourably placed, for Berne is one of the European stations that I seldom hear. By the way, isn't Rome reaching out these days? I was surprised to hear the Italian station the other day, in broad daylight, using a straight Det. and L.F.

Receiving California Direct.

I WAS glad to hear from Mr. J. B. Inglis, Northfield, Hawick, that his recent reception of K G O has now been confirmed. In a letter from the General Electric Company, who operate the Californian station, Mr. Inglis is informed that so far as the authorities can trace, he is the second listener in Scotland who has picked up signals that have traversed the intervening 6,000 miles.

In the Control Room at the Radio Zurich broadcasting station.

6,000 Miles on Two Valves.

THE remarkable thing about the feat is the fact that Mr. Inglis was only using a two-valve set, straight Det. and L.F. He tells me that lately he has been able to receive Hamburg and Prague quite nicely at mid-day, but only when using his larger set, which is a "straight" four-valver.

Prince of Wales to Broadcast.

AMONGST the interesting items announced for next month's programmes is a speech by the Prince of Wales. This will be on May 11th, on the occasion of the Boys' Brigade Demonstration in the Albert Hall, when the Prince is expected to deliver a ten-minute talk, at nine p.m.

Another May item will be the broadcasting of the Brighton Competitive Musical Festival, which will be relayed from the Royal Pavilion and Dome to 2 L O, on May 15th.

A Wireless Baby.

"BOTH mother and child doing well," was the final wireless message received by the surgeon of the S.S. "Montclare," after he had "attended" by wireless to an urgent call from another vessel in mid-Atlantic. Within two hours of the call going out, medical advice had been obtained over the ether, and the baby was born!

At the time the two vessels concerned were about one hundred miles apart.

Wireless and the Nerves.

IT has long been known that when the nerves pass a message to the brain,

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

an electrical disturbance is set up. By means of a three-valve amplifier, Dr. E. D. Adrian, F.R.S., of Cambridge University, has magnified these impulses about two thousand times, so that they can be studied. Records are made upon a rapidly moving photographic plate, and it appears that the different intensities are signalled by different frequencies.

The discovery opens up a new field for the neurologist, and is another proof of the fact that to the possibilities of wireless there is no end.

Service for "Shut-Ins."

IN response to the wishes of thousands of listeners, the B.B.C. is shortly to start a new feature. This will be a Service for "Shut-ins," or, in other words, a special broadcast to hospitals and to the sick. The most convenient time appears to be 4.0 p.m. on Thursdays, and it is probable that a regular half-hour programme of this kind will shortly be commenced.

To America on a Dull Emitter.

AN excellent low-power performance has just fallen to the lot of G 6 Q B, the amateur transmitting station operated by Mr. L. H. Thomas, of 33, Harpenden Road, West Norwood, London, S.E.27. Using an ordinary dull-emitter Osram L.S.5 valve, and getting his H.T. from an M.L. Anode Converter, 6 Q B has been in communication with the U.S.A., as represented by 2 C V J, whose aerial hangs out at Hartsdale, New York State. The input power at 6 Q B was ten watts only—about a quarter or a sixth of the power required by the ordinary electric light!

Bill Sykes and Broadcasting.

TWO hundred valves under repair, some accumulators, a four-valve set, complete with loud speaker, and about 1,000 new valves, were amongst the booty secured by London burglars who broke into the works of the Lumos Radio Valve Co., at Acton.

In addition, they collared about fifteen pounds in cash, so presumably they will now be able to purchase a licence, and listen in!

From 2 L O To-Night.

LONDON'S programme to-night is by The Roosters, and it should prove a good one, for it is virtually an encore performance. So many are the items which have been specially asked for, that on this occasion these requests have been embodied into a complete programme, consisting of the most popular items of earlier performances.

Parlez Vous?

IN a cheery letter from "Down Under," an Australian reader asks to be put in touch with a French reader of "P.W.," with the idea of a radio correspondence. So, if you're a Frenchman, about twenty-three years of age, and able to speak a little English, write to Mr. F. Guinane, 260, Inkerman St., East St. Kilda, Melbourne. He knows a little French, and there ought to be plenty of fun in such a friendship by correspondence.

Japan Forging Ahead.

IN the January 16th issue of "P.W." it was stated under the above title that the number of licence-holders in Japan was over 75,000. This was a very conservative figure, for I learn direct from the Tokyo broadcasting station, that Japan's total is now nearly half a million.

The Japanese programmes have already been picked up as far afield as Australia and the U.S.A.

High-Power Station for Tokyo.

SO great is the popularity of broadcasting in Japan, that that country is now proposing to build the Daventry of the East. This will be a powerful station located about ten miles from Tokyo, and having a crystal range of 100 miles. The aerial output will be ten kilowatts, and it is hoped that the signals will make themselves heard in Europe.

SHORT WAVES.

"A paper asserts that 'the face can now be clearly transmitted by a new television device.' There are some faces we hope will get lost in transmission."—"Electrical Industries."

* * *

"As a listener, I often hear gentlemen, professing to be scientific, broadcasting the most staggeringly questionable statements without a word of remonstrance."—Mr. G. B. SHAW.

* * *

"Beyond any shadow of doubt, broadcasting is helping opera immensely."—Mr. W. D. HUNT, manager of the B.N.O.C., in an interview by the "Daily Mail."

* * *

"No more will it be possible to address 'Mr. Speaker.' Henceforth to Mr. Loud Speaker alone shall appeal be made."—Mr. Leslie HORE-BELISHA, M.P., writing in the "Evening Standard."

Egypt "On the Air."

ANTONY and Cleopatra could have broadcast their love-scenes if they had waited a couple of thousand years or so, for Egypt now has a broadcasting station of its own.

This station has been established by a French company, and employs a power of two kilowatts. It works upon a wavelength of 325 metres, and is situated in Cairo.

A Timely Reminder.

THE violence of the atmospheric interruptions on Easter Sunday gave listeners a timely reminder that during the summer, aerials should be earthed when not in use. Then, as soon as atmospherics ("X's") get strong enough or frequent enough to spoil the programme, the aerial should be switched through to earth, and the set left alone till the clouds roll by!

If you use an outdoor aerial, and haven't yet fitted an earthing-switch, do it now.

The Lucky Listener.

ENFIELD Police Court was the scene of an unusual incident recently, when a man was summoned for installing a one-valve set without a licence. He told the Bench that he had bought the set on the instalment plan, and paid for the licence after the last instalment had been paid. The chairman said he thought it was a trivial case, and should never have been brought. The G.P.O. solicitor stated that the prosecution was under the personal direction of the Postmaster-General, but nevertheless the case was dismissed under the Probation of Offenders Act.

Ending the Battery Nuisance.

NOBODY seems to have noticed that the Government's Electricity Bill will have a very important bearing upon wireless in this country. If the electric-supply frequency is standardised all over Britain, it will mean the end of our battery troubles, for it will then be a simple matter to design a set to work straight off the mains, without any auxiliary accumulators or dry-batteries.

The whole trouble with present-day battery eliminators is that they have to be specially designed for different frequencies and voltages, and the Government's Bill would stop all that at the source.

The Real Reason.

ALTHOUGH the March wireless returns have not been issued at the time of writing, it is confidently expected by Post Office officials that during that month Britain reached the two-million-licensed-listeners mark.

There has been a great rush to take out licences during the last few months—not because programmes are better, but because fines for working an unlicensed set are getting worse!

Europe's New Wave-length Scheme.

ALL the broadcasting authorities in Europe are thinking hard over the latest scheme for the minimising of interference. At the last Geneva Conference two main recommendations were made, which, if adopted by the various countries, will smooth out the ether for next winter's programmes. The first of these recommendations everyone will agree to—that a method should be adopted by which every station should remain exactly upon the wave-length allotted to it.

Dividing the Stations.

THE other recommendation of the experts is that of exclusive and non-exclusive wave-lengths. Stations employing the former will be clear of all interference, and will work upon high power. The non-exclusive stations will all work upon low power, and their wave-lengths will be shared by other stations (also working upon low power) situated so many miles away that no heterodyning will be apparent. It sounds a pretty good scheme, and I hope it gets a fair trial.

The "N" Circuit.

THE Editor tells me that further details regarding the "N" Circuit will be published next week. At the moment special tests are being made with the circuit.

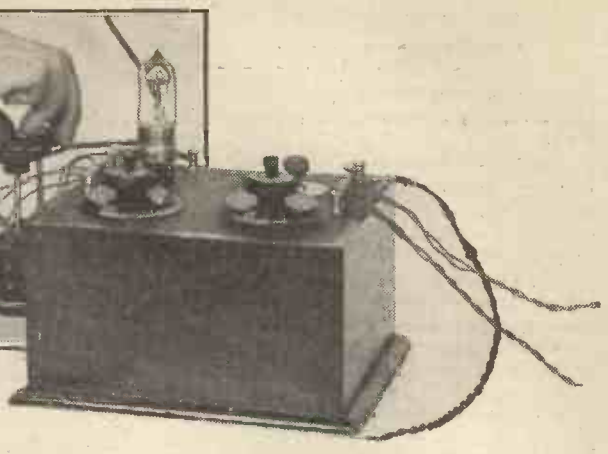
The "P.W." Valve Guide.

THE POPULAR WIRELESS Valve Guide, starting in this week's issue, is the most complete and comprehensive list of British valves which has yet appeared.

To most readers it will be a revelation of the number of valves for different purposes now upon the market, and it will form an invaluable guide to the various types. In addition to the two pages appearing this week, three more full pages of "P.W." will be required to complete the Guide.

ARIEL.

A SELECTIVE ONE VALVE SET



The Set designed and described by
K. D. ROGERS.
(Assistant Technical Editor.)

Constructional work by
C. A. MEADOWS.
("P.W." Technical Staff.)

THIS little one-valve receiver has been designed to meet the needs of the listener who requires an inexpensive set that will give him his local programme and other stations if desired—on the headphones. It is not difficult to handle, in spite of the three-coil holder and the two condensers, while the selectiveness of the set enables many stations to be clearly received which would otherwise be hopelessly jammed.

In order to keep the size of the set as small as possible the coil holder is mounted on the side of the case, which also enables tuning and reaction control to be carried out with the maximum amount of ease. Both variable condensers have verniers incorporated in them, though this is a refinement that can be omitted if desired. Series-parallel three terminal system is employed, so that with one set of three coils the listener should be able to cover practically all the B.B.C. wave-lengths, that is a wave-band of 300–500 metres.

Adaptable for Short Waves.

Alteration of the coils will enable Daventry to be tuned in, and if the wiring is carefully carried out there is no reason, with suitably wound coils of the low loss type, why the set should not be used for short-wave reception of from 50 metres upwards. This would include K D K A, the famous American broadcasting station at East Pittsburg, and many other interesting stations besides a galaxy of amateur transmitters.

On the whole, then, the set is about as adaptable as any one-valve receiver could be, while its loose coupling arrangement allows selectivity to be obtained without any loss of sensitivity and also makes the set more useful on the low wave-lengths. It is well known that for short-wave reception (below 150 metres) it is advisable and below 100 metres practically essential that a loose coupled grid circuit be employed.

The Components.

In this respect the provision for series or parallel aerial tuning is also invaluable, for below 300 metres it is better to use a series condenser, while above 600 or so metres the parallel method is to be preferred.

For the construction of the selective one-valve set the components mentioned in the list of parts are required, though it is not essential that the exact makes and types specified be used. The only difficulty that is likely to occur if different components from those mentioned are employed will be that the variable condensers may not fit in properly—they may touch each other—and the coil holder may not be capable of such fine adjustment as is the Lotus, which we recommend for this set.

Good Apparatus Essential.

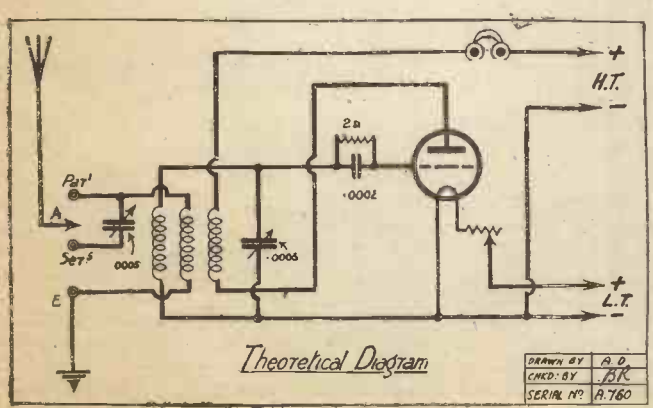
Whatever apparatus is used, however, care must be taken that its quality is above reproach, or the clear reception for which this set is noteworthy and its efficiency may be impaired. In the event of different apparatus from that listed being used the listener will have to alter the panel drilling diagram to suit the various components.

(Continued on next page.)

LIST OF COMPONENTS.

(Single Valve Loose Coupled).	£	s.	d.
1 ·0005 variable condenser (Wates) with vernier	0	11	6
1 ·0005 variable condenser, with vernier (Peto-Scott) ..	0	8	6
1 ·0002 fixed condenser (Lissen)	0	2	0
1 2 mfd. grid leak (Dubilier) ..	0	2	6
1 Rheostat (Precision)	0	3	0
1 Set of valve legs (Security) ..	0	1	0
1 Packet of Glazite	0	1	0
15 Small terminals	0	1	3

This illustration clearly shows the lay-out of the set and the way in which connections are made between the coil holder and the receiver.



A SELECTIVE ONE-VALVE SET.

(Continued from previous page.)

The drilling of the panel is not a difficult matter, though it may appear from the illustrations to contain an unnecessary number of terminals. This is because the coil holder leads—six in all—are brought by flex to terminals on the panel rather than taken through the cabinet to the wiring of the set. This enables the construction to be simplified and the panel to be removed from its case for inspection internally whenever required. It also provides accessibility in cases where reaction leads, etc., require to be changed over and it enables the constructor full control over his coil holder without the need of unscrewing those aggravating screws that are the means of making connection to most holders.

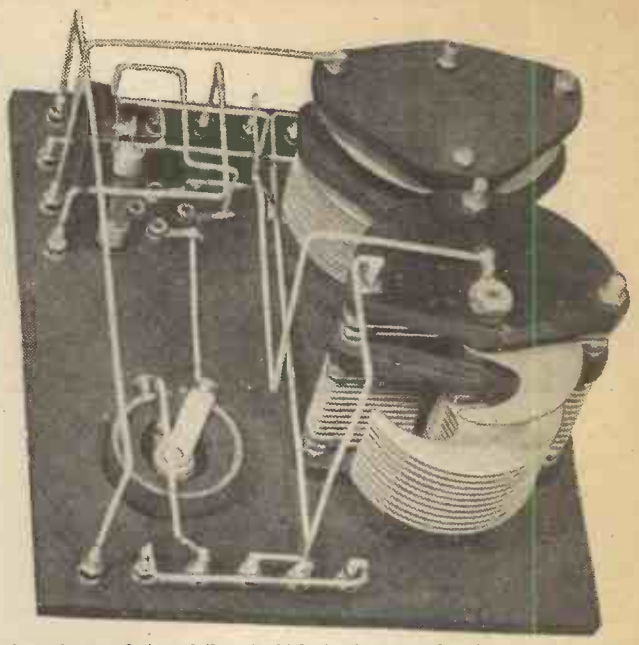
Connecting Up the Components.

Drilling is carried out by means of "metal working" twist drills, and all the terminals, condensers, etc., with the exception of the condenser and leak are mounted in position on the panel before the wiring is commenced. The latter is carried out on the set illustrated by means of 18-gauge Glazite, which forms an efficient and easy method of connecting up the set. All joints are better soldered if the constructor is familiar with the use of an iron, but if not they should be firmly clamped beneath the nuts and washers of the respective terminals, etc. The wiring diagram gives the connections underneath the panel, the grid leak and condenser being supported in a vertical position by means of the two wires from the grid and the moving plates of the secondary condenser respectively.

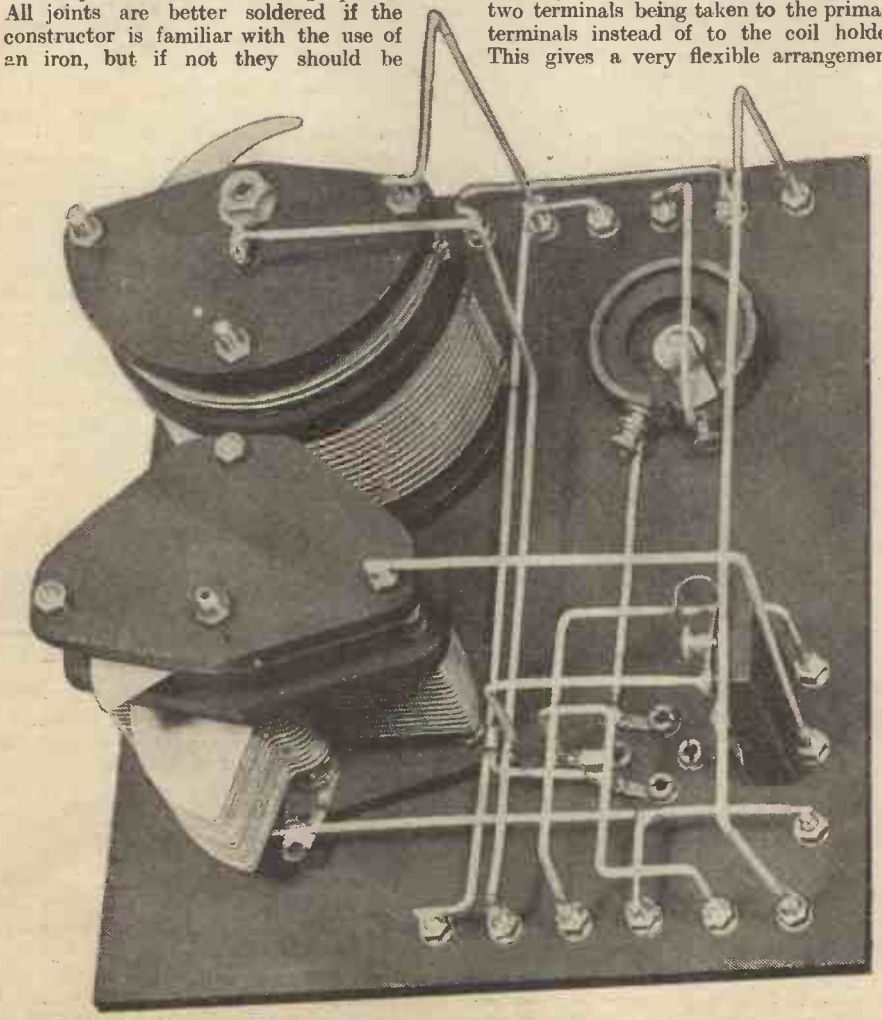
Coil Variations.

When wired up and the coil-holder flexes have been affixed the set can be connected to the batteries for testing. It will not, in its present form, work a loud speaker, but an amplifier can be added without trouble for loud-speaker work if desired.

The three-coil holder can be connected in various ways, so that reaction on either aerial or secondary or both can be obtained. This latter is not to be recommended, and reaction on the secondary is the most efficient. If desired, the reaction can be on the aerial and the secondary coil can be dispensed with, its two terminals being taken to the primary terminals instead of to the coil holder. This gives a very flexible arrangement, and enables the constructor to get the utmost out of his set. In the theoretical diagram and the photographs the coils are arranged for reaction on the aerial, which is useful in some cases where jamming is not very bad. Where this is more intense the reaction should be carried out on the secondary, and the primary, or aerial coil, should be kept as loosely coupled to the secondary as is consistent with adequate signal strength. The terminals on the left of the panel are, from top to bottom, reaction, primary, and secondary, in groups of two. It is by altering the connections to these terminals *externally*, not *internally*, that the various arrangements can be obtained.



An under-panel view of the set which clearly shows the wiring to the battery terminals and secondary condenser.



No difficulty should be experienced in wiring up the selective one-valve set if this illustration is taken as a guide to the connections.

Operating the Set.

For use with this set an outdoor aerial will be necessary, and as good an earth as circumstances permit. The better the earth connection, the more stable and easy will the set be to operate. About 60-80 volts H.T. will be ample, and the L.T. battery can be chosen to suit the particular valve it is decided to use.

Any good general purpose valve, or a valve suitable for "detection" or "rectifying," can be used, the filament current and H.T. voltage being kept down as low as is consistent with good results.

Tuning will be sharp, and so the constructor should test out on his local station first. Keep the two tuned coils close together, and tune both condensers simultaneously. As regards coils, the coil chart given here will prove useful.

Suitable Coils.

If the set does not oscillate on increasing the coupling between the reaction coil and the primary or secondary, the leads from the reaction coil to the two top terminals should be changed over. It is best to remove the H.T. positive plug from its battery before doing this, as otherwise one of the reaction leads might touch a secondary lead and short the H.T. battery—through the filament of the valve.

(Continued on next page.)

A SELECTIVE ONE-VALVE SET.

(Continued from previous page.)

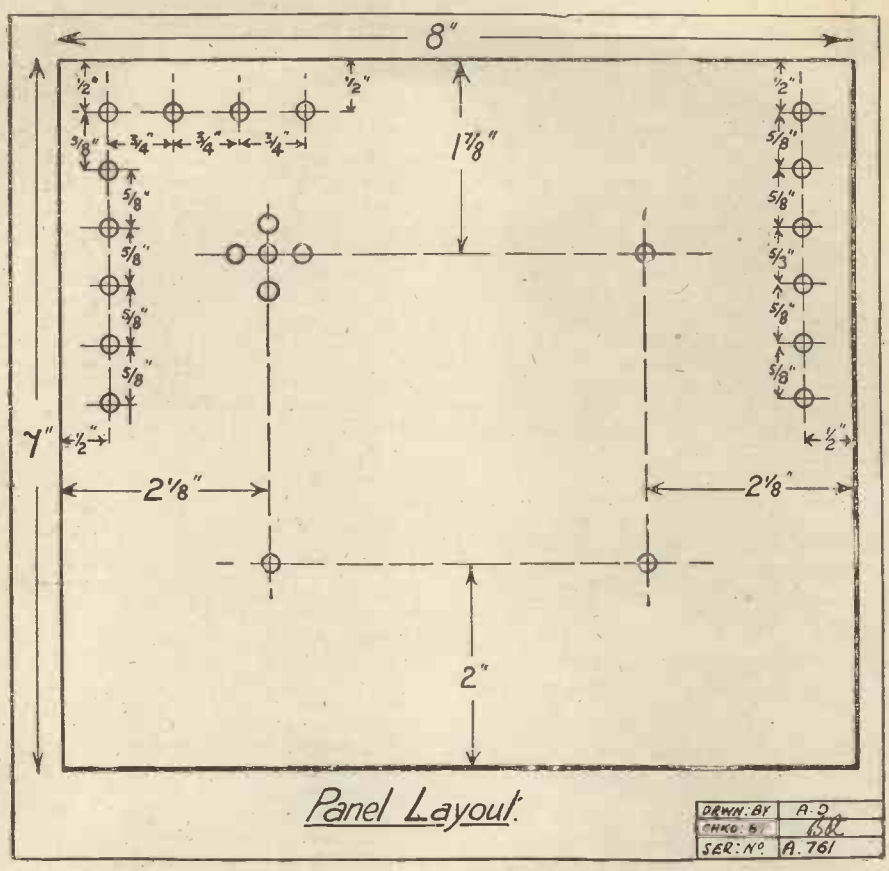
Wave-length with average aerial	Primary Turns Par. Cond.	Secondary Turns	Reaction Turns (approx.)
260–340	25	35	35–50
310–450	35	50	50–75
370–650	50	75	50–75
460–800	75	100	75
580–1200	100	150	75
790–1800	150	200	75
1060–2400	200	250	75
1430–3000	250	300	75–100

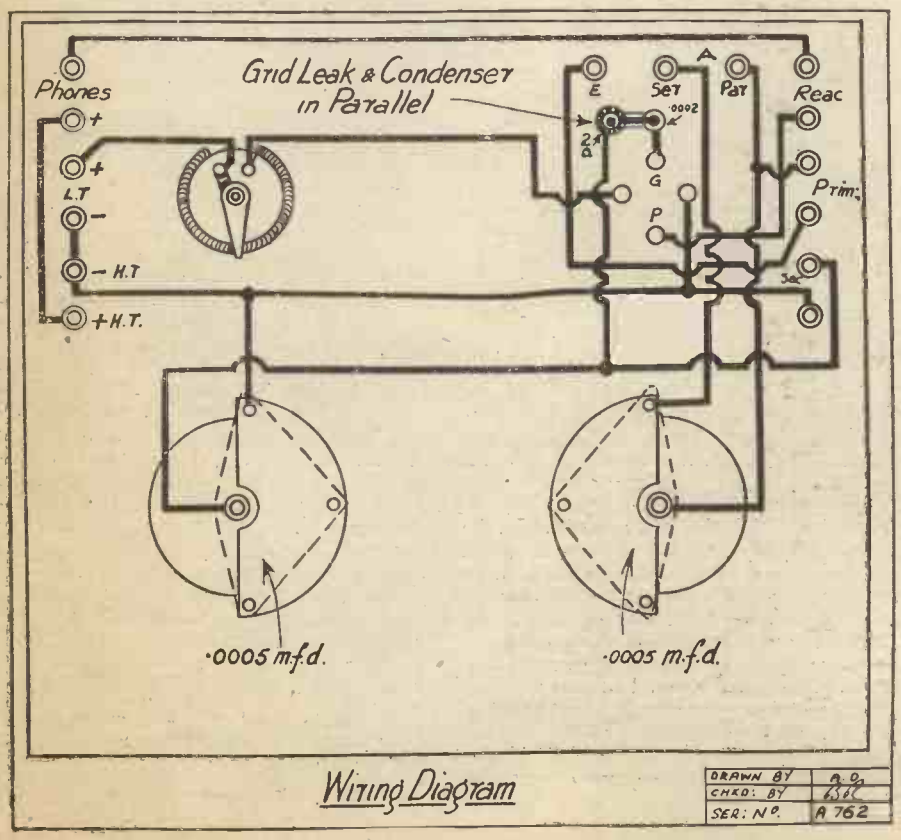
The wave-lengths covered by the set can be seen above, where the approximate maximum and minimum wave-lengths will be decided by the size of the primary coil, as the corresponding secondary will probably be able to tune both above and below the limits determined by the primary.

Where two sizes of reaction coil are stated it is best to use the smaller wherever possible, as this gives more easy control. Although the set is "loose-coupled," it is capable of causing serious interference to neighbouring listeners if it is allowed to oscillate.

Results to be Expected.

The "liveliness" of the set will largely depend upon the type of valve used, local conditions, etc., so that it is impossible to make any definite statement as to range of reception, but under moderate conditions most of the B.B.C. main stations should be audible and many Continental transmissions should be picked up. The listener will require a little practice on the set before the best results are obtained, as the coupling between the primary and secondary coils has a decided effect upon the strength of any transmission, while the selectivity of the set also depends upon the relative positions of the two coils.





For instance, if loud signals are required, the reaction should be applied to the secondary coil, and this and the primary should be coupled at about 1 in. apart. This, however, would not enable a badly jammed station to be received, and for the purpose of reducing the jamming the two coils must be separated still further and the reaction adjusted to the secondary coil so that the set is just off the oscillation point. This is not only the point of maximum sensitivity, but also that of the highest degree of selectivity, so that in this position the listener will have the best chance of cutting out the interference and picking up the required transmission.

POINT-TO-POINT CONNECTIONS.

Aerial parallel terminal to one side of primary coil and primary ·0005 condenser, other side of condenser to aerial series terminal. Earth terminal to remaining side of primary coil.

One side of secondary coil to combined grid leak and condenser, remaining side of combined grid leak and condenser to grid of valve.

Other side of secondary coil to one filament pin, L.T. – and H.T. –

Across the secondary coil is connected the 2nd ·0005 (secondary) condenser.

Plate to one side of reaction coil, other side of reaction coil to one side of 'phones, remaining side of 'phones to H.T.+.

L.T. + to remaining filament pin of valve holder via rheostat.

The set is not a difficult one to handle, and when a little practice has been obtained the listener should be able to go the round of a large number of stations and pick out the programme he most desires, at the same time cutting out interference to a very large extent.

Conducted by our Staff Consultant, J. H. T. ROBERTS, D.Sc., F.Inst.P.

An Efficient Aerial.

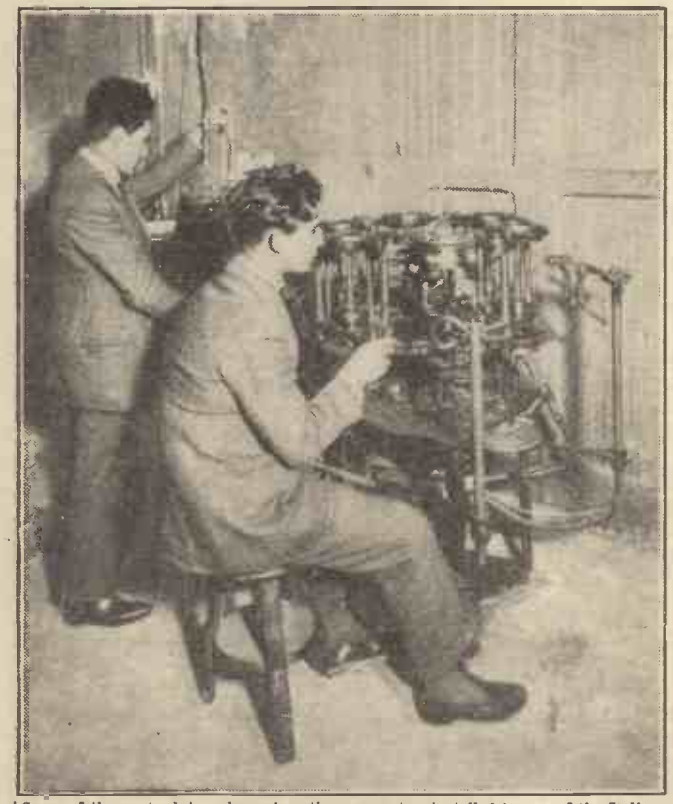
AMONGST the many further replies and suggestions which have been received from readers in connection with the discussion on aerials which was raised by my recent reference to this subject in these notes are several descriptions of special types of aerial wire which have been used with various degrees of success. One reader sends me a detailed account of the results which he has obtained by the use of an aerial wire which I can best describe as being similar to one of the loaded bass wires of a pianoforte. It is probably well known that the wires in the bass register of a pianoforte are generally formed of a straight steel wire which is closely wrapped with another wire in the form of a spiral: this is for the purpose of increasing the mass of the wire without increasing its elasticity. In the aerial wire referred to, the central core upon which the spiral is wrapped may be of copper or steel wire (preferably the latter) and may be either bare or enamelled. In order to obtain the advantage of the spiral cover, however, it is better that the central core should be enamelled so that it is insulated from the spiral; in this case a central wire is purely a carrier for the spiral, the latter being the aerial proper.

Superior to Other Types.

My correspondent states that he has made comparative tests between an aerial of this type and many others of more conventional types, and that he has fully convinced himself of the superiority of the former. Whilst accepting these results, it is nevertheless somewhat difficult to see, at first sight, why such an aerial should have any particular superiority over the ordinary kind, for the diameter of the spiral is so extremely small that inductive effects (treating the aerial as a solenoid) must be very small. Of course, the type of aerial in which a solenoid of comparatively large diameter is used is well known and has been on the market for some time past, more particularly for indoor aerials. It may be remarked that an aerial somewhat of the type described above by my correspondent has also been on the market some considerable time.

Metal Panels.

There is a growing tendency in favour of the use of metal, not only for the panels but also for the cabinets of wireless sets, and a well-known American manufacturer, of Chicago, has recently put on the market a series of metal panels already drilled and engraved as well as being, of course, suitably japanned or otherwise finished for the making-up of various types of set. Contrary to popular impression, the metal panel—which is usually of pressed steel about $\frac{1}{32}$nd thick—has much to recommend it. The first and most obvious point is that it acts as an electrostatic shield and prevents body capacity and the various disturbances of tuning which the latter entails. In the second place, it has much greater mechanical strength than the ebonite panel, and, furthermore, the necessary brackets for the assembly of the components of the set may either be formed as part of the metal panel or may very readily and securely be attached to it. The use of a metal cabinet together with a metal panel provides a complete shield for the whole of the set, and should work out, in quantity, much cheaper than polished wood cabinets. The necessary insulating bushes, etc., are all provided with the panel.



Some of the up-to-date valve exhausting apparatus installed in one of the Italian Radio colleges.

Automatic "Rheostats."

I notice that the idea underlying the automatic "rheostat"—of which the "amperite" is a well-known example—is being extended by the provision of fixed resistances for use with different types of valve. In "Radio Broadcast" (U.S.A.) is a description of what are termed "tube equalisers" or pre-adjusted rheostats. These, notwithstanding their somewhat ponderous name, are "fixed resisters," in plain English, and are a very useful accessory. A list is given showing the type of equaliser which is to be used with any of the well-known makes of American valve, the idea being that if the set employs some 6-volt valves, necessitating the use of a 6-volt accumulator, and you wish to use some other valves which are rated at a lower filament rating, all you have to do is to introduce in series with each of the latter type the appropriate equaliser. Or, to put it into the form of simple equation, any valve plus the appropriate equaliser equals 6 volts.

Equalisers can also be supplied for raising the rating of any valve up to 4 volts.

A Possible Development.

This idea appears to be a very good one, particularly as the fixed resisters are supplied at a very low price. It should be noted that these equalisers are not, however, of the automatically self-adjusting type, like the amperite; they are merely resistances, and they do not compensate for fluctuations in the applied voltage. There is nothing in the system, however, to prevent automatic rheostats being manufactured on the equaliser system, so that the units not only fulfil the purpose of the equaliser but also that of the automatic rheostat as well.

The "Radio Pen."

One of the latest inventions of Mr. Francis Jenkins, the famous American television expert, is the "radio pen," which, as its name implies, is a writing device operated entirely by wireless. In a recent demonstration of this device, the transmitting and receiving sets were separated by a distance of about four miles. At the transmitting end the operator merely writes on a sheet of paper by means of a pen to which are attached certain controls; these controls operate a transmitting instrument in such a way that a similar pen at the receiving station is caused to trace out a facsimile of the writing at the transmitter. The action, in fact, is similar to that in the well-known telegraphic writing appliances.

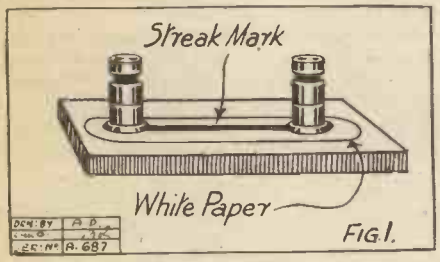
(*Continued on page* 335.)

EXPERIMENTAL GRID LEAKS

AN ARTICLE FOR THE AMATEUR EXPERIMENTER AND CONSTRUCTOR.

By J. F. CORRIGAN, M.Sc., A.I.C.
(*Staff Consultant.*)

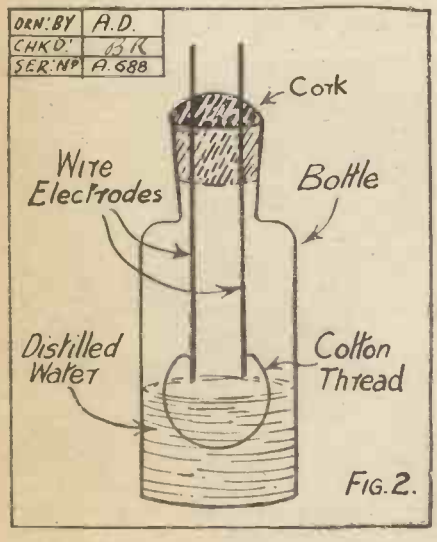
WHILST, with ordinary valve receiving sets which have been constructed with due regard to neatness of appearance and economy of space, no home-made article can equal the all-round efficiency and neatness of the commercial grid leak, yet there are times when one of



these articles is required for the purpose of including in hook-up circuits and for many other experimental purposes.

Not Difficult to Make.

Further, the amateur may not always have the financial wherewithal to equip himself with a full set of commercially manufactured grid leaks of varying resistances, and thus, unless he is able to make a number of these articles for himself, he may very probably have to leave severely alone the extremely interesting task of trying out grid leaks of varying resistances in standard or experimental valve circuits.



A grid leak, however, is not a difficult thing to make. On the contrary, it is probably one of the simplest radio components which it is possible for the amateur to construct. For the advanced experimenter, even, the subject of the grid leak is by no means final. It is quite possible that more efficient grid leaks may be devised, and that they may supersede the highly satisfactory ones which are now obtainable commercially. Thus the construction of one or more grid leaks of a rough and experimental type is a matter which will appeal to the experimenter, as well as to the comparative beginner in the science of radio reception.

It is therefore the purpose of this article to describe the construction of a few experimental and improvised grid leaks which, on an average, will be found to possess resistances from 1½ to 3 megohms,

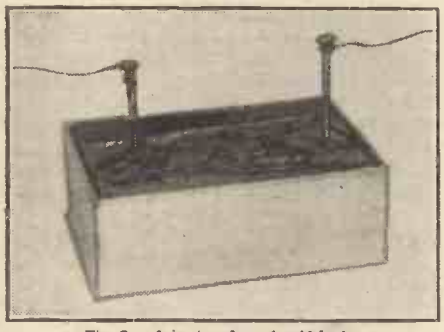


Fig. 3. A soot and sand grid leak.

and which will thus be extremely useful for experimental work in connection with new circuits.

What we may call the simplest and the "classical" form of grid leak is illustrated at Fig. 1. It consists of two terminals separated from each other by about an inch and a half. The terminals bind down to the baseboard a strip of white glazed paper on which is drawn a straight pencil or blacklead mark, the blacklead mark, of course, making good contact with both terminals.

Such a grid leak is of the simplest possible variety, and the reason why I have called it a "classical" one is because it is the sort of thing which is generally illustrated when the subject of grid leaks has to be explained in principle. Such a leak will have a resistance of about 2 megohms, according to the length and thickness of the pencil line, and it will function well when included in the circuit of any set.

Crystal Streaks.

But the principle of this type of grid leak does not stop here. With two terminals, a baseboard, and a few strips of paper we may construct many experimental "mineral grid leaks." It is well-known, of course, that many minerals having an appreciable amount of electrical conductivity possess the property of leaving a streak when they are rubbed on paper. Now, with the aid of a few small fragments of these minerals, many interesting experiments can be made in the construction and use of mineral grid leaks of varying resistances.

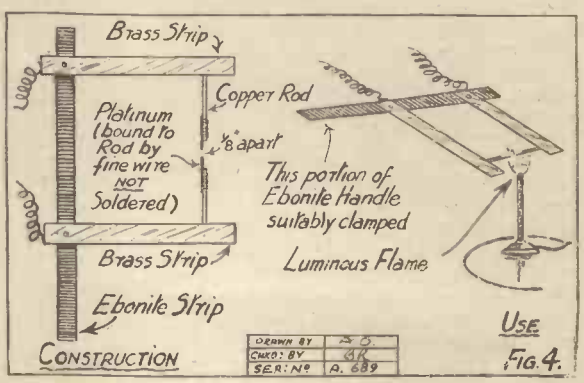
For instance, many varieties of galena, the crystal which is so commonly employed for rectifying purposes, will mark paper, and thus by drawing a line across the sheet of white paper with a very small fragment of soft galena, and subsequently mounting the terminals in contact with the line, an experimental galena grid leak may be devised.

A Bottle Type.

The crystal molybdenite is still better for this purpose, for it easily leaves a thick streak when drawn across paper, and as this streak will have a considerably high resistance, grid leaks of higher resistances than are ordinarily constructed may be made.

The bottle grid leak is another pattern which may appeal to the amateur. Such an instrument is illustrated at Fig. 2. All it consists of is a wide-mouthed bottle fitted with a cork and two pins. Across the points of the pins is tied a piece of cotton. The bottle is now half-filled with *distilled* water and the cork replaced. The water must be of the distilled variety, otherwise it may form a conducting path, and thus destroy the action of the grid leak.

Varying degrees of resistance can be obtained with this simple instrument by varying the length of the thread, and also by varying the area of it which is immersed in the distilled water. Also, by adding minute amounts of common salt to the distilled water in the bottle, the resistance of the leak may be controlably lowered.



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EXPERIMENTAL GRID LEAKS.

(Continued from previous page.)

High-resistance grid leaks can also be made by omitting the cotton thread in the bottle, and by allowing the pins to dip into distilled water containing the merest trace of sulphuric or hydrochloric acid (about 1 part in 2,000). Leaks may also be made by substituting traces of ordinary vinegar for the sulphuric or hydrochloric acids.

"Photographic" Grid Leaks.

A small wooden box containing a mixture of sand or chalk and soot into which two small electrodes are placed at varying distances makes a form of grid leak from which many interesting experiments can be obtained. Such a leak is indicated at Fig. 3. The box, of course, must not be a metallic one, otherwise short-circuiting would arise. The resistance of the leak can be varied by altering the relative proportions of sand and soot in the box. The greater the amount of sand mixed with the soot, the higher will be the resistance of the leak. A fair average mixture for experimental purposes may be made by mixing one part of good soot with about twelve to fifteen parts of sand, chalk, lime, or similar insulating material.

Fig. 5. An interesting experiment with a pipe.

"Photographic" grid leaks may be constructed by substituting a strip of blackened photographic printing paper for the sheet of white paper in the grid leak shown at Fig. 1. In this case the metallic deposit of silver in the print very often acts as a conducting path of high resistance. The print, however, must be a "matte" one, otherwise it will be found an extremely difficult matter to effect an electrical connection between the binding terminals and the gelatine of a glossy print.

Using a Gas Burner.

A grid leak of high resistance may be made by placing two platinum wires, separated about an eighth of an inch apart, in the luminous flame of a gas burner or oil lamp. Such an instrument is shown at Fig. 4, but, of course, the construction indicated in that diagram can be varied to suit the convenience of the individual experimenter.

In this instrument the particles of white-hot solid carbon which exist in the luminous portions of the flame form the electrically conducting path, and experiments of extreme interest can be carried out by this simple apparatus. The wires must, however, be made of platinum or some similar "noble" metal, otherwise they would oxidise and soon become useless as electrodes.

Quite an interesting although rough form of grid leak may be produced by sticking two thin metal rods in the uncleaned bowl of a foul tobacco pipe. In this instance the moisture, nicotine, and the various organic acids which are always present among partially burned tobacco will form a conducting path. Such a form of leak, of course, cannot be relied upon, because the conditions prevailing in the pipe can never be constant, but nevertheless the device is so readily put together that it will not fail to be of interest to every valve-set owner—beginner, amateur, and experimenter alike. This leak will be seen at Fig. 5.

Variation Required.

From the above few suggestions it will be seen that a grid leak in one form or another is very easily made. Other devices for producing the requisite conditions of a grid leak can be made without number. The one thing to remember is that the leak must possess an electrical conducting path of high resistance, and if possible, the resistance of this path should be capable of being varied more or less at will.

Of course, none of the devices mentioned above is of the slightest use for including in properly-fitted sets which are meant to look attractive. But, nevertheless, they are of interest from the point of view of experiment, and it is chiefly for that purpose that their use has been suggested here.

The Latest Development.

Many readers may be aware of the latest development of the grid leak. This takes the form of a specially constructed selenium cell of high resistance. Now, as the resistance of a selenium cell varies according to the amount of light which falls upon it, it stands to reason that the selenium grid leak is one which can be automatically varied by the light of the valve filament. This new development in grid leaks is a very fascinating one, and it is one which I hope to be able to describe to "P.W." readers later on.

TIMELY HINTS.

IF you intend adding a valve to your set, do not do so on the same panel unless provision has already been made for its accommodation. A panel that has been designed for two valves will obviously not take three without "crowding" of components and consequent instability in the circuit.

The correct way to add it is either to wire it on another panel and then connect it to the set by means of short lengths of flexible wire, or else relay the whole set out with the addition of the extra valve on a larger panel.

On the whole the latter arrangement is to be preferred, especially in the case of an H.F. valve, where the whole tuning system has to be shifted to the grid current of the extra valve.

Components and Accessories.

Remember, too, that the best set is not necessarily the one that incorporates all your spare components. The "straighter" the circuit the more efficient the set and the better the results.

Do not purchase all the apparatus that catches your eye and then expect to make up a set from such parts.

Choose your circuit first. Similarly, an L.T. battery should be obtained that will suit the valves both as regards voltage and current consumption.

If you intend using 3-volt valves and you already have a 6-volt accumulator, do not tap on to 4 volts on the battery, but use the *whole* battery with a suitable *fixed filament resistance*, as well as a rheostat for each valve.

In this way the whole battery can be kept in condition, instead of letting one of its cells deteriorate—you may want to use if for 6-volt valves again.

The studio of the well-known Paris station P.T.T. which broadcasts on a wave-length of 458 metres.

SWITCHING-IN VALVE CIRCUITS.

SERIES-PARALLEL SWITCHES.

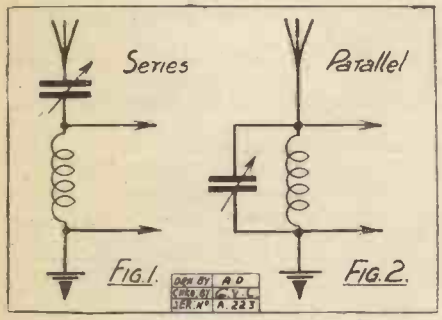
By G. V. COLLE

(*Technical Staff, "Popular Wireless"*).

A SERIES-PARALLEL switch, as its name implies, is usually employed for automatically transferring a variable condenser from a position in series with an inductance to a position across or parallel with it.

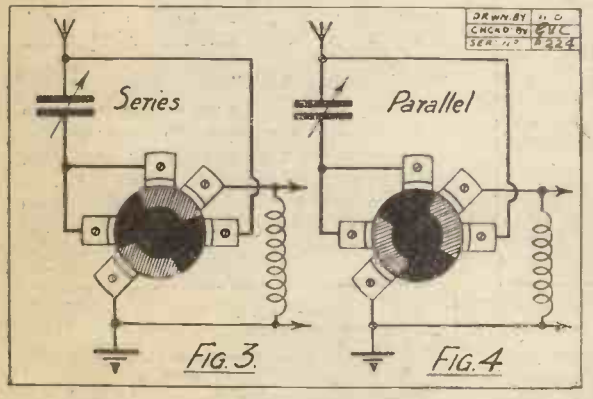
So that the reader may be clear as to what series and parallel condensers are, they have been shown in Figs. 1 and 2 respectively.

When a variable condenser is placed in parallel across an inductance, the wave-length of the latter is increased as the condenser is rotated towards maximum capacity. The maximum wave-length to which the inductance will tune will, of course, depend on the capacity of the variable condenser across it. *Usually, when a variable condenser is placed across an inductance the natural wave-length of the coil will be raised some few metres, even when the condenser is "all out."* This is due to the self-capacity of the condenser and varies with individual makes. In the better makes of variable condensers, this self-capacity is usually very low and can be neglected when making any calculation, etc.



Decreasing the Wave-length.

By placing the variable condenser in series with the inductance, the maximum wave-length to which the coil will tune with the condenser "all-in" will be approximately 30 to 50 metres below the actual wave-length of the coil (on the broadcast band of wave-lengths). As the condenser is rotated towards minimum capacity the wave-length is decreased. The drop in wave-length with the condenser in series with the coil varies. Thus, on short wave-lengths it is very small, and on high wave-lengths quite considerable.

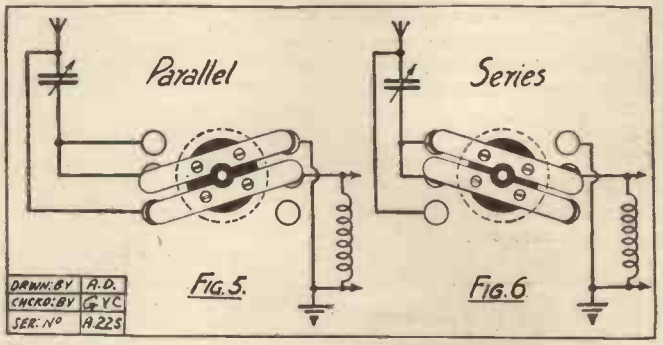


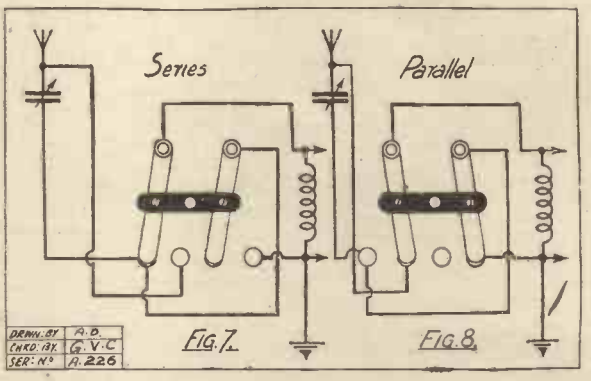
In the former case a small variable condenser will bring the wave-length of the coil nearly up to its original one; but a variable condenser having about four or five times its capacity will be required for bringing the high wave-length coil up proportionately.

As it is not a practical proposition to use different condensers for different bands of wave-lengths, some intermediate capacity must be employed. For this reason a ·0005 variable condenser is favoured as being suited for the purpose, while a series-parallel switch allows the maximum range of wave-lengths for each coil.

A condenser of the above capacity can be employed to advantage for wave-lengths between 200 and 2,000 metres. Above the higher limit an ·001 variable condenser is very useful, while below 200 metres ·0002 is very satisfactory.

Should the reader be able to "go down" to 40 or even 20 metres, he will probably find that an .0001 variable condenser is all that is necessary, any condenser above this capacity giving too coarse an adjustment, the change in frequency being too great for each degree of rotation.





Useful Types.

There are many types of series-parallel switches now on the market, giving the amateur a wide choice. While it is not possible to recommend any particular make or type to the reader, it is suggested that preference be given to that class of series-parallel switch which is simple and has a low self-capacity.

Coming to the different types themselves, Figs. 3 and 4 show a series-parallel switch of the rotary pattern. Figs 5 and 6 show the parallel and series positions respectively of a "double-arm" series-parallel switch.

The "Utility" Switch.

A switch not often used at the present time is given in Figs. 7 and 8. Figs. 9 and 10 illustrate a D.P.D.T. switch, used in the aerial circuit for the purposes related in this article. This switch is very simple to operate, is not complicated to wire, and has everything to recommend it. A type of switch similar in operation to this is the "Utility" which is very popular at the present time. A sketch of the "Utility" appears in Fig. 11, while the wiring of it is identical to that of the D.P.D.T. switch.

A series-parallel switch of unique design is shown in Fig. 12. This switch, which is of the push-pull type, can be incorporated on a panel where there is little room to spare.

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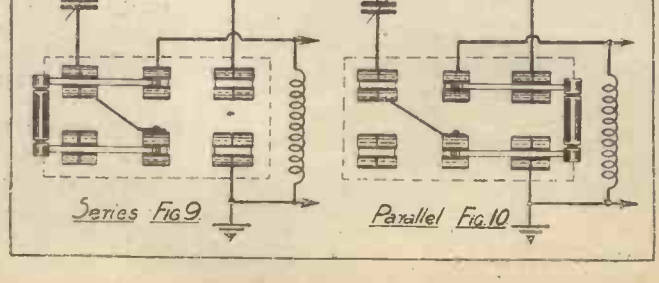

DESCRIPTION OF COIL-DRIVEN CONE LOUD SPEAKER.

Designed by Dr. N. W. McLACHLAN.

THERE are two very important requirements to be met in designing loud speakers. It is necessary to avoid resonances, and it is desirable to give equal prominence to all notes in the musical scale. There are, of course, a limited number of ways of achieving such results. Thanks to Sir Oliver Lodge*, who devised the use of a coil in the field of a magnet, and to the late Lord Rayleigh†, who showed that the sound from a vibrating body was increased by screening one side from the other, we are able to satisfy the above wants extremely well. Fig. 1 shows a sectional diagram of the loud speaker designed by Dr. N. W. McLachlan.

The Moving Coil Principle.

Currents of speech or musical frequencies are passed into a moving coil fixed to the

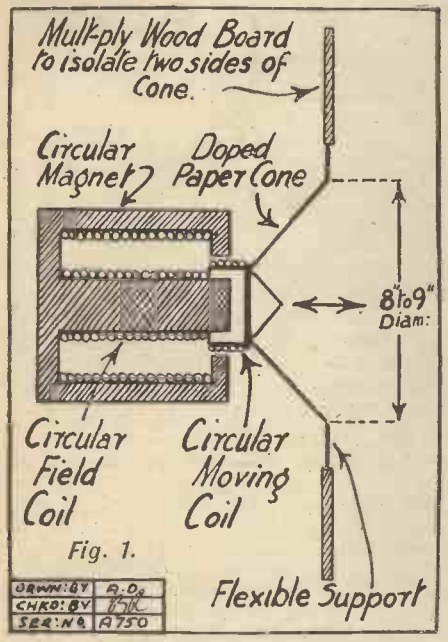

Fig. 1.

apex of a paper cone. The moving coil is situated in a strong magnetic field, and the currents in it react on the field. The coil, therefore, moves in and out in the directions shown by the arrows. The edge of the cone is lightly supported by some pliable material, such as stockinette or thin rubber, so that it can move freely.

Compression and Rarefaction.

Thus the cone is driven by the coil and in so doing radiates sound from both back and front. But when the air at the front of the cone is compressed, that at the back is rarified. Thus the front will be at a greater pressure than the back, and the air will rush round to equalise the pressure. In fact, there would be a miniature draught. Now no sound would be radiated if both sides were at the same pressure.

This never actually occurs, because it takes time for the pressure-wave to travel from one side of the cone to the other. At low frequencies, however, there is a reduction in the sound, because the cone is moving slowly and the wave has plenty of time to get round.

To prevent the wave getting from one side to the other, a large board 3 ft. 6 in. square is placed round the cone—i.e. the cone is at the centre of the board. In this way the low tones are preserved.

Free from Resonance.

As there is no reed and the diaphragm is quite small, the instrument is devoid of resonance. It will reproduce any sound from the pedal pipes of the organ, the double bass, to the high harmonics of the violin.

With a suitable valve circuit it is comfortably audible at a distance of 100 yards. Even at the large intensity required to carry this distance the reproduction is so natural that it is easy to deceive the listener.

This has happened on numerous occasions. There is much less focusing than is obtained with a horn loud speaker, and since both sides of the cone radiate sound it is more uniformly distributed.

Loud Speaker for Outdoor Work.

The arrangement of Fig. 1 is for use indoors. For use outside the magnet and cone are put in a box, the wooden board being removed. The box will be seen in the lower part of the photograph, and the upper part consisting of cradle, magnet, and cone is slid out of the top runners and pushed into the box. A door with a copper gauze window is fitted to the front of the box to keep the weather out.

* British Patent 9712, 1898.

† Philosophical Transactions of the Royal Society, 1866.

SWITCHING-IN VALVE CIRCUITS.

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Before closing this article it would not be out of place to mention the "three-terminal" arrangement which is becoming increasingly popular. A sketch of the arrangement is given in Fig. 13.

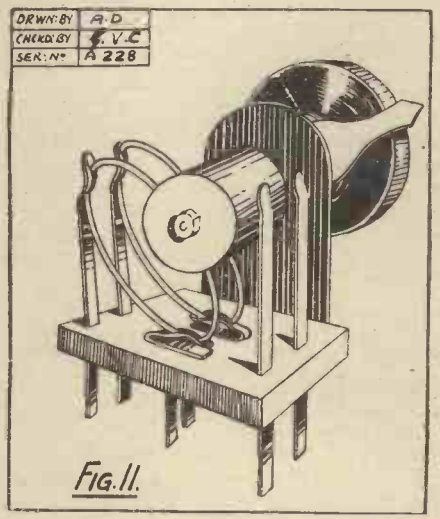


Fig. 11.

As the reader will observe, three terminals, about 1 in. apart, are utilised. One is marked "parallel," one "series," and the other "earth."

"Three Terminal" System.

When it is desired to place the variable condenser in series with the aerial, the aerial lead is joined to the centre terminal marked "series," and the earth permanently to the "earth" terminal.

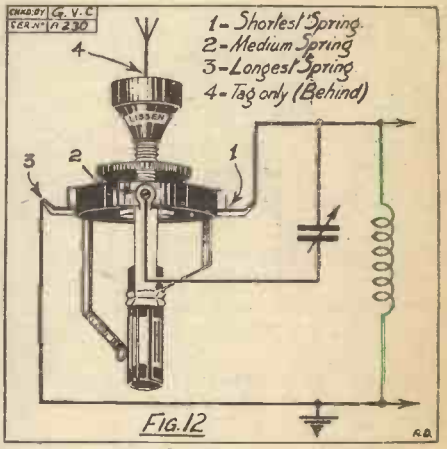


Fig. 12.

For placing the condenser in "parallel" with the aerial coil, the aerial lead is removed from the centre terminal and joined instead to the top terminal marked "parallel." The centre terminal at the same time is joined to the "earth" terminal. The condenser is now in parallel.

The "Shorting Strap."

To facilitate quickness of connection, a brass strap can be made to swing on the earth terminal, and engage, by means of a cut or fork, with the centre terminal.

When the condenser is in the series position this strap can hang from the earth terminal.

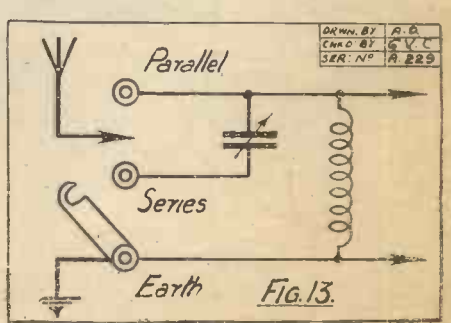


Fig. 13.

Variometers in Valve Circuits

The second and concluding instalment on the ways variometers can be utilised in various valve circuits.

By C. E. FIELD, B.Sc.
(Staff Consultant.)

VARIOMETER tuning suffers under certain disadvantages when compared with the coil-and-condenser method, but many of these may be overcome, and variometers may be used for a variety of purposes other than simply tuning an aerial circuit within their own wave-length range.

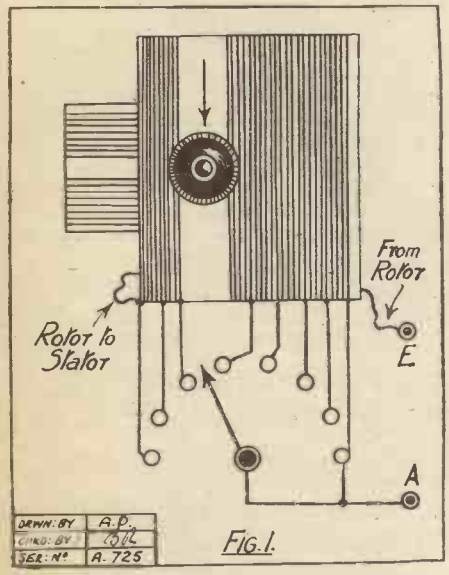


FIG. 1.

Perhaps the two most serious drawbacks to the variometer as an aerial tuner are the limited wave-length range obtainable, and the lack of selectivity.

Use of a Loading Coil.

A tuner employed for the reception of short-wave broadcasting will not be highly efficient if it is capable of tuning the circuit much above six or eight hundred metres. In order to tune to longer wave-lengths, therefore, a small variometer should be employed in conjunction with a loading coil connected in series with it. It must be remembered that when this is carried out the variation in the wave-length to which the circuit can be tuned is no greater than it was without the loading coil. Thus, if a variometer tuned an aerial circuit from 250 to 550 metres wave-length, and a loading coil was added to bring up the maximum value to 2,000 metres, the minimum value would then be about 1,700 metres.

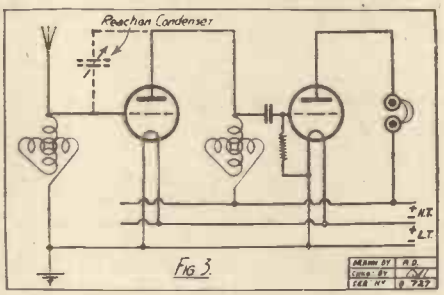


FIG. 3.

Moreover, since practically the whole of the tuning capacity is that of the aerial, the latter will have a very great influence upon the wave-length to which the circuit may be tuned by the variometer. Consequently it is difficult to predict the value of a suitable loading coil within close limits, and the correct size of coil should be found by experiment.

Introducing Series Capacity.

The wave-length of a variometer-tuned circuit may also be increased by means of a condenser connected in parallel. If this is made variable, a wide tuning range is obtained, but the method is not so efficient as that employing a carefully selected loading coil or a specially made long-wave tuner. By joining either the two windings, or the two halves of each winding in parallel, instead of in series, the wave-length can be reduced, but a better method is to join a small condenser in series with the aerial. Just as with plug-in coils, a change-over from series to parallel may be arranged, but provision should be made for cutting the condenser entirely out of circuit.

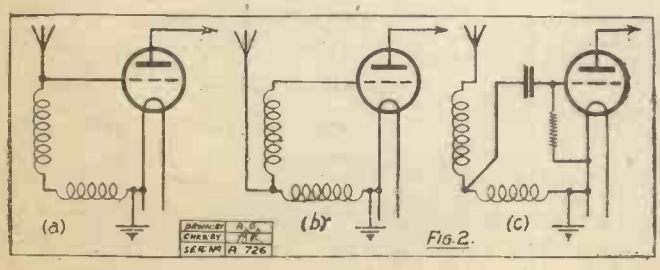


FIG. 2.

Making a Vario-Coupler.

A modification of the variometer, which provides a wide tuning range, is the vario-coupler. This is simply a variometer with a relatively long stator, tapped at intervals, with the usual arrangements for cutting down dead-end losses, as shown in Fig. 1. Coarse tuning is then carried out by means of the tapping switch, final adjustments being made with the moving coil.

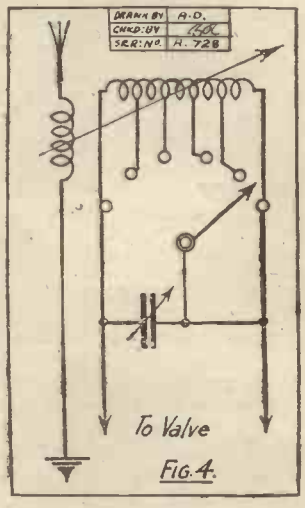


FIG. 4.

In order to obtain selectivity with variometer tuning, the first essential is a small, well-made tuner. This should have the rotor and stator of spherical form, with the windings as nearly as possible touching one another. It must not be thought, however, that a tuner which brings a station in, and cuts it out, by a dial rotation of a few degrees is necessarily selective, for in so doing it may have skipped over a wave-length range of a hundred metres and missed several other stations.

(Continued on next page.)

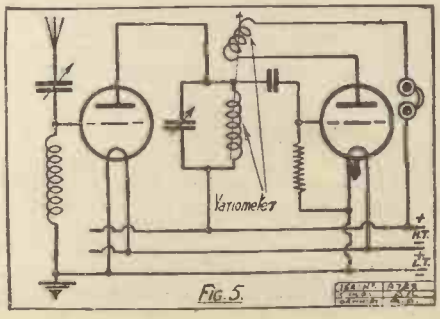


FIG. 5.

VARIOMETERS IN VALVE CIRCUITS.

(Continued from previous page.)

That is not selectivity, although the tuning may be very critical. A selective tuner must be able to cut one station right out when tuned to receive another on a wave-length differing by only a few metres.

In order to accomplish this, the damping of the aerial circuit must be reduced to a minimum. Now, in an oscillatory circuit the damping—that is, the dying away of the wave-trains—is greatest when the circuit contains a large proportion of resistance and capacity to a small proportion of inductance.

Some Interesting Modifications.

It does not follow, however, that the circuit containing the biggest possible inductance coil is the most satisfactory, for, although added capacity may be reduced to a minimum, the resistance of the coil is increased, as are also dielectric and copper losses in the winding. It will usually be found that a small (vernier) condenser of not more than ·0002 mfd. in parallel with a variometer will provide the sharpest tuning.

Sometimes a series condenser is better (as, for instance, in the case of a very long, inefficient indoor aerial, possessing a high capacity to earth), and sometimes the best results are obtainable with a combination of the two.

Improved results will usually be obtained by adopting one of the modifications shown in Fig. 2. The variometer is not represented in quite the usual manner, in order to make the connections clearer. In Fig. 2 (a) is shown the conventional method of connecting a variometer to aerial, earth, and detector or amplifier. In Fig. 2 (b) the aerial and earth are joined across one winding only, the valve grid and filament bridging both stator and rotor.

The reader will see in this arrangement a resemblance to the "P.W." Ultra-coil system, as a step-up transformation is obtained from the aerial circuit to the valve. This scheme of connections will usually give the best results on very weak signals, and is particularly efficient when followed by a high-frequency amplifying valve.

As an Intervalve Coupler.

In Fig. 2 (c) a step-down transformation is obtained by tapping the detector or amplifier across only one section of the tuned circuit. This introduces less damping into the aerial circuit, and is to be recommended when the greatest selectivity is desired, especially when followed by a low-resistance crystal or a valve detector taking a high grid current.

The use of a variometer as an intervalve coupling is not as general as it deserves to be, for the anode coil and condenser of a tuned anode circuit may be replaced by a variometer or vario-coupler, and a very efficient and selective circuit results. Reaction is usually unnecessary, the valve capacity being sufficient to produce oscillation when the aerial and anode variometer are in tune.

Using the Windings Separately.

Should this not be the case, reaction is most easily introduced by means of a small variable condenser, as shown in Fig. 3. If desired, however, a reaction coil may be coupled to the stator winding of either the aerial or intervalve variometer.

The amateur is advised always to purchase or construct a variometer in which both ends of both windings are brought out to terminals, for such an instrument can be made to serve a variety of purposes.

For instance, the rotor of a vario-coupler may be used as an aperiodic aerial coil, the stator forming a closed secondary circuit tuned with a parallel condenser, as shown in Fig. 4.

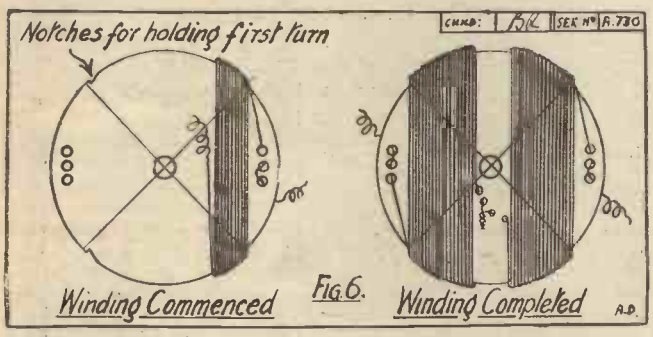


Fig. 6.

Another arrangement consists in tuning each winding, in which case the variometer resolves itself into a loose coupler, and provides a highly selective means of tuning an aerial or intervalve circuit. In fact, a variometer used in this way provides, within a somewhat limited wave-length range, probably the most efficient type of loose coupling, and is to be preferred to either cylindrical or honeycomb coils.

Reaction may conveniently be introduced by means of a variometer, the rotor being used as the reaction coil, the stator being tuned by a parallel condenser. This is shown carried out in Fig. 5. An advantage of this method is the ease with which reversed reaction may be obtained for stabilising purposes.

A Useful Wave-length Approximation.

The wave-length to which a variometer will tune an aerial circuit is very uncertain, for so much depends upon the type of instrument and the capacity of the aerial in conjunction with which it is employed. The following rules, however, will serve as a rough guide to the range to be expected from variometers consisting of two coils on cylindrical formers, wound with the approximately equal numbers of turns.

Count the number of turns of wire on the *rotor* and measure the length of the winding, including the gap between the two halves. Double both these figures, and, from the "P.W." wave-length tables, or wire tables, find the gauge of wire which would be required if the winding occupied the *whole* of that length. Then measure the diameter of the rotor, and find from "P.W." tables the wave-length of a coil of that diameter, wound with the number of turns and gauge of wire previously determined.

This sounds much more complicated than it really is, for it simply amounts to assuming that both coils are wound end to end on the rotor. We will then have approximately the maximum wave-length to which the variometer will tune a normal P.M.G. aerial. The minimum with a tuner of this type will usually be found to be rather more than one-third of the maximum.

Let us take an example:

Diameter of rotor = 2½ inches. Number of turns on rotor = 50. Overall length of rotor winding = 2 inches. Doubling the number of turns, the length gives us 100 turns, occupying 4 inches. No. 20 S.W.G., D.S.C. wire will satisfy these conditions. Reference to wave-length tables for the wave-length of 100 turns of No. 20's D.S.C. wire on a 2½-inch diameter former gives us the value 475 metres. The minimum wave-length in this case would be about 180 metres.

For reception from 5 X X, a cage variometer constructed to the following dimensions will be found very efficient.

Making a Cage Variometer.

Diameter and length of rotor, 3½ inches and 4½ inches. Diameter and length of stator, 3¾ inches and 5 inches. Mark stator and rotor end-shields with two diameters at right angles, and commence winding as shown in Fig. 6, completing each half separately and joining in the centres. One hundred turns of No. 34 D.C.C. wire on both stator and rotor will give a maximum wave-length of about 1,750 metres. The coupling factor is rather more than 0·8, giving an inductance ratio of at least ten to one, or wave-length range of about 3·2 : 1. The variometer will therefore tune down to below 600 metres.

In conclusion, let it be emphasised that a poor variometer is not worth having, but that a really good one will nearly always score over other tuning and coupling devices.

FIVE HINTS.

FROM A CORRESPONDENT.

1. When finished with the set remove wander plugs from the H.T. battery and put this away just before undoing accumulator connections. This obviates the risk (which is considerable) of L.T. leads brushing the top of H.T. battery. When connecting up, reverse the procedure.

2. It pays in the long run to keep accumulators well "up." Never run them till the filament dims before re-charging. Use a hydrometer, failing this, a good H.R. voltmeter. Test always when under load.

3. Always test a condenser before placing across the H.T. battery. The writer once nearly shorted a new 72 v. battery with a faulty condenser, though the latter was new.

4. For long distance work a variable grid leak is invaluable. Ascertain, however, that the resistance really varies when the leak is operated. Look for an instrument in which the central screw makes good contact with the screwed portion which carries it.

5. One should experiment with different values of grid condenser and that across I.P. O.P. of the transformers. Better results are sometimes obtained when the former is ·0002 mfd. or even ·00015 mfd. The latter may vary from ·0005 to ·002.

By O. H. M.

Those Banquet Speeches—The Problem of Studio Echo. A Broadcasting Knighthood—Radio Development Association—A "B.B.C. Book"—Uncertainties of Finance—Who Will Be the Chairman?

THIS year's Faculty of Arts festival, from May 9th to 16th, is likely to be broadcast in more liberal portions than on previous similar occasions. As one who knows enough about the recent work of the Faculty of Arts to appreciate something of its unique artistic quality, I confess to feelings of pleasurable anticipation of the broadcasting of the special Chamber Music Concert of the Faculty of Arts Festival on May 11th.

Those Banquet Speeches.

A friend of mine, who is a member of the Committee of the Chartered Institution of Patent Agents, tells me that there is some heartburning among his colleagues because of the reluctance of the B.B.C. to take the speeches at the annual dinner of the Institution on April 16th. The speakers include the Lord Chief Justice, the Attorney General, and several well-known judges. I am bound to say that news of such "reluctance" on the part of the B.B.C. was very welcome to me.

I think we have had too many broadcasts of public functions. It doesn't matter how eminent or excellent the speakers may be. At best, this is not material out of which entertainment is made. At worst, it is intolerable. About six public functions a year is an ample sufficiency in a wholesome broadcast fare.

The Problem of Studio Echo.

The problem of studio echo and resonance still eludes solution, although there is satisfaction in the knowledge of unremitting research and experiment at Savoy Hill. As soon as its right to borrow for capital expenditure is authorised, the new B.B.C. will have to tackle this studio problem. The ear of the listener is already sufficiently trained to recognise the superior quality of transmissions of classical music from certain outside halls.

The up-to-date studios give faithful representation of most sounds, but they fall down on the echo necessary for some of the best music. There is the further point that the really big symphony orchestras do not do themselves justice in the changed surroundings of a studio. British broadcasting must have its own concert hall if the "perfection" policy of the B.B.C. is to persist.

A Broadcasting Knighthood.

Rumours in the press about a Broadcasting knighthood in the New Year's Honours List appear to have been premature. I happen to know, however, that a recommendation was approved and was only held up because of a point of procedure connected with the date of publication of the Report of the Broadcasting Committee. The knighthood in question will probably be included in the Birthday Honours, and will certainly not be delayed beyond the next New Year's list. These delays no doubt are technically impeccable, but they have been the cause of a good deal of disappointment and resentment among listeners generally. The discussion in Parliament on the proposal to broadcast the Budget speech rather strengthened the view that there is an irrational reluctance in official circles to recognise the fact that British broadcasting is already a great and indispensable public service. That its executive head should receive some signal honour would give real pleasure to millions of listeners who incidentally are voters. Those members of Parliament who still think it worth while to keep in touch with the development of opinion in the constituencies would find themselves amply rewarded if they undertook the advocacy of a proposal so widely desired.

Radio Development Association.

For the past month or so I have heard rather too little about the progress of the Radio Development Association. Readers of this page will recall the circumstances of the inception of the idea of the association. A proposal had been made that the B.B.C. should start a big advertising campaign on behalf of the wireless industry which has found itself recently in some temporary difficulty. But the only source of revenue of the B.B.C. is its proportion of licence money, and it was only right and proper that the company declined to spend licence money on an advertising campaign designed to benefit the wireless industry. Having turned down this proposal, the B.B.C. determined to show its good will by sponsoring an alternative proposal not open to the same policy objections. The company called together representatives of a large number of wireless firms, and suggested co-operative publicity on the lines of such schemes as the "Eat More Fruit" campaign. The proposal was welcomed and the preliminary work of organisation put in hand promptly. All the money was to be found by the industry, but the B.B.C. would give whatever other assistance it could. It was understood that the scheme would be in operation by midsummer. But, apparently, certain hitches have occurred, and there is some danger of the B.B.C. dropping out altogether. I sincerely hope that this eventuality will be guarded against. A healthy and active British wireless industry is indispensable to British broadcasting, and it would be a grave misfortune for all concerned if the present opportunity were lost.

A "B.B.C. Book."

I hope the B.B.C. is considering the publication of a suitable memorial volume of its four years' work. I am sure many listeners would welcome something of the kind as a permanent record of a fascinatingly interesting period in the development of broadcasting. But, if such an enterprise is attempted, it must be personal and intimate. The anonymity touch is probably essential in the broadcasting service henceforth, but any flavour of official aloofness in the "B.B.C. Book" would be extremely disappointing. Let's have the human story of British broadcasting from its birth; let the Uncles and Aunts speak under their own names to their millions of worshippers!

Uncertainties of Finance.

The big success of "Kitesh," the Russian opera introduced to England by the B.B.C., calls attention again to the importance of the efforts of the Broadcasting Authority in making original and substantial contributions to the sum total of British artistic enterprise. Uncertainties of finance have considerably hampered the B.B.C. during the present season, but I gather that plans have been made for next season on the reasonable assumption that there will be no such financial handicap. The musical festival in October and November, following the completion of the £1,000 prize competition for young composers, should set a new musical standard for our best musical programmes. These plans, with their adequate "follow-ups," if implemented by a substantial instalment of the new high-power distribution scheme, will add greatly to the quality and variety of our broadcast fare.

* * *

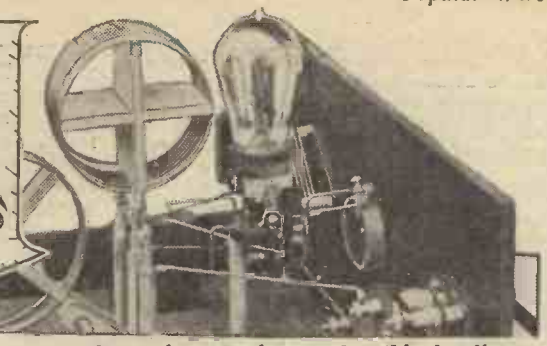
I am glad to hear that my suggestion about adapting existing material for broadcast drama is being acted upon. The B.B.C. is making good progress with a number of interesting experiments of this nature. From what I have heard I have little doubt of the probability of success, but it would detract from the ultimate dramatic effect to say more about the matter at this stage.

Who Will Be the Chairman?

The betting on the chairmanship of the new B.B.C. is still light. But I have heard firm quotations in small sums at the following odds:

—	Evens	Lord Crawford.
100—8	against	Sir Auckland Geddes.
10—1	„	Sir Arthur Stanley.
25—1	„	Lord Gainford.
50—1	„	Sir Frederick Radcliffe
100—1	„	All others.

Short Wave Jottings by 2OD



E. J. SIMMONDS, M.I.R.E., writes from time to time under this heading.

THE present period is proving a very good time for communication with Australia and New Zealand, and during the last fortnight some interesting and useful experiments have taken place between A 2 C M, of Sydney, New South Wales, and 2 O D in this country. A 2 C M is operated by Mr. C. Maclurcan, and will be remembered as having carried out a long series of regular tests with the writer on the many problems encountered in short-wave work, and much useful information has been obtained.

Working with this station by arrangement on Sunday, March 21st last, at 19.00 G.M.T., the writer successfully transmitted *intelligible* speech which was received in Sydney on the loud speaker. As a test of the accuracy of reception of the Australian station, figures relating to barometer readings, temperature, wind direction, wave-length and power input, were transmitted on speech by the British station, and successfully received and repeated back on Morse by A 2 C M. The power input this end was under 100 watts, to Master oscillator drive circuit, with special form of modulation and the wave-length used was 45·3 metres.

Smooth Carrier.

The Australian station used a supersonic heterodyne for this reception, both stations being equipped with this type of receiver, specially designed for short-wave reception.

On Sunday last, March 28th, a series of tests were carried out to obtain data on various forms of power supply, and their suitability for long-distance work.

The writer had available the standard power supply, viz., A.C. mains transformed up to 1,500 volts, rectified and effectively smoothed, and also batteries of high-tension accumulators for approximately the same voltage. The transmitter was arranged to be switched quickly to either supply to facilitate accurate observation, and report at the receiver.

These tests proved, beyond doubt, the marked superiority of the high-tension supply from the accumulator battery, the resulting carrier being of exceptional purity and crystal quality, with absolutely no background noises and ideal for modulation by telephony. Such points become of enormous importance in these long-distance transmissions, where high magnifications are being used at the receiver. Another important point was the extreme steadiness in frequency, as, of course, there would be no voltage fluctuations with such a supply.

Reception at Good Strength.

The chief point of interest in short-wave reception is the good strength of New Zealand and Australian stations, both in the morning and evening. These stations come in very well between 6 and 8 a.m., and 6.30 and 8.30 p.m., and as the cooler season is now approaching in the Antipodes reception conditions are daily improving there, and European short-wave signals are being received at very good strength.

Referring to the standard frequency signals for wave-meter calibration transmitted by American station 1 X M, and details of which were published under this heading in "P.W." a few weeks ago, this service is being continued every Saturday until May 28th. There are some slight changes in the procedure, and if readers are sufficiently interested the writer will be pleased to give further information through this paper.

Testing one of the water-cooled valves employed by Radio-Paris, the well-known broadcasting station.

While this question of standard frequencies is being considered, it is of interest to note that crystal quartz has been utilised for frequency control on the regular 5 kilowatt broadcast transmitter of the American station W G Y for several months, and many measurements made over long intervals by the best available measuring instruments have failed to record even a fractional departure from the wave-length assigned to this station by the American authorities. The new 50 kilowatt output, super transmitter at W G Y, is also equipped with quartz crystal frequency control. Special conditions have to be met in adapting this form of control to such high power.

Correspondence

Letters from readers discussing interesting and topical wireless events or recording unusual experiences are always welcomed, but it must be clearly understood that the publication of such does in no way indicate that we associate ourselves with the views expressed by our correspondents, and we cannot accept any responsibility for information given.—Editor.

THE ORIGIN OF THE CRYSTAL TELEPHONE.

The Editor, POPULAR WIRELESS.

Dear Sir,—It is interesting to note the letter of Mr. H. Gernsback, Editor of the American "Radio News," published in the issue of POPULAR WIRELESS, dated March 27th, 1926. I take it that Mr. Gernsback would claim priority for the invention of the crystal telephone, the nature and constructional details of which were recently described in my articles in "P.W." In view of this claim, therefore, I would beg to be allowed to record the following facts.

Mr. Leslie Miller, A.M.I.E.E., an English experimenter well known in electrical and radio circles, was granted his patent for the invention of the crystal telephone on July 8th, 1921. In this patent specification (No. 183692/21) the use of the local sensitising current across a loose contact at which thermal changes occurred was pointed out for the first time. So, also, was the employment of the receiver for wireless purposes. In the same year the inventor delivered a lecture on the subject of "Loose Contact Thermophones" (Crystal Telephones) to the Wireless Society of London. This event anticipated Mr. Gernsback's "Radio News" article by at least two years.

Again, even if Mr. Gernsback did possess the germ of the crystal telephone idea in 1909, I would like to point out the fact that certain correspondence exists between Mr. Leslie Miller and the late Prof. David Hughes, the original inventor of the microphone, on the subject of loose-contact sound reproducers. These letters were written in the year 1879, and are now in the possession of the Institute of Electrical Engineers. Here, I think, we have conclusive evidence of priority.

Although one must not disregard the possibility of two sets of workers being independently engaged upon the same problem, I think it necessary to state that the crystal telephone, as described in my recent "P.W." articles, is essentially the invention of Mr. Leslie Miller, to whom all credit is due for bringing within the bounds of commercial possibility that which may be the beginnings of a new and highly important principle in wireless reception.

I am, sir,
Yours very faithfully,
J. F. CORRIGAN,
M.Sc., A.I.C.

The University Union.
The Victoria University of Manchester.

SELECTIVITY.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have seen references at various times to the difficulty experienced by some experimenters in separating distant stations which are only, say, four metres apart. For example, Mr. Player writing a letter in a recent "P.W.," regards the separation of Hamburg from Dublin as the exception rather than the rule.

I have always been rather surprised at these difficulties, and I am now beginning to think that my experiences must be the least common and therefore of interest.

Without any wave-trap or without any particular precautions against flat tuning, I must say that I have never had any interference from any other station while listening to Bournemouth, Dublin, Oslo, London, Cardiff, Aberdeen, Petit-Parisien, Stuttgart, etc. There has been spark jamming, of course. But the only slight interference I get is from Newcastle when getting Münster, Breslau, and Glasgow, and I have since eliminated this by a ten-turn coil in series with the aerial tightly coupled to a closed circuit. The set I am using (with which I have been satisfied for some time) is only a two-valve reflex (H.F. and L.F.) det., which sets are usually thought to lack selectivity.

The only circumstances which I think may contribute towards the good selectivity are the fact that I use a ·0003 mfd. condenser in series with a large aerial coil (about 90 or 100 turns tapped off with plenty of dead end!) and that I naturally bring up the reaction on to the aerial for maximum signal strength without distortion. I find no difficulty in tuning in almost any of the British or near continental stations without howling, which shows that the set is not so unduly selective as to be difficult to handle.

Thanking you for all the useful information I have gleaned from "P.W.,"

Yours faithfully,
"REFLEX."

Rosebery Villa, Hutton Avenue,
West Hartlepool.

(*Continued on page* 336.)

The IDEAL MICROPHONE

Eliminating Sources of Distortion.

By SEXTON O'CONNOR.

THE microphone is the first link in the chain of communication between the broadcast studio and the circle of distant listeners. It serves the purpose of converting the energy contained in sound waves into corresponding variations of an electric current. Once this step has been taken, the rest of the process of transmission is purely electrical.

The change from acoustic to electrical energy is, therefore, of fundamental importance, and should be carried out as perfectly as possible. If any loss or inequality of response occurs in the microphone, distortion is introduced at a point where it cannot be remedied, but must affect the quality of reception, no matter how perfect the rest of the chain may be.

It must be remembered that the comparatively small current variations taken from the microphone subsequently pass through several stages of power amplification before they reach the aerial, in the course of which any microphonic error or defect is magnified enormously.

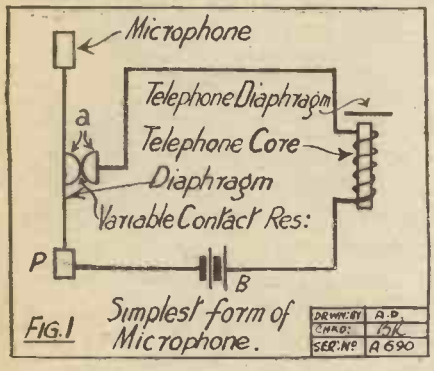


FIG. 1. Simplest form of Microphone.

The Simplest Microphone.

The simplest form of microphone is the variable-resistance type shown diagrammatically in Fig. 1. Its action is based upon the fact that the resistance between two or more bodies in light contact varies with the pressure between them.

This property of varying resistance with change in pressure is found in most substances, but it is particularly pronounced in the case of carbon, so that in practice a mass of carbon particles is generally used for the purpose.

In the diagram of Fig. 1 one of the carbon buttons, *a*, is secured to the centre of a flexible diaphragm held in a supporting frame, P P, whilst the other carbon button is rigidly fixed. Under the influence of air waves from the speaker's mouth, the diaphragm vibrates and causes the pressure between the two buttons to vary. This alters the resistance of the whole circuit, so that corresponding current variations from the battery B pass through the telephone-receiver coil. These, in turn, vibrate the receiver diaphragm, and so reproduce the original sounds.

There are two possible sources of distortion in this type of instrument. The first is due to the natural inertia of the diaphragm, which causes it to favour certain notes (approximating to its own natural frequency of vibration and to harmonics thereof) at the expense of others. The result is that whilst some tonal qualities are weakened, certain others are over-emphasised at the receiving end.

Another difficulty arises from the imperfect action of the carbon granules. The variation in the effective resistance is due more to changes in the area of contact than to actual compression, but if undue pressure is applied the carbon mass tends to pack together, so that it passes excessive current, or "blasts."

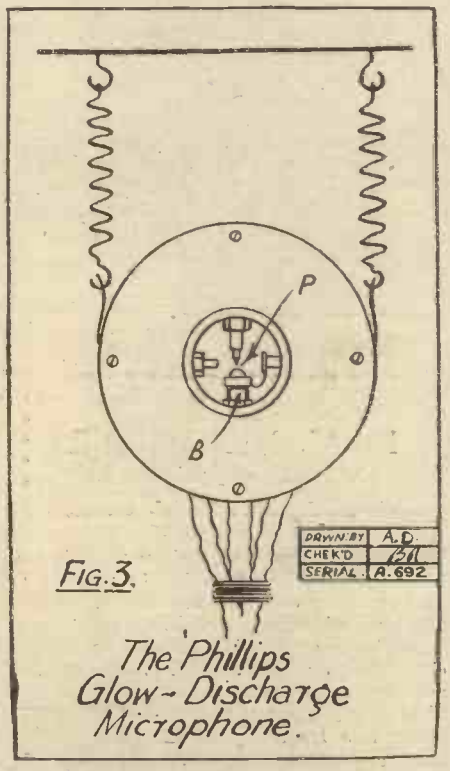


FIG. 3. The Phillips Glow-Discharge Microphone.

The Kathodophone.

In order to overcome these defects, it has been found possible to replace the carbon granules by the electron discharge path formed between a heated wire and an adjacent surface, kept at a high positive potential. The arrangement, in fact, forms a kind of open-air valve.

This instrument, called the kathodophone, is shown diagrammatically in Fig. 2. The mouthpiece is closed by a diaphragm, D, carrying a central button as shown, close to which is an incandescent filament, K, heated by a battery, A. The diaphragm, D, is kept at a positive potential by means of a battery, B.

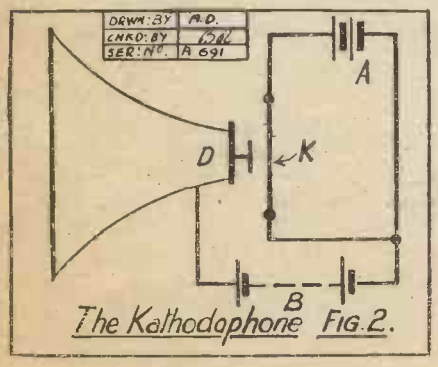
So long as the diaphragm is at rest a steady electron flow takes place between the filament and the button on the diaphragm, the discharge being absolutely silent and regular so far as any transmission effect is concerned. The vibration of the diaphragm by sound waves, however, causes the resistance of the air-gap to alter in exact correspondence with the applied voice pressures, and so gives rise to corresponding current variations. The kathodophone is now being used for broadcasting in Germany, and reproduces both speech and music of excellent quality.

The Phillips Glow Microphone.

The Phillips glow microphone is a somewhat similar arrangement, in which a discharge path or arc is utilised as a flexible variable-resistance device. In this case, however, no diaphragm is used, so that a second source of inherent distortion is avoided. As shown in the sketch, a glow discharge is formed between the exposed point P and a second point inside the tubular electrode B.

Only a portion of the total discharge-path is exposed to the impact of the sound waves, as it is found that certain portions of the

(*Continued on next page.*)



The Kathodophone FIG. 2.

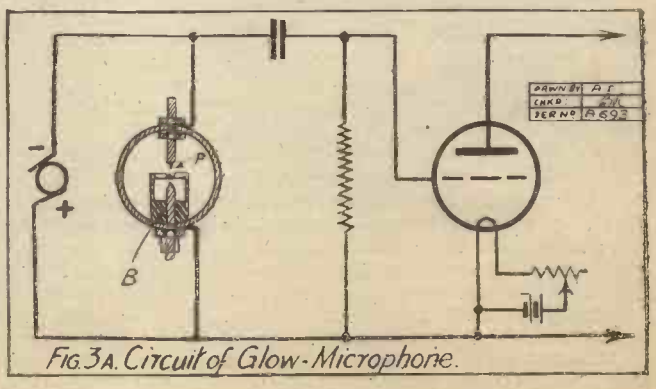


FIG. 3A. Circuit of Glow-Microphone.

NOTES ON SUPER HETS.

FROM A CORRESPONDENT.

THE popularising of short waves has resulted in general interest in that extremely interesting type of receiver known as the super-heterodyne, which employs a method we owe to America. High-frequency amplification of short waves, especially by multi-valve circuits of the usual types, shows a marked drop in efficiency when compared with the results obtainable by the same amplifiers on longer waves, and the super-heterodyne method overcomes the difficulty, not because it is an improved method of amplifying short waves, but because it is a frequency-changer. In effect, it lowers the frequency of the received oscillations, which is equivalent to the reception of longer waves. It should be noted, however, that the resultant frequency is still *radio* frequency. The method is valuable for waves up to 500–600 metres long.

The "Beat" Effect.

The means by which the frequency of the received signals is lowered is the application of the principle underlying "beat" reception, a principle which was first employed for the reception of "continuous" waves. In other words, the received oscillations are heterodyned by a local oscillator, which is a closed oscillating circuit forming part of the receiver.

If two high-frequency oscillating currents of *different* frequencies are superimposed on each other—or *mixed*, as it were, in one circuit—the frequency of the resulting current flowing in the circuit will be somewhere between both frequencies of the component currents, but the *amplitude* of the resultant current will not be constant, but will vary rhythmically. This is the "beat" effect. At regular intervals in time the maximum amplitude is greater than that of either of the component oscillations. The frequency of this "beat" is equal to the *difference between* the frequencies of the components.

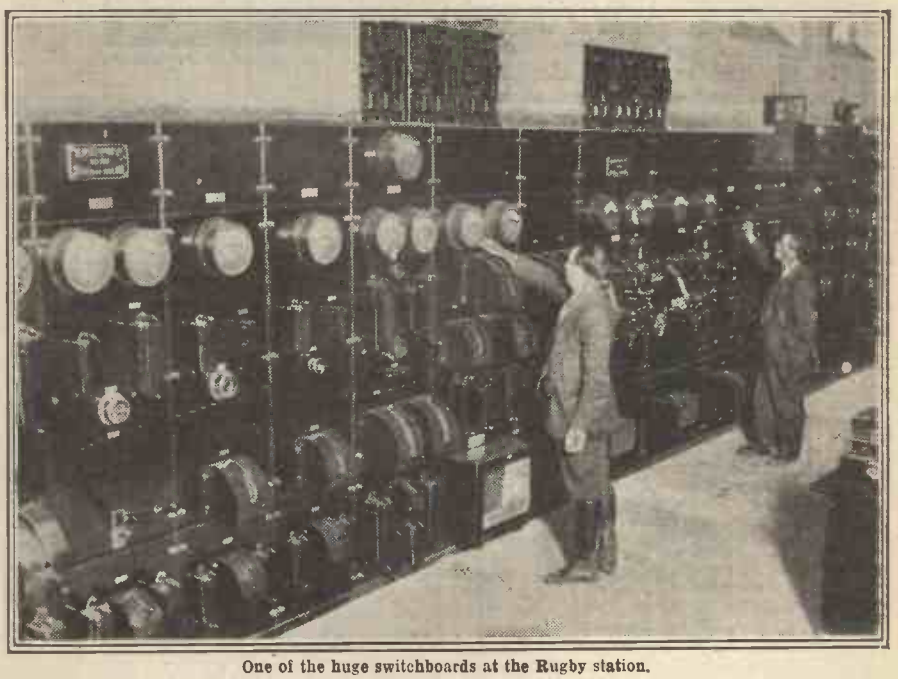
For example, if the frequency of the received oscillations is 1,000,000 (corresponding to a 300-metre wave-length) and we superimpose on this oscillations having a frequency of 500,000, the frequency of the resultant "beat" will be 1,000,000 minus 500,000 = 500,000 (corresponding to a wave-length of 600 metres). The frequency to which the original oscillations are converted by super-heterodyne receivers is generally about 50,000; at any rate, that would be a convenient figure.

How to Obtain Stability.

The local oscillator is coupled to a detector circuit and the resulting oscillations are then subjected to several stages of radio-frequency amplification, and are then rectified to audio-frequency in the usual way. This method is unusual by reason of the employment of two detector circuits.

The super-heterodyne circuit is especially prone to instability, the interaction between the stages being due not only to ordinary conduction but to electrostatic and electro-magnetic coupling. In particular the local oscillator is actively parasitic and is liable to affect other nearby receivers as well as that of which it forms a part.

The only practical method of ensuring stability is to screen each stage from the electric fields of the others by enclosing it in an earthed metallic shield or screen, for which sheet copper about one-hundredth of an inch thick is suitable, though S. Ballantine recommends sheet iron ($\frac{1}{16}$ in.) for shielding at audio-frequency. As a rule the whole apparatus is also screened by lining its case with copper sheet or foil. Constructors should note that it is advantageous to use anti-microphonic valve holders for the second detector and first note magnifier.



One of the huge switchboards at the Rugby station.

THE IDEAL MICROPHONE.

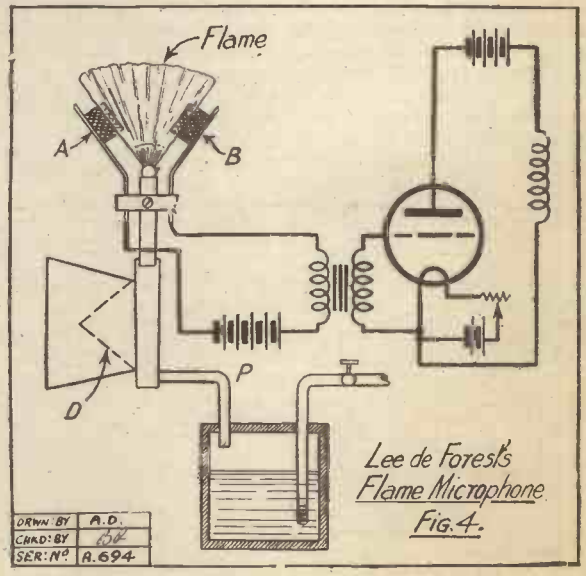
(*Continued from previous page.*)

are do not give an exact resistance variation for all frequencies. By shielding such parts and exposing only the constant-resistance portion, including the Faraday "dark space," the output is found to be rigidly controlled by the applied voice or air-pressure variations. A true microphone effect is thus secured free from any of the usual sources of distortion.

Fig. 4 shows a naked-flame microphone recently invented by Professor Lee de Forest. The two electrodes, A B, of the microphone circuit are immersed in an open gas flame as shown, the gas supply passing from a purifying chamber and pipe P through a conical paper or mica diaphragm, D.

Owing to the potential difference existing between the two electrodes, an electronic or ionic current passes from one to the other across the incandescent gas, the value of the current depending upon the condition of the flame at any instant. The conductivity of the flame can be varied by speaking directly at or near it. More usually, however, the speech waves are directed against the conical diaphragm D, thus changing the pressure of the gas supply and simultaneously the conductivity of the flame.

Another type of microphone which has been successfully developed by the Western Electric Company consists of two metal sheets separated by a distance of only three or four miles. The arrangement acts as a condenser, the capacity of which changes with the alteration in the thickness of the dielectric caused by the impact of speech waves.



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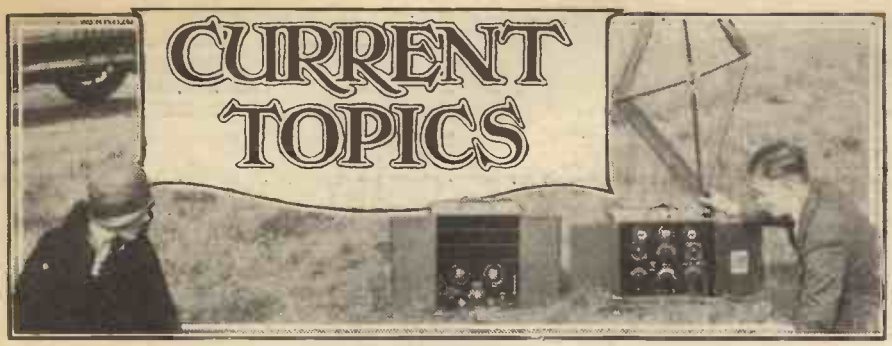


By THE EDITOR.

THE International Radiophone Bureau held recently another meeting of the Union Council at Geneva. At a general conference representatives of broadcasting companies from the twenty European stations were present.

The meeting was convened in consequence of a previous conference of experts held at Geneva last year, at which discussions took place regarding wave-length distribution. These early discussions prepared the way towards a new plan of wave-length distribution between 200 and 600 metres.

From reports received it would appear that the meeting had a satisfactory result inasmuch as all the represented broadcasting companies approved of the new plan for the distribution of wave-lengths proposed by Mr. Braillard, the President of the Technical Committee of the International Radiophone Bureau.

His plan is based, we understand, on the results of a series of experiments in various countries by which he has classified broadcasting stations into two categories. In the first category he places the large broadcasting stations entitled to an exclusive wave-length of their own, while in the second category he places the smaller broadcasting stations which have to work on a common wave-length.

The plan, approved and adopted by the International Radiophone Bureau, stipulates that each station shall receive at least one exclusive wave-length, while some countries, in view of their population, have been granted more than one exclusive wave-length. But, in all, the total number of broadcasting stations allotted exclusive wave-lengths does not exceed 83.

It was urged by the British representative that it would be in the interests of all if the strongest possible concentration was made on the limitation of bigger broadcasting stations, and it was suggested that secondary stations should be induced to accept common wireless programmes. It is possible that one main B.B.C. station will be closed down.

The new plan of distribution of wave-lengths was adopted by the conference and submitted to the various governments for their approval, and it is to be hoped that no delay will be occasioned in the adoption of a plan which, despite its drawbacks, is a meritorious attempt to meet the growing evils of the congested ether.

Radio Dancing.

This is no place in which to discuss the merits or demerits of dancing, but there has appeared lately in certain sections of the press statements to the effect that Mr. A. M. Low objects to dance music being allowed to interfere with the conversation of non-dancers; and in consequence he has offered to broadcast music from a building in which a wireless dance will shortly be held, in such a way that it can be picked up by dancers wearing telephones fitted with a special coil. In other words, Mr. Low has devised an inductive radio system so that dancers, each wearing a pair of telephones and an inductive coil, will be able to dance to music without the band interfering acoustically with any of the onlookers.

We can imagine a large ballroom in a West-End hotel presenting an exceedingly dismal, not to say *macabre*, appearance, if this scheme were widely adopted. Nevertheless, it has its merits, but we think in this case they will be wrongly applied.

It would be a greater boon if diners in restaurants could be fitted with headphones so that one could enjoy the meal without the accompaniment of undesirable cacophony from the restaurant band.

Some years ago an ingenious inventor suggested that patrons of restaurants should be fitted with "soup silencers"; but Mr. Low has gone one better in suggesting the "jazz silencer"

Some Disadvantages.

It is rather difficult to imagine his idea becoming popular; and yet the more we write about it the more we see, in the abstract, the beneficial results which might be obtained from it

Some people like dancing to the accompaniment of a good deal of noise, the latter being supplied not only by the band but by one's dancing partner. Sometimes it is the lady and sometimes it is the gentleman who helps swell the strange noises one hears in a modern ballroom, but if each was fitted with a pair of telephones, each would have some difficulty, possibly a considerable difficulty, in hearing each other talk.

Whether this would lead to an increased interest in the art of lip reading we cannot say, but every amateur knows that when he has a pair of telephones on and somebody speaks to him, he always replies in an exceedingly loud voice, because it is a curious psychological fact that a man or woman is not satisfied with his, or her, vocal efforts unless he, or she, can hear themselves speak.

The result might be that dancing couples, fitted with headphones, would still continue to talk to each other while dancing, but at the tops of their voices. This might, of course, lead to the drowning of the noise of the dance band and, although Mr. Low's desirable object would have been reached in a somewhat roundabout method, the disadvantages of a hundred or so dancing couples talking to each other at the tops of their voices would outweigh the advantages of eliminating the orchestra.

We have no doubt that when this experiment is tried at the Wireless Club dinner above referred to, it will create some amusement, and we can imagine a new dancing vocabulary coming into vogue. Instead of the clumsy male partner being reproved in a petulant voice by the lady on whose feet he is demonstrating the concrete evidence of his avoirdupois, we can imagine in the near future the lady saying, instead of "Mind my feet," "Mind my coil" or "Mind my telephones," or "Don't jam my wave-length."

The "Asthmatic Corncrake."

Sir Thomas Beecham, a disciple of music and a conductor of eminence for whom we have the greatest admiration, has been delivering another of his amusing speeches on "unmusical England."

This time we see that he has had a few words to say about broadcasting. The other day he was speaking in a hall in Manchester from which the speeches were being broadcast, and he spoke as follows:

> "I may tell you that some time ago I vowed eternal warfare on the wireless. To me wireless is one of these modern inventions to which I shall never accommodate myself. I have heard other people on the wireless and I have not recognised their voices. I am quite sure (pointing to the microphone in the hall) that my ordinarily pleasant organ of speech will sound on that thing like some asthmatic corncrake. I have broken a solemn pledge to myself by speaking into that instrument to-night. To me it is a very serious thing that I should violate one of my sternest principles."

We very much regret that broadcasting has been the means of persuading Sir Thomas Beecham to break one of his sternest principles, and we regret even more the fact that hitherto his experience of wireless receivers has been such as to allow him to express the opinion that a voice of a friend of his, when broadcast, resembled the asthmatic noises made by the mysterious corncrake.

We have never heard a corncrake, especially an asthmatic corncrake, but we have heard asthmatic wireless receivers and we can conceive nothing more horrible nor more devastating to the musical ear of Sir Thomas Beecham; nevertheless we are inclined to deprecate his wholesale condemnation of "that thing."

A Challenge.

After all, the microphone is more sensitive in many ways than the gramophone, and Sir Thomas Beecham, during his career, has not looked unkindly on the gramophone.

Therefore, we would beseech him to give the microphone another opportunity. We publicly offer to demonstrate a good wireless receiving set to him, and we also publicly challenge him, after that demonstration, to say that any voice he may hear, be it that of a friend or an enemy, resembles an "asthmatic corncrake."

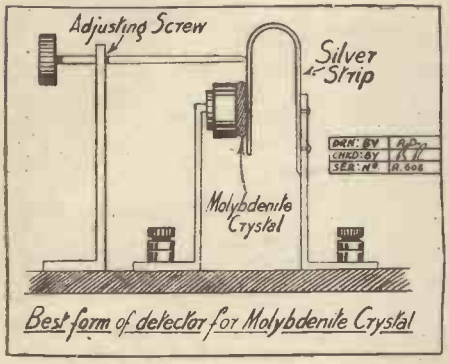
Wireless to-day is very different from what it was even twelve months ago. We do not know when Sir Thomas last listened-in, but we feel it must have been a very long time ago; or if it was recently, then he must have listened-in on an exceedingly inferior receiver.

CRYSTAL CHATS

By J. F. CORRIGAN, M.Sc., A.I.C.
(Staff Consultant).

No. VIII. MOLYBDENITE.

ONE does not see molybdenite used to any very appreciable extent in amateur crystal sets nowadays, and, in fact, unless the crystal set owner happens to be a serious experimenter in the subject of mineral rectification, it is more likely than not that he will never have attempted to use this mineral at all.



Best form of detector for Molybdenite Crystal

But, despite its unpopularity, molybdenite is capable of giving very good results when used as a crystal rectifier. With signals of strong initial intensity, molybdenite affords reception which is not to be excelled so far as its essential purity and distortionless nature goes. But, unfortunately, molybdenite is not a very sensitive mineral, or, rather, I should say that its distance-sensitivity is not very great. Therefore the mineral is not much use for the purpose of receiving signals coming over distances much greater than five or six miles from a main broadcasting station. That is with an ordinary crystal set, of course. Used in a valve-crystal set, a good molybdenite detector will reduce any transformer-distortion enormously, and, to a very great extent, it will also filter out atmospheric and other parasitic noises.

A Suitable Detector.

The best detector to employ with a molybdenite detector is shown in the above diagram. This type is not sold commercially, so far as I am aware, but it is simple to make, and, as it is practically a permanent one, it can be mounted away out of sight within the cabinet itself. A slight adjustment of the contact pressure now and then is all that is necessary to ensure perfect reception with initially strong signals.

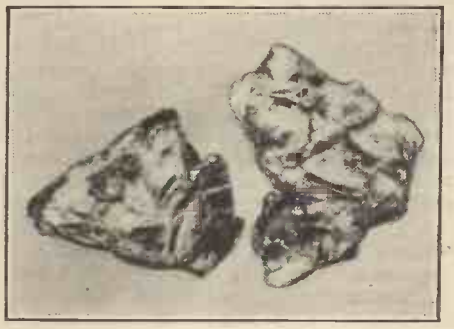
It will be noticed that a silver strip is required in the construction of the detector. Strictly speaking, this is not absolutely essential, a strip of white metal giving results of almost equal efficiency. However, comparative tests of these two molybdenite contacts will prove that the silver spring contact is the most efficient of any, especially so far as purity of tone goes, but against this there is the disadvantage to be considered that silver easily tarnishes in town atmospheres, and thus the strip will need periodic cleaning.

The Contacts to Use.

Molybdenite will function quite satisfactorily with contacts consisting of copper, tellurium, antimony, lead, and aluminium, but in order to work well under these conditions the set itself must be exceptionally efficient, or else it must be situated within close range of the broadcasting station.

The mineral will also work quite well with contacts of zincite, copper pyrites, iron pyrites, silicon, graphite. These are by no means experimental contacts. Their efficiency has been proved in use, and the only fact which must be remembered when applying them is that the signals to be rectified must be initially strong.

In composition, molybdenite is a simple sulphide of the metal molybdenum, having the chemical formula MoS_2. It is a mineral which is very like galena. Chemically, it is similar to galena, and in many of its physical properties it resembles that mineral.



Molybdenite in appearance is of a leaden grey colour, without the minute crystalline structure which is so characteristic of galena. Usually it occurs in the form of flat-looking crystals. These masses of molybdenite are laminated, and, very often, layer after layer of the mineral can be peeled off very much in the same way as mica.

Affected by Heat.

The mineral is very sensitive to the effects of heat, and therefore it should never be cemented to its cup in the detector by means of high-temperature melting solders. Even when heated in the flame of a candle, the mineral quickly tarnishes and gives off a sulphurous smell. The part so heated will then be found to have lost its sensitive properties.

Molybdenite is a soft mineral. It can easily be flattened out with a hammer without breaking. Its electrical resistance is comparatively low, and it alloys readily with mercury. On account of this latter fact, the mineral should never be affixed to its crystal cup by means of fusible metals containing mercury in their make-up.

A Very Valuable Mineral.

Molybdenite (known also as "Molybdenum Glance") is a most valuable mineral. Almost the whole of the commercial supply of molybdenum is obtained from the mineral. The various molybdenum steels are well known. Alloyed with steel in certain definite proportions, molybdenum has the very useful property of making the steel extremely hard and tough. Such steel is used for the purpose of making machine bearings, rifle and gun barrels, but its most valuable use may be seen in the construction of "high-speed steels"—that is, steels which are employed in the manufacture of machine tools which have to be run at high speeds. Such tools can be raised almost to red heat by friction without undergoing any appreciable process of wear.

Certain compounds containing molybdenum are also used in the manufacture of dyes, and in the routine operations of analytical chemistry.

Interesting experiments can be made with graphite-molybdenite contacts and also with combinations of molybdenite and galena. These rectifying combinations are highly sensitive, but, at the same time, they are difficult to adjust and to retain in a sensitive condition. Thus they are not suited to the ordinary purpose of listening-in, but for the crystal experimenter they will provide interesting objects of study.

Finally, in most cases, the mineral or metal which is used in conjunction with a crystal of molybdenite should not be applied in a pointed condition to the molybdenite surface. Molybdenite needs a flat contact, and therefore a considerable area of the companion rectifying element should be allowed to make contact with the molybdenite crystal.

SOME USEFUL FACTS.

COMPOSITION.—Molybdenum sulphide, MoS_2.
APPEARANCE.—Similar to galena, but duller in shade. Usually occurs in the form of flat, tabular masses.
CHARACTERISTICS.—Very soft. Can easily be bent. Leaves a streak when drawn across paper. Is easily tarnished.
With initially strong signals it provides an efficient rectifier, but its sensitivity is not well retained in impure atmospheres.
BEST CONTACTS TO USE.—Flat, springy strip of silver, or white metal. Also zincite and silicon.
CURRENT PRICE.—10d. per ounce.

THE "POPULAR WIRELESS" VALVE GUIDE

Specially Compiled by K. D. ROGERS (*Assistant Technical Editor*). (*An asterisk denotes General Purpose Valve.*)

2-VOLT H.F. VALVES.

Make and Type of Valve	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp Fac.	Price s. d.	Remarks
B.T.H.								
B3*	1·8	·35	20–80	—	27,000	7·5	14 0	
BURNDEPT								
H.L.213*	1·8–2	·13	30–45	—	21,000	7·6	15 6	
CLEARTRON								
C.T.15*	1·8	·15	30–120	—	18,000	7·5	12 6	
COSMOS								
S.P.18 (Green Spot)	1·7–1·8	·30	20–120	—	17,000	15·0	12 6	Also Det. or for L.F. Res. coupling
D.E.11*	1·1	·25	40–100	—	16,000	6·5	12 6	
COSSOR								
W.2	1·6–1·8	·3	20–80	—	30,000	10·5	14 0	
W.R.2	1·6–6	·3	20–80	—	30,000	10·5	16 0	Can be used with 6-volt L.T.
DEXTRAUDION								
D.E.X.235*	2·0	·35	40–75	—	21,000	6·5	14 0	
EDISWAN								
A.R.D.E. H.F.	1·8–2	·3	20–100	—	40,000	9·5	14 0	Also used as Det.
LOUDEN								
L.E.R.2	2·0	·2	40–80	—	25,000	10–12	8 0	
LUSTROLUX								
H.F.206	1·7–2	·06	20–80	—	60,000	12	9 0	Also Det. and Res. coupling
H.F.234	1·8–2	·34	20–100	—	60,000	10	9 0	
MARCONI								
D.E.R.*	1·8	·35	30–80	—	32,000	9·0	14 0	
D.E.2 H.F.	1·8–2	·12	40–120	—	45,000	12·0	15 6	Also used as Det. and for Res. L.F.
D.E.7*	1·8–2	·4	6–15	—	20,000–8,000	4·5	22 6	Four-electrode valve
MULLARD								
D.3 H.F.	1·8–2	·3	50–125	—	60,000	17·0	14 0	
Wecovalve A (Red)	0·8–1·1	·25	15–25	—	18,000	4·7	16 6	Also for Detector
NELSON (3-fil. valves)								
D.E.2*	1·8–2	·35	30–80	—	32,000	9·0	15 0	Using 1 filament only
NEUTRON								
H.220	1·8–2	·2	20–80	—	20,000	11·0	12 6	
OSRAM								
D.E.R.*	1·8	·35	30–80	—	32,000	9·0	14 0	
D.E.2 H.F.	1·8–2	·12	40–120	—	45,000	12·0	15 6	Also used as Det. and for Res. L.F.
D.E.7*	1·8–2	·4	6–15	—	20,000–8,000	4·5	22 6	Four-electrode valve
RADION								
D.E. 34 H.F.	1·6–2	·34	30–100	—	60,000	16·5	10 6	Also used as Det.
"SIX-SIXTY"								
S.S.2 (Red Disc.)	2·0	·3	50–125	—	60,000	17	14 0	Used as Det. or L.F. when Res. coupling employed
WECOVALVE*								
(Red Spot)	·85–1·1	·25	30–60	—	25,000	5–6·5	16 6	

2-VOLT DET. VALVES.

Make and Type of Valve	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp Fac.	Price s. d.	Remarks
B.T.H.								
B3*	1·8	·35	20–80	—	27,000	7·5	14 0	
BURNDEPT								
H.L.213*	1·8–2	·13	30–45	—	21,000	7·6	15 6	
CLEARTRON								
C.T.15*	1·8	·15	30–120	—	18,000	7·5	12 6	

2-VOLT DET. VALVES—*continued.*

Make and Type of Valve	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp Fac.	Price s. d.	Remarks
COSMOS								
S.P.18 (Green Spot)	1·7–1·8	·30	20–80	—	17,000	15·0	12 6	Also H.F. and for Res. L.F.
D.E.11*	1·1	·25	20–45	—	16,000	6·5	12 6	
COSSOR								
W.1	1·6–1·8	·3	20–80	—	19,000	7·2	14 0	Also used for L.F.
W.R.1	1·6–6·0	·3	20–80	—	19,000	7·2	16 0	Can be used with 6-volt L.T.
DEXTRAUDION								
D.E.X.235*	2·	·35	40–75	—	21,000	6·5	14 0	
EDISWAN								
A.R.D.E. H.F.	1·8–2	·3	20–100	—	40,000	9·5	14 0	Also used as H.F.
LOUDEN								
L.E.R.1	2·0	·2	40–80	—	13,000	5·6	8 0	Also as L.F.
LUSTROLUX								
H.F.206	1·7–2	·06	20–80	—	60,000	12	9 0	Also Res. L.F. and H.F.
H.F.234	1·8–2	·34	20–100	—	60,000	10	9 0	Also Res. L.F. and H.F.
MARCONI								
D.E.R.*	1·8	·35	30–80	—	32,000	9	14 0	
D.E.2 H.F.	1·8–2	·12	40–120	—	45,000	12	15 6	Also used as H.F. and for Res. L.F.
D.E.2 L.F.	1·8–2	·12	20–80	—	22,000	7	15 6	Also for 1st stage L.F.
D.E.7*	1·8–2	·4	6–15	—	20,000–8,000	4·5	22 6	Four-electrode valve
MULLARD								
D.3. (Det.)	1·8–2	·3	50–125	—	16,000	6·5	14 0	
Wecovalve A.	0·8–1·1	·25	15–25	—	18,000	4·7	16 6	Also H.F.
NELSON (3-Fil. Valves)								
D.E.2*	1·8–2	·35	30–80	—	32,000	9	15 0	Using 1 filament only
NEUTRON								
H.220	1·8–2	·2	20–80	—	20,000	11	12 6	Also H.F. and Res. L.F.
L.220	1·8–2	·2	30–80	—	15,000	8	12 6	Also L.F.
OSRAM								
D.E.R.*	1·8	·35	30–80	—	32,000	9	14 0	
D.E.2 H.F.	1·8–2	·12	40–120	—	45,000	12	15 6	Also used as H.F. and for Res. L.F.
D.E.2 L.F.	1·8–2	·12	20–80	—	22,000	7	15 6	Also for 1st stage L.F.
D.E.7*	1·8–2	·4	6–15	—	20,000–8,000	4·5	22 6	Four-electrode valve
RADION								
D.E.34 H.F.	1·6–2	·34	30–80	—	60,000	16·5	10 6	Also used for H.F. L.S.2 also used for Det. (*See* L.F. Valves).
"SIX-SIXTY"								
S.S.2 (Red disc)	2·0	·3	50–125	—	60,000	17	14 0	Use for Det. where Res. coupling is employed
S.S.2 (Green disc)	2·0	·3	30–100	—	16,000	6·5	14 0	Det. for general purposes
STANDARD (Western Electric)								
Wecovalve* (Green spot)	·85–1·1	·25	15–30	—	25,000	5–6·5	16 6	

(*Continued on next page*)

THE "POPULAR WIRELESS" VALVE GUIDE—(continued from previous page).

2-VOLT L.F. VALVES (including Power Valves).

Make and Type of Valve	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp Fac.	Price s. d.	Remarks
B.T.H.								
B3*	1·8	·35	20–80	0–3	27,000	7·5	14 0	Use for 1st stage only
BURNDEPT								
H.L.213*	1·8–2	·13	45–90	1½–3	21,000	7·6	15 6	Use for 1st stage only
L240	1·8–2	·40	60–120	3–7½	8,000	5·2	18 6	Power valve
CLEARTRON								
C.T.15*	1·8	·15	30–120	0–6	18,000	7·5	12 6	Can be used as Power Valve
COSMOS								
S.P.18* (Red spot)	1·7–1·8	·3	20–120	0–7½	7,000–8,000	7·0	12 6	1st or 2nd stage L.F.
S.P.18 (Green spot)	1·7–1·8	·3	20–120	0–9	17,000	15·0	12 6	For Res. coupling and as Det.
D.E.11*	1·1	·25	40–100	0–6	16,000	6·5	12 6	
COSSOR								
W.1	1·8–2	·3	20–80	0–6	19,000	7·2	14 0	1st stage. Also as Det.
W.3	1·8–2	·5	50–150	0–4½	13,000	8	18 6	Power valve
W.R.1	1·8–6	·3	20–80	0–6	19,000	7·2	16 0	1st stage. Can use 6 volts L.T.
DEXTRAUDION								
D.E.X.235*	2	·35	40–75	3–6	21,000	6·5	14 0	
D.E.X.240	2	·4	50–90	3–6	18,000	7	16 6	L.F. valve
EDISWAN								
A.R.D.E. L.F.	1·8–2	·3	30–100	0–4½	15,000	5	14 0	1st stage L.F.
P.V.6 D.E.	1·8–2	·4	60–120	0–6	12,500	6	18 6	Power valve
LOUDEN								
L.E.R.1	2·0	·2	40–80	0–3	13,000	5–6	8 0	L.F. valve
LUSTROLUX								
L.F.206	1·7–2	·06	40–80	0–6	27,000	7	9 0	All stages L.F.
L.F.234	1·8–2	·34	40–100	0–6	25,000	7	9 0	All stages L.F.
P.V.234	1·8–2	·34	60–120	0–6	13,000	5·5	11 0	Power valve
MARCONI								
D.E.R.*	1·8	·35	30–80	0–3	32,000	9	14 0	
D.E.2 L.F.	1·8–2	·12	20–80	0–4½	22,000	7	15 6	Use H.F. for Res coupling
D.E.6	1·8–2	·5	60–120	5–10	10,000	5·5	18 6	
D.E.7*	1·8–2	·4	6–15	—	20,000–8,000	4·5	22 6	Four-electrode valve
MULLARD								
P.M.2	1·4–1·8	·13–·16	50 100	0–10½	8,750	5·4	18 6	Power valve
D3 L.F.	2	·3	30–100	0–4½	16,000	7	14 0	
Wecovalve B (Green)	0·8–1·1	·25	30–50	0·2	18,000	4·5	16 6	
NELSON (3-fil. valves)								
D.E.2*	1·8–2	·35	30–80	0–3	32,000	9	15 0	First stage with 1 filament
D.E.2 (with 2 fil.)	1·8–2	·7	80–120	0–6	16,000	9	15 0	Power valve. Two fils. used.
NEUTRON								
L220	1·8–2	·2	30–100	0–6	15,000	8	12 6	Use H220 for Res. coupling
OSRAM								
D.E.R.*	1·8	·35	30–80	0–3	32,000	9	14 0	
D.E. L.F.	1·8–2	·12	20–80	0–4½	22,000	7	15 6	Use H.F. for Res. coupling
D.E.6	1·8–2	·5	60–120	0–6	10,000	5·5	18 6	
D.E.7*	1·8–2	·4	6–15	—	20,000–8,000	4·5	22 6	Four-electrode valve
RADION								
D.E.34 L.F.	1·6–2	·34	40–120	2–6	30,000	8·4	10 6	Can be used for Det.
L.S.2	1·6–2	·34	40–120	1–6	12,700	6	12 6	Power valve and Det.
Pyramid 4	1·8–2	·7	40–120	3–9	8,000	5·6	22 6	Power valve
"SIX-SIXTY"								
S.S.2 (Red)	2	·3	50–300	0–9	60,000	17	14 0	For Res. coupling
S.S.2 (Green)	2	·3	30–100	3–6	16,000	6·5	14 0	For transformer coupling
STANDARD (Western Electric)								
Wecovalve* (Orange spot)	·85–1·1	·25	30–60	0–4½	25,000	5–6·5	16 6	

4-VOLT H.F. VALVES.

Make and Type of Valve	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp Fac.	Price s. d.	Remarks
B.T.H.								
B5*	3	·06	60–80	—	17,000	7	16 6	Can be used with dry battery L.T.
R*	4	·7	60–100	—	27,000	7·5	8 0	
BURNDEPT								
H.310	2·8–3	·1	40–60	—	77,000	15	16 6	Also for Res. coupled [L.F.
H.L.310*	2·8–3	·1	30–45	—	19,000	5·7	16 6	
CLEARTRON								
C.T. ·08*	2·8–3	·08	30–120	—	18,000	7·5	12 6	Can be used with dry battery L.T.
COSMOS	—	—	—	—	—	—	—	A.45 can be used but 6 volts advised
COSSOR	—	—	—	—	—	—	—	P2 can be used but 6 volts advised
DEXTRAUDION								
D.E.X.306*	3	·06	40–75	—	20,000	5·5	14 0	
D.E.X.406*	4	·06	40–75	—	21,000	6·0	14 0	
EDISWAN								
A.R.06 H.F.	2·8–3	·06	20–100	—	35,000	10	16 6	Also used as Det. Dry battery O.K.
A.R. H.F.	4	·75	30–80	—	30,000	10	8 0	6-volt L.T. should be
R.*	4	·75	50–100	—	25,000	7·5	8 0	used when more than one valve employed
LOUDEN								
E.E.R.2 (4 volt)	4	·1	40–80	—	25,000	10–12	8 0	
LUSTROLUX								
H.F.306	2·8–3	·06	20–80	—	61,000	10	9 0	Also L.F. Res. coup- [ling
G.P.470*	3·8–4	·7	20–80	—	27,000	7	7 0	
MARCONI								
D.E.3.B.	2·8	·06	20–120	—	50,000	17	16 6	Also for Res. coupled L.F.
D.E.3*	2·8	·06	20–80	—	22,000	7	16 6	Can be used with dry L.T.
D.E.V.	3	·2	20–60	—	24,000	6	25 0	Specialanti-cap valve
R*	4	·7	30–100	—	40,000	9	8 0	Use 6 volts for more than one valve
F.E.3*	4	·7	6–15	—	20,000–8,000	4·5	16 6	Four-electrode valve
MULLARD								
P.M.3	3–3·7	·1	50–100	—	16,000	13.5	16 6	
R.A.*	4	·65	30–90	—	18,000	7	8 0	
Red Ring	4	·6	30–90	—	40,000	9·8	8 0	
S.3*	4	·65	15–50	—	24,000	4	20 0	
D ·06 H.F.	3	·06	15–125	—	60,000	17	16 6	Can be used with dry L.T.
D.G.*	3·4–3·8	·65	0–30	—	—	—	16 6	Four-electrode valve
NELSON								
A*	4	·45	30–100	—	40,000	7	9 6	One filament in use
D.E.06*	2·8–3	·06	30–80	—	40,000	7	16 6	One filament in use
D.E.A.*	2·6	·18	30–80	—	40,000	7	15 0	One filament in use
NEUTRON								
H.406	3·5–4	·06	20–100	—	22,000	9	12 6	
OSRAM								
D.E.3B.	2·8	·06	20–120	—	50,000	17	16 6	Also for Res. coupled L.F.
D.E.3*	2·8	·06	20–80	—	22,000	7	16 6	Can be used with dry L.T.
D.E.V.	3	·2	20–60	—	24,000	6	25 0	Specialanti-cap valve
R*	4	·7	30–100	—	40,000	9	8 0	Use 6 volts for more than one valve
F.E.3*	4	·7	6–15	—	20,000–8,000	4·5	16 6	Four-electrode valve
RADION								
G.P.*	3·6–3·8	·6	30–60	—	27,000	9	7 0	Also Det.
H.F. ·6	3·6	·6	40–120	—	59,000	16·5	7 0	Also Det.
Non ring H.F.	2·7–3	·06	40–120	—	59,000	16·8	12 6	O.K. with dry L.T.
D.E. ·06 H.F.	3	·06	40–120	—	59,000	16·6	10 6	Also for Det. and use with dry L.T.
"SIX-SIXTY"								
S.S.3 (Red)	3	·06	50–90	—	60,000	17	16 6	Also for Det. and L.F. where Res. coupling is used.
S.S 1* (Blue)	3·7	·66	50–100	—	28,000	8·5	8 0	Dry battery O.K.
XTRAUDION								
4v. G.P.*	4	·4	60–100	—	30,000	12	6 6	
4v. H.F.	4	·5	60–90	—	20,000	7	6 6	

(To be continued.)

Apparatus Tested

Traders and manufacturers are invited to submit wireless sets and component parts to the "P.W." Technical Dept. for test. All tests are carried out with strict impartiality in the "P.W." Test Room under the supervision of the Technical Editor, and the general reader is asked to note that this weekly article is also intended to provide a reliable and unbiased guide as to what to buy and what to avoid.—EDITOR.

OF late considerable interest has been evinced in the subject of home accumulator charging, and our correspondence clearly shows that all classes of wireless enthusiasts are turning their attention to rectifiers, resistance boards and other such apparatus. For instance, we have received a large number of enquiries concerning the "Marc" charger, a device sold by S. S. Garrigan, of 83, Rue Lamark, Paris, at 15s. In order that we could thoroughly test it we sent for one, and immediately placed it in commission.

The Marc rectifier is a form of Noden valve in which is employed a spiral aluminium electrode. The device, as illustrated in advertisements, is not complete, for it is necessary to use with it an earthenware vessel capable of holding at least two quarts of fluid. This is not supplied. The spiral aluminium electrode can be replaced by another special electrode provided when the rectifier is required for charging H.T. accumulators, or used directly in series with the mains without a transformer.

We prepared an electrolyte consisting of four ounces of bicarbonate of soda and two quarts of distilled water, and, in the first place, connected the apparatus up in the conventional manner with a step-down transformer, a variable resistance, a 4-volt accumulator and an ammeter. The mains employed are 200 volts, 50 cycles.

Charging commenced at 10 a.m. on a Thursday morning, the resistance being set to allow a current of 2·8 amps. The secondary voltage was 13. Current tended to fluctuate slightly, but not sufficiently to cause trouble. As the electrolyte heated the current increased, but this was only to be expected, and the resistance was increased to bring the current down to 2·8 again. After an hour's steady and quite satisfactory work the resistance was reduced, and current increased to 3 amps., but at this point the rectifier ceased to function as such and to act merely as a series resistance in the circuit.

The current was then reduced to 1·65 amps., and rectifying re-continued to take place. After 12 hours continuous functioning at a fairly steady rate it was necessary to add 2½ ounces of water. At 12 o'clock midday on the Friday, 14 hours from the commencement of the test, the positive (aluminium) element showed signs of decomposition.

From the above, and other intermediary observations, we deduced that the highest efficient charging rate was 1·8 to 2 amperes; that the approximate efficiency of the rectifier was 37 per cent, and that it would be necessary to renew the aluminium element (this costs 2s.) at every 440 ampere hour mark or so.

The makers claim that the device incorporates a thermo-syphon cooling system, and this is correct, although we would advise them to enlarge the holes in the metal jacket slightly. Undoubtedly the cooling system is efficient, but in our opinion it could be even further improved.

Using the 'Marc" rectifier directly in series with the mains, a resistance in the form of a 100-watt carbon lamp and an H.T. accumulator (the special element being brought into service), an efficiency of about 18 per cent. was registered, a great deal of loss being occasioned by the lamp. Charging was steady and satisfactory, some ·3 or so of an ampere being continually registered.

The efficiency figures quoted are very good for this type of rectifier, better than

(*Continued on page* 330.)

APPARATUS TESTED.

(*Continued from page* 328.)

they would at first sight appear to be to those unacquainted with such devices, for it must be remembered that it is only possible to obtain half-wave rectification with one "Marc" unit. With two and a special transformer, full-wave rectification could be carried out.

We would not advise the use of a "Marc" without a transformer, although methods of doing this are advocated in an explanatory leaflet. Transformers suitable for various voltages are available from the same firm at prices round about £1.

In conclusion, we are able to say that we consider the "Marc" rectifier has a fairly high degree of efficiency, and is of a good standard—in its class. It is reasonably cheap and is not difficult to handle. Whether or not we prefer the "Noden Valve" system to the several others available we would rather not state, but readers will no doubt be able to draw their own conclusions.

* * *

An interesting type of low-loss former was recently sent us for examination. It is known as the "Estro," and can be obtained at most wireless stores or direct by post from Mr. A. Couldwell, 63, Queen's Road, New Malden, Surrey. The former consists of three circular pieces of insulating material which are slotted to carry six strips, whose edges are cut in order to form "teeth," as it were, to retain the turns of wire securely in position. The length of the former is 6 inches, but, by supplying six additional ¼-inch wide strips, diameters of either 3 inches or 3½ inches are made available. Two small brass brackets enable the former to be mounted on a panel or baseboard. Holes are drilled in the circular end pieces, presumably so that terminals can be screwed on easily.

The "Estro" is priced at 4s., but in our opinion it would attain greater popularity were it somewhat cheaper.

* * *

The Transformer Repair Co., of Hay Street, Portsmouth, certainly know how to rewind a burnt-out transformer, and they carry out such a task with very satisfactory results, as we have discovered in the past, so that they should know how to wind transformers of their own design. It is almost a logical development for an ambitious transformer repairing concern to produce a transformer, so that we were not surprised when we received a "Renown" from the above firm for examination and test. The outstanding feature of this particular L.F. component is that it is designed for one-hole panel or baseboard mounting. It is metal cased and is cylindrical in form. At one end are four terminals, and centrally placed at the other a single mounting screw.

The ratio is stated as "power." Personally we should prefer figures instead or additionally. However, we tested the component in a second stage of L.F. amplification and it gave results that indicated that it was certainly suited to such work.

Amplification was carried with commendable freedom from frequency distortion, and the resultant tone, using a small power valve and appropriate grid bias, was both full and mellow. The "Renown" also operated well in a first stage, and our impression is that the windings are liberal, and the core carefully designed. It is by no means dear at 12s. 6d.

* * *

We have received from the Marconiphone Co., Ltd., 210-212, Tottenham Court Road, London, W.1, a Marconiphone H.F. choke. This component, although specially designed for H.F. choke-capacity amplifiers, is stated by the makers to be suitable for use in reflex and other circuits as an H.F. blocking unit. It has an inductance of 100,000 microhenries and a resistance of 770 ohms.

The most important requirement of an efficient H.F. choke is that it should have a very low self-capacity, and the Marconiphone component, wound carefully in sections, fulfils this to a degree superior to many others we have examined. Given practical tests in a choke coupled H.F. amplifier, a Reinartz set and a reflex receiver employing a valve detector, it evinced a high order of efficiency.

It is supplied with a nut and bolt at its base for mounting purposes, and on the top are two contact terminals. It is cylindrical in design, and is small, neat and nicely finished. The price is 10s. 6d., and we can thoroughly recommend it to our readers as a most trustworthy component.

* * *

The Benjamin baseboard mounting valve holder costs 2s. 9d. and the price of six is therefore 16s. 6d. and not 15s. 8d. as stated in the list of components for the "Fleetway Five" ("P.W." No 201, April 3rd). We have to thank the Benjamin Electric Ltd. for drawing our attention to this error.

RADIOTORIAL

All Editorial Communications to be addressed to The Editor, POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

The Editor will be pleased to consider articles and photographs dealing with all subjects appertaining to wireless work. The Editor cannot accept responsibility for manuscripts and photos. Every care will be taken to return MSS. not accepted for publication. A stamped and addressed envelope must be sent with every article. All inquiries concerning advertising rates, etc., to be addressed to the Sole Agents, Messrs. John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4.

As much of the information given in the columns of this paper concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and the trader would be well advised to obtain permission of the patentees to use the patents before doing so.

Readers' letters dealing with patent questions, if sent to the Editor, will be forwarded to our own patent advisers, where every facility and help will be afforded to readers. The envelope should be clearly marked "Patent Advice."

TECHNICAL QUERIES.

Letters should be addressed to: Technical Query Dept., "Popular Wireless," The Fleetway House, Farringdon Street, London, E.C.4.

They should be written on one side of the paper only, and MUST be accompanied by a stamped addressed envelope.

Queries should be asked in the form of the numbered questions: (1), (2), (3), etc., but may be accompanied by a short letter giving any necessary additional particulars as briefly as possible.

For every question asked a fee of 6d. should be enclosed. A copy of the numbered questions should be kept, so that the replies may be given under the numbers. (It is not possible to reproduce the question in the answer.)

BLUE PRINTS. A series of 20 Blue Prints can be obtained from the Query Dept., price 6d. per Blue Print.

Only a limited number of circuits are covered by this series, and full details of the circuit arrangements available in Blue-Print form are published fortnightly in the advertisement columns of this journal.

All other back-of-panel wiring diagrams are specially drawn up to suit the requirements of individual readers, at the following rates: Crystal Sets, 6d. One-Valve Sets, 6d. One-Valve and Crystal (Reflex), 1s. Two-Valve and Crystal (Reflex), 1s. Two-Valve Sets, 1s. Three-Valve Sets, 1s. Three-Valve and Crystal Reflex, 1s. 6d. Four-Valve Sets, 1s. 6d. Multi-Valve Sets (straight circuits), 1s. 6d. Except SUPER-HETERODYNE DIAGRAMS, all of which, irrespective of number of Valves used, are 2s. 6d.

If a panel lay-out or list of point-to-point connections is required, an additional fee of 1s. must be enclosed.

Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.)

Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1/- per diagram, and these should be large, and as clear as possible.

No questions can be answered by 'phone.

Remittances should be in the form of Postal Orders.

Questions and Answers

SHORT-WAVE STATIONS.

P. D. (Bristol).—What stations are now transmitting on short wave-lengths of the order of 100 metres and lower?

We have prepared a list and this will appear either in this or the next issue. Over 100 stations are represented.

VALVES IN SUPER-HETS.

D. S. G. (Manchester).—I have been told that in a seven- or eight-valve super-heterodyne receiver total failure to obtain results can be caused by the inclusion of just one unsuitable valve. Is this the case?

Yes, that most certainly can happen and more particularly in the detector positions. The first detector (oscillator in tropadyne circuits) is probably the most critical and some super-hets. are absolutely "dead," and others howl their heads off unless the valve is used. Unfortunately, it sometimes happens that the type specified tends towards unstandardisation and different samples of an exactly similar type and make vary slightly in characteristics. This makes it difficult to state for certainty in all cases that a certain valve will give certain results. It is, however, satisfactory to note that the larger valve manufacturers are now producing valves that are standard in the full sense of the word.

AN OLD QUESTION.

K. M. (London, N.E.).—Is it advantageous to employ insulated wire for aerials?

That is a question frequently asked even these days, although it has been answered many times. In short, the "pick up" efficiency of an aerial wire that is insulated is approximately the same as one that is not, although the existence of insulating material causes absorption and surface losses. But from a practical point of view, enamelled wire is deserving of attention. The enamel can be regarded not as an insulator, but as a protection against the corrosive action of the weather, and for this it is to be advocated. An idea was prevalent "once upon a time" that wireless waves were unable to pass through insulating materials, but nowadays everybody knows that the wireless wave is "an effect caused by electricity which can cause electricity" and is not to be likened to that mysterious fluid itself that flows through wires around the house making light and heat for its occupants.

ADJUSTING A NEUTRODYNE.

M. I. T. (Brighton).—Does a Neutrodyne receiver have to be "re-neutrodyned" when one or more of its valves are charged?

Yes, certainly, for it is the valve mostly that is "neutrodyned." Its internal capacity is balanced out by neutralising capacity and the capacities of valves vary enormously in the manner of speaking of such values!

(*Continued on page* 334.)

TANTALUM RECTIFIER

(Patent No. 235658.)

AMATEURS who wish to construct a Tantalum Rectifier for Wireless or Motor Car Accumulator charging can obtain an envelope containing two strips of Tantalum, complete instructions for use and a licence under the above patent to construct one charger for their own use—price 15/- post free from the sole British licencees

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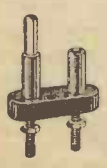
Valves repaired by a patent process incorporating best material and skilled workmanship.

TRANSMITTING VALVES REPAIRED

Up to 3 valves. Cheapest method is by letter post. Remittance should be enclosed with valves.

VALCO LTD. Dept. P.W., Tabor Grove, Wimbledon. *Phone: Wimbledon 951.* London, S.W.19.
(Contractors to H.M. Government.)

TIGER SINGLE COIL HOLDER



For panel mounting, No. T.C.101. Perfect insulation, only best English porcelain used. Brass Fittings. Price 9D. each.

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It's *Tone* that matters now in listening in!

ANY decent set will bring stations strong and clear, but to get the very best and purest in radio you must have an Ericsson Super Tone to follow your last valve. Go to the nearest Ericsson dealer (all over the U.K.), ask to hear the Super Tone, and be convinced. 18 in. high, on wood base, is **63/-**

The Junior Super Tone for small rooms—a worthy smaller edition of the Senior, complete with lead, **32/6**

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The BRITISH L.M. ERICSSON Mfg. Co., Ltd., 67/73, Kingsway, W.C.2.

HAVE YOU EVER BURNT OUT A VALVE?
It is so easy to destroy a valve by faulty connections. The experience is a costly one, but can be easily avoided by the use of an Ericsson Safety Wander Plug in place of the ordinary type.
A customer writes: "These accessories have again saved my valves from destruction and my pocket from expense."
For use with any valves whose current consumption exceeds ·25 amps., 1/- each. Spare fuses, 5d. each.

Ericsson
SUPER TONE LOUDSPEAKERS

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page 332.*)

ARE ATMOSPHERICS DANGEROUS?

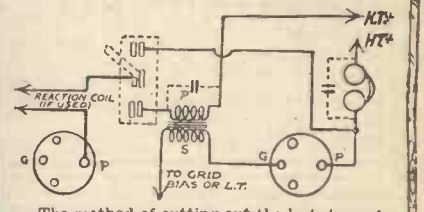
S. N. D. (Cheltenham).—Is there any danger of fire or damage to a wireless set and the house when loud atmospheric noises are heard, although actual thunder and lightning is not occurring? Are such noises the result of heavy charges of electricity on the aerial?

Generally speaking it is only when overhead forked lightning is present that the remote possibility of damage being caused by such means is to be feared. Such can be entirely prevented by efficient aerial earthing systems. Lightning arresters are quite preventative. The fact that during particularly heavy thunderstorms it sometimes transpires that one wireless aerial out of some millions *may* have attracted lightning with disastrous consequences is proof that wireless aerials are not the danger some would have us believe. As a matter of fact, an aerial that is efficiently earthed during a thunderstorm by an outside switch acts much more as a lightning protector than an attractor of danger.

However, with regard to strong X's, or atmospherics, these are quite innocuous, terrifyingly loud though they sound at times. On very rare occasions enough energy may be induced on to aerials to cause sparks, and operators may receive rather severe shocks when touching the aerial, but in this country at least it is safe to say that it requires a thunderstorm to produce atmospheric energy in dangerous quantities. We have intentionally reversed cause and effect for in some countries severe static charges accumulate without thunderstorms resulting.

For the Constructor

No. 6.—Cutting Out an L.F. Valve.



The method of cutting out the last stage of low-frequency amplification (transformer-coupled) by means of an S.P.D.T. switch is shown above. The plate lead of the preceding valve is disconnected between the reaction coil and the L.F. primary. The side nearest the valve is taken to the centre of the switch, whilst the primary side goes to the lower switch contact, so that when the switch is "Down" this lead is restored.

The top switch contact is joined to a point between 'phones and the plate of the last valve, so when the switch is "Up," the transformer is put out of circuit and the preceding valve's plate current flows through the 'phones instead of through the primary.

THE "P.W." SUPER-HET.

SUPER (Egham).—I have built the "P.W." super-het. and find that best results are obtained when the coupler is set so that the first valve is just oscillating. Should this be the case?

Yes. If the first valve oscillates too violently it will lose a great deal of its detecting sensitivity and the weak impulses of the signals will be unable to affect the grid which will have all its attention taken up, as it were, by the power oscillations generated by the valve itself. The most sensitive adjustment is when the valve is just oscillating.

RESISTANCE AMPLIFIERS.

A. P. T. (St. John's Wood).—In building a resistance-coupled amplifier should the inter-valve condenser be of high or low capacity?

They should be of high capacity. The actual value will vary with the loud-speaker you use, and the valves and resistances, but for general work, unless you are going to work exactly to frequency curves, etc., and for pure results the values should be between ·01 and ·06 or thereabouts. If less than ·01 is used the low notes will suffer and if above ·06 or so the high notes and overtones may be on the "thin" side. Use reliable condensers, if possible, with mica insulation and with values between those stated.

TECHNICAL NOTES.

(*Continued from page* 396)

The use of quartz resonators or quartz oscillators has been mentioned in these notes some considerable time ago, and it was explained how a circuit employing such a quartz oscillator could be used—owing to the constancy of its natural frequency of oscillation—for keeping a check, so to speak, on the output wave-length of a transmitting station.

This system has now been largely adopted, particularly in America, where many stations regulate their wave-length by means of a quartz oscillator standard. In particular, station W H T (Chicago), which transmits on a wave-length of 400 metres, has been equipped with a special frequency indicator, and is guaranteed not to vary more than 0·01 of a metre on either side of the 400. American experimenters are thus using the transmission from W H T for the purpose of calibrating or correcting their instruments.

Eliminating Interference.

Several readers have asked recently questions connected with the suppression of interference due to electrical machinery, alternating-current power-lines, and so on, and, as this seems to be a fairly common trouble, a few words on the subject may be useful. If interference is experienced from power-lines, tramway wires, etc., it is a well-known artifice to run the aerial as nearly as possible at right angles to the conductor which causes the trouble, and also, of course, to place the aerial and the earth as far from the source of trouble as possible. If this arrangement does not overcome the interference sufficiently, a counterpoise earth may be used instead of a true earth, as sometimes the interference is transmitted through the earth. Another dodge which may be tried, and which is sometimes very successful, is the introduction into the earth lead of a condenser of as large capacity as possible, at least 2 microfarads. This should be introduced between the earth terminal of the set and the earth connection.

Of course, another fundamental way of avoiding interference is by the use of sharp selectivity in the receiver, and this includes the employment of reaction. For the avoidance of interference, particularly of the high-frequency type, rejecter circuits are quite common, but the reader will no doubt be well acquainted with these without further discussion. Another device for cutting down a comparatively low-frequency interference such as that due to power-lines, and so on, is a wave-trap tuned to the approximate wave-length of the interfering radiation.

CORRESPONDENCE.

(*Continued from page* 316.)

MORE CHITOS SUCCESS.

The Editor, POPULAR WIRELESS.

Dear Sir,—Having read with great interest the various reports in "P.W." of the "Chitos" circuit, I thought perhaps my experience with the two-valve "Chitos" may interest you. My aerial consists of about 75 ft. of electron wire supported by 20 ft. of gas barrel one end, and slung over the house supported by the roof at the other, aerial and lead-in being continuous. Earth 18 ft. of ignition cable, to cold water pipe.

The condensers both have vernier plates, ·0003 low-loss, 7s.; ·0005, 5s. 9d.; "Bulldog" transformer, 4s. 11d.; "Triotron" ·06 valves, 5s. 6d. each; H.T. 2 doz. flash lamp batteries at 3s. 5d. per doz.; 2 mfd. across H.T.; separate H.T. tappings; coils, home-made honeycomb; Watmel grid leak. So much for the set. Now for the performance of same.

London, loud and clear on the speaker. Radio Berne (woman announcer) on loud speaker. Radio Belge (?) Brussels, Madrid, San Sebastian (woman announcer), audible in average-sized room on the loud speaker.

On the 'phones, the following stations have been heard :—

Dortmund (badly heterodyned by another foreigner), Petit-Parisien, and five other foreign stations unidentified. The only B.B.C. stations I can get are Birmingham and Newcastle, other than London.

London is easily cut out within 5 or 6 degrees on the condenser. Hand capacity absent with aerial condenser, but very marked with the grid condenser. The grid leak makes no difference whatever to the tuning and so is left alone.

I have made up many valve circuits, but never one to beat the "Chitos."

Hoping this letter will be of some interest, and wishing you and "P.W." "all the very best."

Yours faithfully,
E. J. WALKER.

305, Derinton Road,
Tooting, S.W.17.

DX RECEPTION.

The Editor, POPULAR WIRELESS.

Dear Sir,—The following experience, somewhat surprising to me, may be of interest to your readers, should you care to publish it.

I have on several occasions during the past three weeks tuned in the new station at Rome, twice with the aid of a wave-trap to reduce interference from London. Apart from other clues, I have become thoroughly familiar with the announcer's voice. On most of these occasions I have heard him say that they were the new station at Rome, broadcasting on a wave-length of 424 metres. Reports from English listeners would be welcomed, and should be sent to the Marconi Office, 11, (Conditti ?) Street, Rome. I have not heard any music from this station. My set, on which these results were obtained, consists of a valve detector and low frequency, with reaction to the aerial (straight circuit).

On Friday evening last, the 12th instant, I fixed up an indoor aerial, consisting of 100 feet of electron wire, around the picture rail. This length was somewhat too much, but, not wishing to cut off the surplus, I left it, at the end to be attached to the set, trailing on the floor. At no time was any part of this indoor aerial parallel with the outdoor one (this latter consisting of a single wire 100 feet in length and from 40 to 45 feet high). I mention this fact because my father thinks it possible that the indoor aerial obtained some energy from the outdoor one.

With this indoor aerial, and with the same coils, etc., as for London on the outdoor one, London came in on a reading slightly lower than with the outdoor aerial. I then searched for other stations, and to my surprise, picked up the above Rome station, calling Bonsa, or Bonza, as before. Thinking to improve reception of this by getting it on a lower condenser reading, as speech was not as clear as with the outdoor aerial, I plugged in a higher coil (one with a greater number of turns), but with this reception was neither as clear nor as strong. Finally, I lost the station altogether, and could not pick it up again.

Since that evening I have tried again for this same station with the indoor aerial, but so far without success, though Glasgow, Hamburg, and Radio Iberica came in clearly and at fair 'phone strength, but noticeably inferior to reception of these stations on the outside aerial.

Doubtless weather conditions, the state of the ether, etc., happened to be particularly favourably on the 12th.

Hoping to see shortly in your publication other readers' reports of reception of this new Rome station.

Yours faithfully,
E. SAULL.

"Two Elms,"
Lauderdale Road, Hunton Bridge,
King's Langley, Herts.

T/R

The Shanty-man

flourished in the palmy days of the sailing ship, when the handling of capstan, windlass or sails depended on the lusty arm of the seaman. His duty it was to sing the shanty which kept the hands heaving or hauling in time, while the latter took up the refrain, and the great ships were warped to their berths or headed for the open sea to the strains of 'Away, Rio,' 'Reuben Ranzo,' 'Shenandoah,' 'The Hog-eye Man,' and many another of these curious and attractive airs. Alas! the stately Indiaman and the graceful clipper ship have vanished from the sea, and the Shanty-man sings no more.

20 for 11d.
10 for 5½d.

PLAYER'S NAVY CUT

Reg. No. 154011

Player's
WHITE LABEL
NAVY CUT CIGARETTES

P.W.38

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R R