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"P.W." BUILDS THE "SIMPLE TELEVISOR"

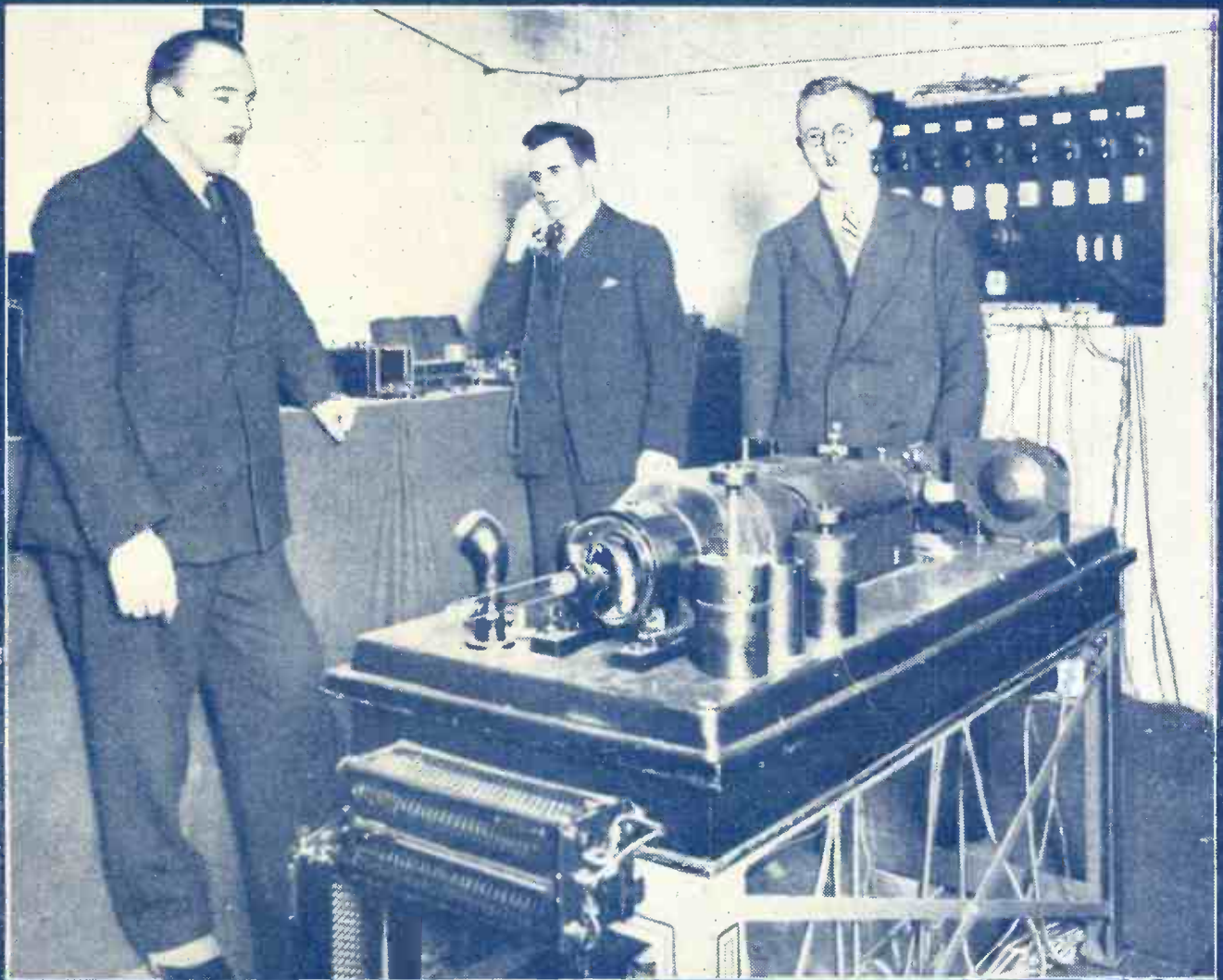
Popular Wireless

Every Thursday
PRICE
3d.

No. 309. Vol. XIII.

INCORPORATING "WIRELESS"

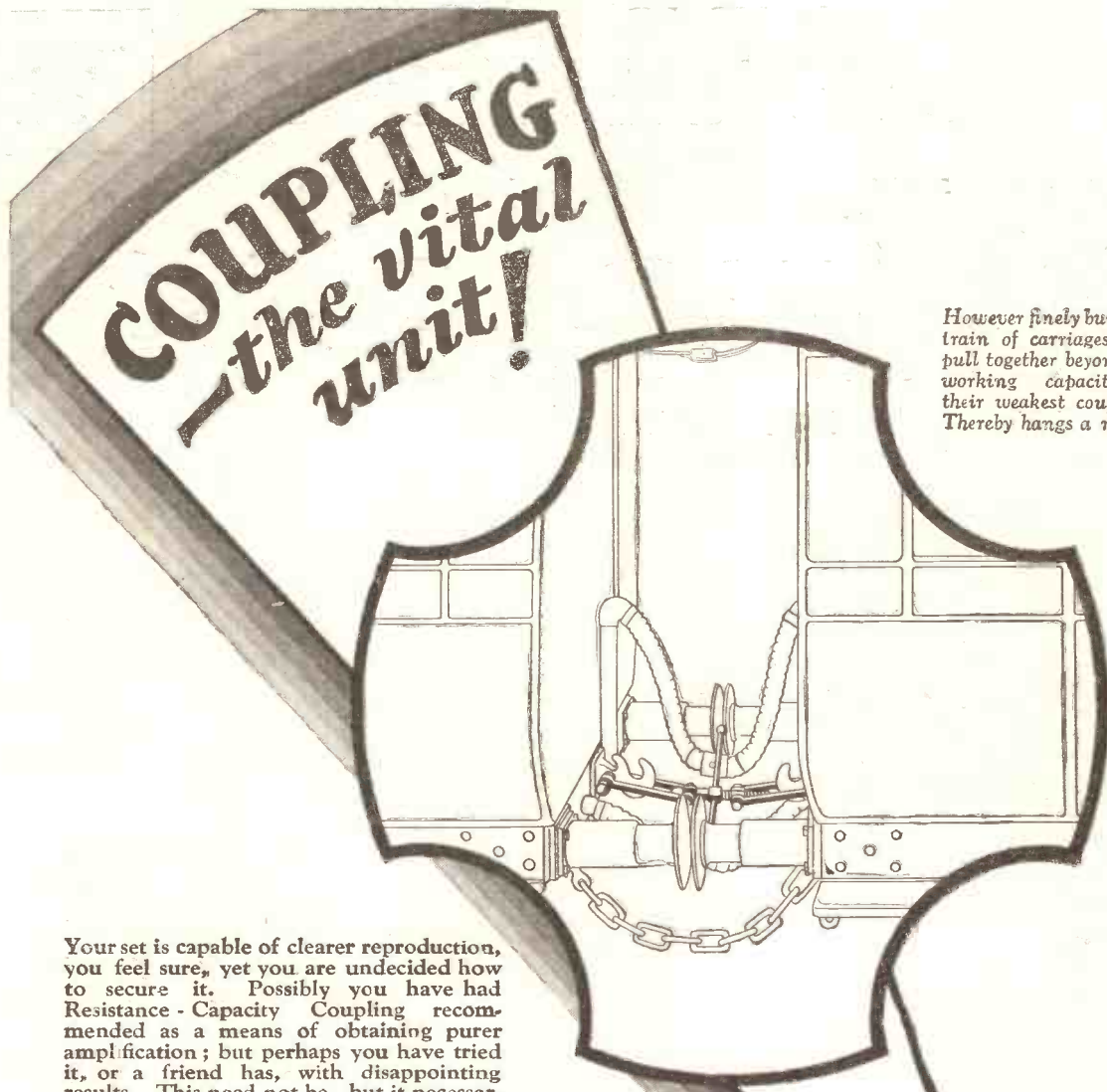
May 5th, 1928.



SPECIAL FEATURES IN THIS ISSUE.

The A to Z of H.T. (Pt. II). Simple Summer Portables
HOW TO MAKE THE "GRID-TAP" ONE
The New 2 D.A. Those Broadcast Criticisms, etc., etc.

In the photograph can be seen a portion of the apparatus used by a section of the London Daily Press for transmission of photographs to their provincial offices



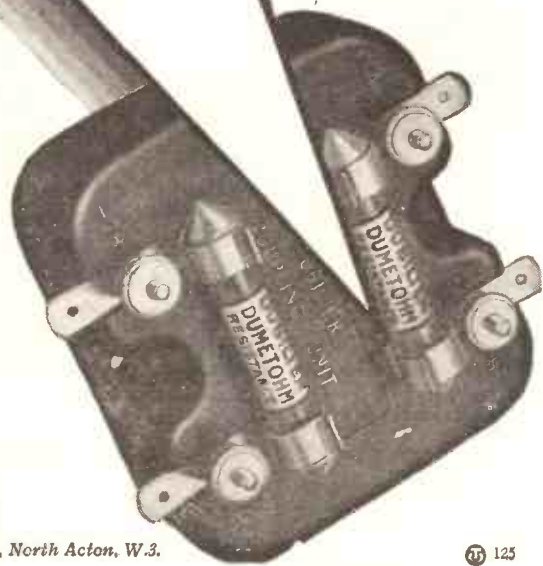
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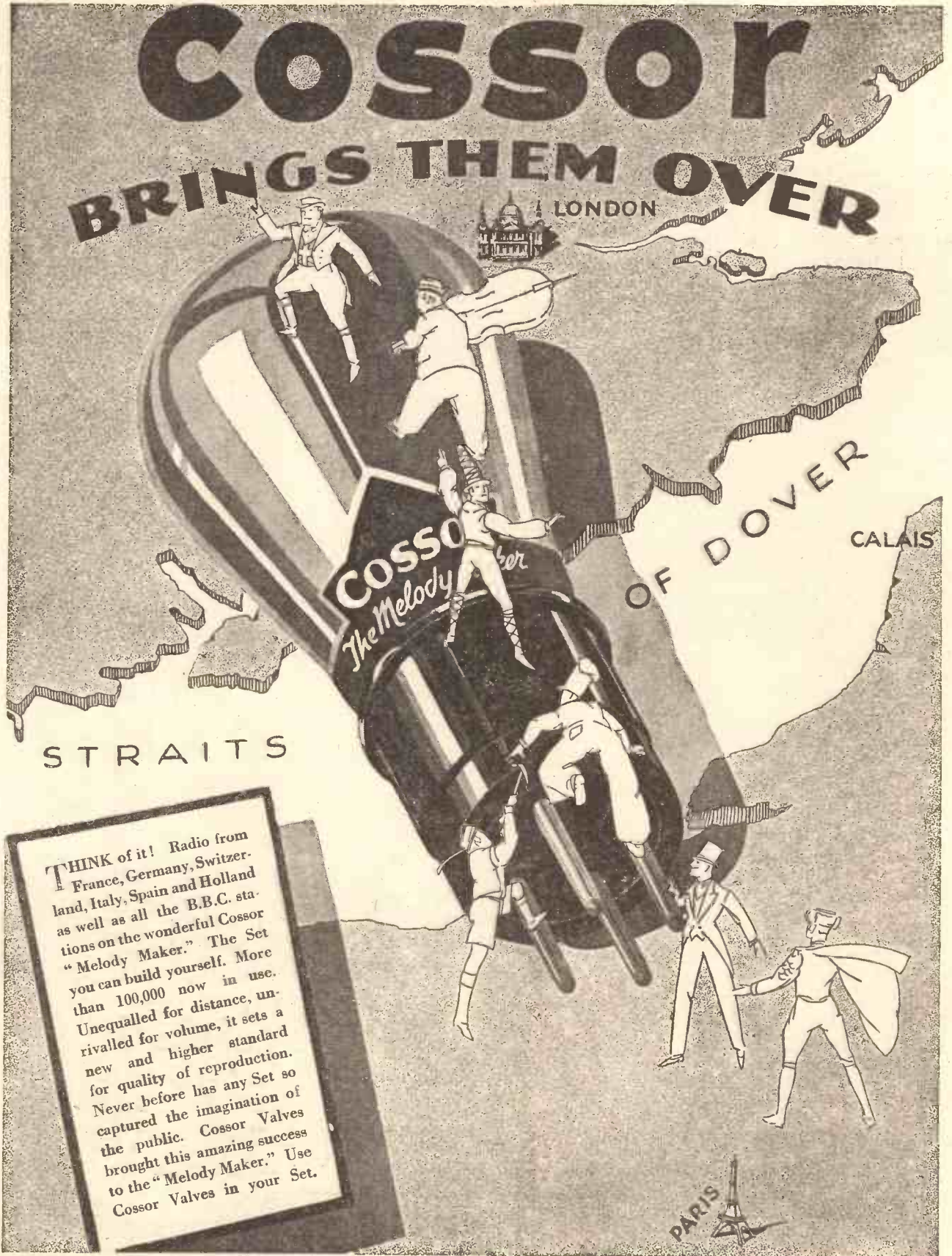
Name.....

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P.W

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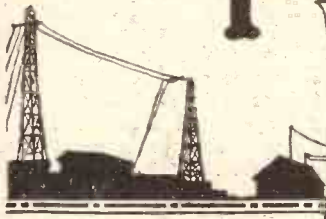
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RADIO NOTES AND NEWS.

The "Force" Drops Radio—Eric Dunstan—The Shy Pianist—The Marcuse Broadcasts—Radio and Rain—National Publicity—The "Gas" Attacks.

Word Wanted.

SOMEbody has recently been objecting to the use of the word "eliminator" in connection with rectifiers and other apparatus through which sets take power from the mains. He said one would not call a motor a horse-eliminator. There he is wrong, because I should. Still, it is rather a mouthful, and we await the inspired word. Funny how "valve" sticks, in spite of the campaign in favour of "triode," etc.

Paying the Piper.

ACCORDING to new arrangements, the members of the five provincial high-power station orchestras are to be paid on the basis of a 24-hours' week. At Manchester, for instance, they will get £380 per annum, two weeks' holiday with pay, overtime and travelling expenses. Not too bad, as jobs go—and there's time to give a few lessons. No one will grudge the orchestras all they can get, surely, seeing that they are the backbone of broadcasting.

The "Force" Drops Radio.

I REMEMBER that it was only about a year ago I mentioned that the New York police were being equipped with portable radio sets. Now, I understand, the sets are to be sold by auction, because the men cannot work them; though whether the men or the sets are deficient I do not know. The idea was a mistaken one. The sets ought to be located in booths, one on every "beat," each officer should have a key and listen-in for a minute or so at stated times, criminals permitting.

Eric Dunstan.

CONTRARY to what was suggested in "P.W." for April 7th, Mr. Eric Dunstan tells me that he is definitely returning to India at the earliest possible moment, whether he gets fresh capital for the I.B.C. or not. It's our money he wants, but not so badly that he is going to hurl up the sponge if it is not subscribed. Our loss is India's gain. It is amusing to learn that an epidemic of mumps in the ranks of B.B.C. announcers was responsible for Mr. Dunstan's reappearance at the "mike" here.

The Worms Turn.

IT is proverbial in this country at least, that even a worm will turn at bay if sufficiently angered. Listeners in Germany have formed a union to protect their rights, and their first wriggle has been the passing of a resolution that they will not pay their fees unless and until the interference with reception caused by the overhead cables of the trams is abolished. In England, the P.M.G. would retort by prohibiting them from using radio sets "unless and until" their fees were paid. Have listeners any rights—legal rights—over tram noises?

The Irish Listener.

I HAVE always understood that the Irishman regarded the Anglo-Saxon as positively tongue-tied when it comes to telling a story, and that he is himself most eloquent in speaking of his wrongs. But I am forced to revise all this on learning that when the Free State (Advisory) Committee came to consider the wrongs of 27,000 licensees they had only 38 letters to work upon. The only typically Irish feature of

the affair was the report that the Committee found it impossible to reconcile in any general way the views expressed by the gallant 38.

The Shy Pianist.

I AM glad to see that Miss Cecil Dixon's very pleasant voice has been traced to her by the newspapers. She does not disown it, but she thinks it is a deceiver if it makes listeners believe that she is shy. Bless me! I thought that everybody knew Auntie Sophy's voice by this time.

What the Figures Show.

IN what country is radio most popular? Probably most of us would say England or the U.S.A., but judging by the number of licences per 1,000 head of population, and excluding America where no licence is needed, Victoria (Australia) heads the list with 78. Sweden, with 53.6, comes next, Great Britain being third with 53. Germany has 28.1, Norway 22, and Belgium 5.

(Continued on next page.)

"P.W.'s" SHORT-WAVE STATION.



This photograph shows the receiving apparatus at 2DA—"P.W.'s" experimental station—which is described in detail in this issue. Messages picked up in the 'phones are typed direct as received. The Morse key and switch on the bureau control the transmitting apparatus, which is situated at some distance from the receiver.

NOTES AND NEWS.

(Continued from previous page.)

The Marcuse Broadcasts.

THE Post Office has extended Mr. Marcuse's broadcasting licence until June 1st. Continuing my notes on long-distance reception in India, I am able, through the courtesy of Mr. Marcuse, to cite the instance of A.E.H. (Peshawar), who picked up 2 N M's programme on March 11th at strength R7 on 0-v-1. The same programme is reported by J. G. B. (Cossipore), moderate L.S. strength on Det. and 2 L.F.; and by K R B (Allahabad) on a one-valve Reinartz plus one L.F.; and also by A.P. (Bombay), who says the signals equalled those of the local station.

Vagaries of Short Waves.

THESE short waves have a lot of tricks up their sleeves yet. For example, why did Mr. Marcuse get all over the British Isles on March 18th with "tremendous volume and clarity," in defiance of "skip" theories, and never do so before or since? And why should his signals and those of P C J J and 2 X A F be receivable at a certain spot in the Grecian Archipelago, and 5 G B and 5 X X, and others, be absent? I am coming round to the idea that a short-wave signal's performance depends upon the date and time, the weather, the price of canpacs, "sunspots," the circulation of the "Daily Mail," and the number of goals scored by Chelsea.

To Move or Not to Move.

A SPECIAL correspondent of "The Observer," says of wireless waves, "... they move through the ether with a fixed rate of progression." And again, "They pass from point to point at the same speed as light." Now this is all very misleading, and I beg "P.W." readers to believe that, (1) Radio waves do not move through the ether or through anything. (2) Therefore they do not pass from point to point, and (3) Light does not pass from point to point.

A Better Conception.

AN other wave may be said to die in its birthplace. It is created and its "crest" appears in a certain place; it is reproduced with its crest one wave-length from where the crest of its parent existed; and it is re-produced over and over again, each new wave having its crest one wave-length distant from where that of its immediate predecessor was. And the speed of the propagation is equal to that of all ether-waves, light included, 186,200 miles per second. That is a more scientific statement and just as easy to grasp as the slipshod talk about waves moving from point to point.

The B.B.C.'s Mutton-Trap.

THEY say that a strayed lamb fell into a cooling-tank at 5 X X, and that mamma, arriving hot on its wayward heels, also took the plunge. Happily both were rescued by the kindly engineers, dried, smacked, and sent back to gambol on the greensward. I should like to hear Captain Eekersley burst into poetry on this incident. The vision of a radio engineer, fresh from cursing a "soft" valve or a hot bearing, gathering a wet lamb to his bosom is a sight

I would go far to see. My theory is that the lamb had some wild idea of stopping a "talk" on the dietetic value of mint sauce.

Radio and Rain.

THEY are still at it. Enter, with a flourish, Mr. E. S. Bruce, M.A., a Fellow of the Royal Meteorological Society, who is not at all sure that wireless does not cause rain. The argument is that if an electrified stick of sealing-wax can cause the fine drops of a water-jet to

SHORT WAVES.

The star, Nova Pictoris, is reported to have been split in two. We knew something would happen if the B.B.C. carried on with their improving lectures.—"Punch."

THE RETORT COURTEOUS.

Henpeck: "Does the loud speaker of our radio annoy you?"

Mrs. Nextdoor: "Is that what it is? I thought it was your wife."—"Radio News."

Why are high-tension batteries like spinsters? Because the longer they are left on the shelf the worse they become.

For "wishes" while listening-in. There are some folk who don't care a pin.

But I like "Variety."
And say, with propriety,
That the wittiest wish is Wish Wynne.
—Mr. L. Joyner, "Evening News."

Indoor aerial hint: Sling the wire between two shoe trees.

Now that conditions are generally favourable for picking up long-distance stations, there is a revival of coast-to-coast reception, or should it be called boast-to-boast deception?—"News of the World."

THIS WEEK'S FABLE.

Once upon a time a man with a five-valve set said, "No, I cannot get long-distance stations on my receiver."

Have you heard of the wonderful radio set that my friend, Mr. Jones, was persuaded to get.

Which after he got it remodelled his life, and made such a difference that even his wife was in doubt that she knew him—this radio fan who developed from this most commendable man?

To the radio microbe a victim he fell, and had such a case that he never got well, till he bought him a peach of a radio set, and sat down to listen to what he could get; and the dishes from dinner are now made to wait until after the concert at quarter to eight.

And so busy is he in employing the set, and trying the various stations to get, that his wife says he seldom, if ever, is seen any more to beat rugs, or the carpets to clean; and she vows not again would she marry a man.

Who showed promise of being a radio fan.
D. F. Kirby, in "Radio News of Canada."

coalesce into "enormous" drops, may not the "electrical waves" cause rain by a similar process.

What are the Facts?

TO my untutored mind the first point is that we ought to blame the forces which produce the moisture which is coalesced into rain-drops, and not radio; secondly, are the field strength of an electrified stick of sealing-wax, and the area of the experimental water-jet, comparable to the average field strength over a given rainy area, at a given time, and to the said area itself. This is the sort of problem which would appeal to Dr. E. V. Appleton—and I appeal to him for an answer.

National Publicity.

ALTHOUGH the B.B.C. does not allow its stations to be used for commercial publicity—except on behalf of its own publications—I consider that it ought to devote a certain amount of time to national advertising, especially in favour of the "Come to Britain" movement. I understand that the idea of transmitting items designed to attract foreign visitors has already been considered by the B.B.C., whose decision was adverse. I hope the B.B.C. will think again, and enlist the services of an expert propagandist in the preparation of talks likely to make foreigners hunger to come over.

Without Prejudice.

SCEPTICS are requested to note that C.C.M. (Bromley), Radio BRS 88, reports that on his Reinartz 0-v-1, 20-80 metres, he received during the three months prior to April 18th, 560 foreign amateur stations; of these 160 were in America, 20 in Brazil, 8 Australia, 7 Uruguay, 6 Chile, 5 South Africa, 3 India, 1 Indo-China, 4 Canada, and 1 Japan. He says, also, that he has received 230 stations on an underground aerial. Finally, he says he has received from "all six continents." What was the sixth? Mars?

Transmitting Note.

MR. G. A. JEAPES, G 2 X V, who is well known as a successful amateur transmitter, states that during part of March and April he set up two-way communication (C.W.), on 23 metres generally, with over eighty amateur stations in America. But his last sensational job was about an hour's Morse talk with O A 7 C W, Tasmania, on 32.5 metres. Mr. Jeapes used an Osram L.S.5 D. valve in a tuned grid, tuned plate transmitter, and an aerial only 30 feet long and 32 feet high. It beats cock-fighting, doesn't it?

Poster Competition.

THE R.M.A. offer six prizes, ranging from £5 to £50 for a poster for the National Radio Exhibition. The sketches (finished rough, in colour) must be double crown full size—30 in. by 20 in. vertical—and the maximum number of colours permissible is nine. Designs, which must apply to Radio, should incorporate these words: "The National Radio Exhibition, Olympia, September 22nd to 29th, 11 a.m. to 10 p.m. Admission 1/6 daily. (Tuesday, September 25th, up to 5 p.m., 2/6). Dancing." Send sketches with name and address on backs to Secretary, R.M.A., Astor House, Aldwych, London, W.C.2, to reach him not later than May 31st, 1928.

The "Gas" Attacks.

THE April to July programme of B.B.C. Talks and Lectures lies before me. It is cleverly arranged, I am bound to admit, but it has an "education experts" look about it which is positively terrifying. There is a talk about the Earwig, and one on "The Functions of Clothing," besides one on "Primary and Subsidiary Functions of Feeding." But the best of all is "On Reading Poetry Aloud." Don't say that I failed to warn you. Hurrah for short waves and the "Sydney" Revue. Driven from home!

ARIEL.

THE NEW 2DA



ALTHOUGH last year the POPULAR WIRELESS experimental station did little in the way of transmitting, a great deal of useful receiving work was carried out on various wave-lengths, but particularly in the region of 40 metres.

This year 2DA (the "P.W." station) has been "on the air" quite a lot, and many people who read Morse and possess a short-wave receiver must have heard its continuous-wave signals on 45 metres.

The transmitter uses extremely low power, but appears to get out quite well, being reported generally as "strong" in most parts of the British Isles and Europe.

Short-Distance Experiments.

Experiments are being conducted more with a view to communicating reliably over comparatively short rather than long distances, so that, although America has been "worked," results are considered perfectly satisfactory if transmission is really reliable up to about 800 miles.

In order to do this certain difficulties have to be overcome, due to the peculiar skipping effect produced by the Heaviside Layer, and it is in this direction that efforts are at present being made. Of course, telephony transmissions would be suitable for such experiments, but at present it is found more convenient to use C.W., and, in any case, observations made on C.W. would be equally applicable to speech.

The complete transmitting gear is housed in a small shed under the aerial and is situated some distance from the receiving room where it is controlled from. This "remote-control system" is perfectly simple, and consists of a number of relays so arranged that it is possible to work the transmitter without anyone actually having to be in the shed. The idea being that the aerial shall be used only for transmitting, so that it is possible to "listen through" on another aerial while actually sending, and also to avoid changes in the wave-length emitted due to the operator moving about near the apparatus.

Practically the whole of the installation at 2DA, the "Popular Wireless" Experimental Transmitting Station, has lately been thoroughly revised. Modern remote control and other such systems have been incorporated, and many up-to-date improvements of an important nature have been made. These are briefly dealt with in the following article, and interesting details concerning the future programme of the station's activities are given.

By THE ENGINEER-IN-CHARGE.

In Fig. 1 is shown a simplified diagram of the actual circuit used at 2DA, but it must be understood that, since the apparatus is

essentially experimental, many and frequent changes take place.

It will be seen that the alternating-current mains are applied to a step-up transformer to give 1,000 volts H.T., and also to a step-down transformer which supplies the necessary current for heating the filaments of the rectifying valves.

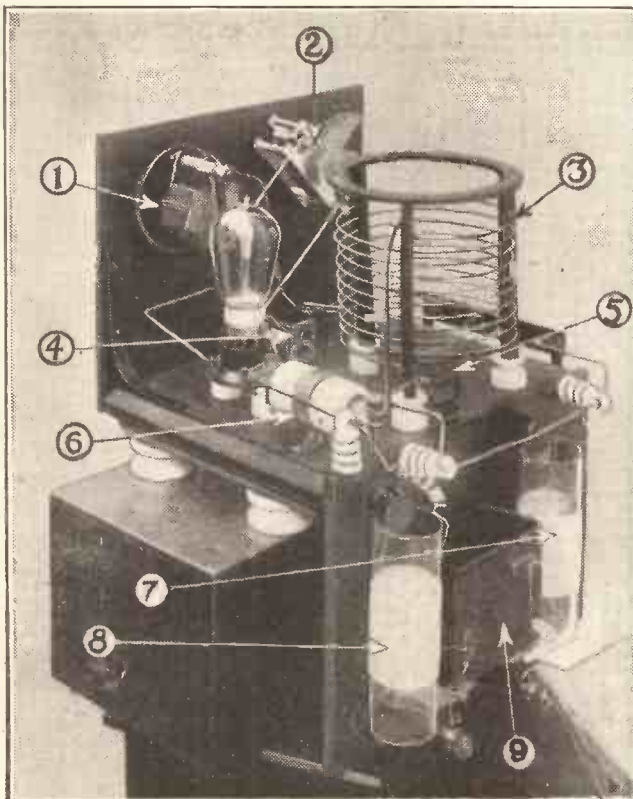
These two valves act as a full-wave rectifier, and the output is smoothed by a system of chokes and condensers, the whole circuit, so far, being a straightforward "B" eliminator, except from a power point of view. In fact, it has actually been used to supply H.T. to a receiver with considerable success. (And some kick from the loud speaker, too!)

The Circuit.

The transmitter itself is a more or less simple Hartley circuit which has been found hard to beat under certain circumstances. Many circuits have been tried out, but it has always been found best to use some adaptation of the one shown in the diagram.

As far as possible, every endeavour has been made to use receiving components, since the station is "amateur," and it is realised that if all special transmitting gear is used one might as well have a complete low-powered commercial set and be done with it.

(Continued on next page.)



The 45-metre transmitter. (1) Aerial tuning condenser. (2) Grid condenser. (3) Tuning inductance. (4) Rheostat. (5) Grid coil. (6) Anode blocking condenser. (7), (8) H.F. chokes in H.T. leads. (9) Steadying and final smoothing condenser across the H.T. supply.

THE NEW 2 D A.

(Continued from previous page.)

Using receiving components has added considerably to the interest of the transmitter, as each part has had to be thoroughly reliable to stand the strain. Starting at the very beginning of the circuit we have the H.T. transformer. Even here R.I. interval-valve transformers in parallel were at one time used! It was found that, although capable of working well, their resistance was too high for such heavy work, so a special Zenith power-transformer was obtained.

Reports Urgently Wanted.

The smoothing condensers are T.C.C., as used in battery eliminators, and prove very satisfactory. Ordinary receiving valves worked well as the rectifiers, but could only be used on powers up to about 5 watts.

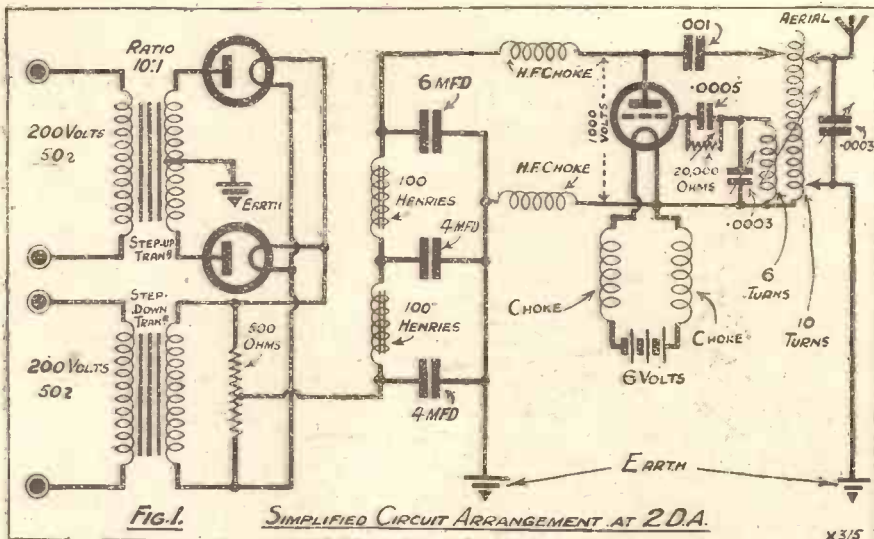
The oscillator valve is a Marconi L.S.5, and, although at times it is working with the anode at "cherry red," it gives every satisfaction.

So much depends upon the anode blocking condenser that it was decided to use a special transmitting type. The one seen in the photo is a Dubilier Type A.F.77. Other condensers are of the ordinary receiving kind.

Tests are made from 2 D A at all times of the day and always on 45 metres. In the near future some transmitting may take place on 23 metres, but as a rule the higher wave will be used.

Anyone picking up signals from 2 D A is asked to send in a report to the Editor of "P.W." It is particularly desired that reports shall be sent in reporting on reception at night, no matter how short the distance.

As a general rule, 2 D A is reported as "pure C.W. note and very steady," but at times quite contrary accounts have been



received, although no alteration is made to the transmitter apart from a slight decrease of power at night-time when the voltage of the electric-light mains has dropped owing to everyone using their lights and putting a load on the supply mains.

Mains Voltage Variations.

This effect of decreased voltage at night should be carefully noticed by amateurs who have battery eliminators, as the resulting change in their H.T. voltage may quite considerably alter their quality of reception. According to Board of Trade regulations, the voltage of electric-light mains may not vary more than 5 per cent either side of the normal, but in practice this appears to be winked at, for, although the voltage at 2 D A is supposed to be 200, it is usually about 215 during the day and 180 during the night! This is a variation of 35 volts which is enough to effect some experiments quite considerably.

ITEMS OF INTEREST.

It is a good plan before cutting up threaded rod to screw on several large nuts of suitable size so that after the cut has been made the removal of the nuts will tend to straighten out the thread and thus make replacement easy.

If you remove the diaphragm from a 'phone earpiece it should not be pulled upwards, against the magnetism, but should be slid across its supporting ring in a sideways direction, across the face of the magnet.

The masts of the Zeegen Station are nearly 700 ft. in height.

A hard pencil of the HH or HHH type makes a good emergency potentiometer if soaked in boiling water so that half the wood covering comes away, leaving the lead exposed in the other half. Connections are made to the ends, and by a sliding contact to the middle, as in the ordinary potentiometer.

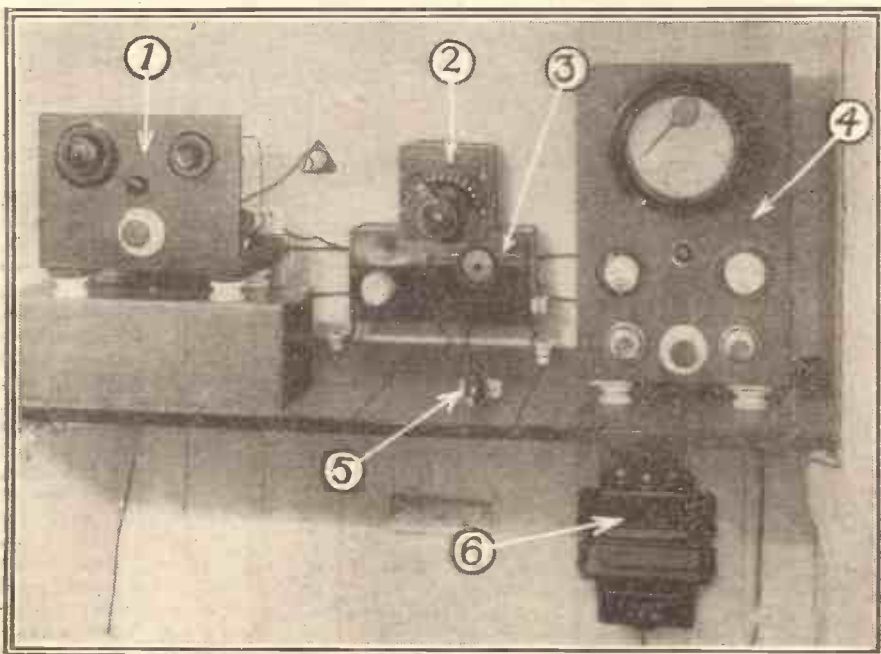
Accumulators should not be allowed to stand idle for too long, so that a battery which is not in use should not only be fully charged before it is put aside, but every six or eight weeks should be partially discharged through a suitable resistance, and then recharged.

The Kootwijk (Holland) Station transmits every Wednesday from 2 to 3 p.m. on 18 metres.

Canada is projecting a powerful and up-to-date broadcasting station at Brandon.

For the benefit of the many residents in East Africa a short-wave station is to be erected at Nairobi.

The Paris-Bordeaux afternoon express is now equipped for receiving wireless programmes, and about sixty pairs of headphones are available for passengers.



The 45-metre remotely-controlled transmitter at 2 D A. (1) The transmitter. (2) Power regulator. (3) Box containing relays for remote control. (4) Rectifier board for power supply. (5) "Testing" Morse key. (6) Step-up power transformer.



SIMPLE SUMMER PORTABLES

The author has conducted many experiments with portable sets, and has been responsible for several of the successful designs which have appeared in "P.W." from time to time. The practical constructional hints he gives in the following article are, therefore, the result of first-hand experience, and should prove of great interest and value to constructors.

By J. ENGLISH.

A PORTABLE RECEIVER, be it large small, opens up a new and varied or field of experiment for the enthusiastic amateur, and provides him with ample scope for the exercise of his ingenuity in design and construction. While the hardened "fan" can only derive a thrill

intensely interesting this branch of radio can be.

First of all, do not be too ambitious in the matter of results you expect from your portable. A compact receiver to give loud-speaker results from distant stations on a built-in frame aerial is no mean problem even for an expert to tackle.

Using a Temporary Aerial.

Unless you have ample experience, time and money, I would advise you to be content with a more modest set, which will certainly give a greater return of pleasure for your outlay. The type of receiver which is most easy to build and operate has no more than three valves, and on a self-contained frame aerial good reception is possible on the built-in loud speaker within "crystal range" of a main transmitting station. If provision is made for the use of a temporary aerial such as you can easily erect in the country, then loud-speaker reception of more distant stations becomes possible.

If you limit your requirements to loud-speaker reception of the local station on a frame aerial with good 'phone reception of the stronger Continental stations, then it

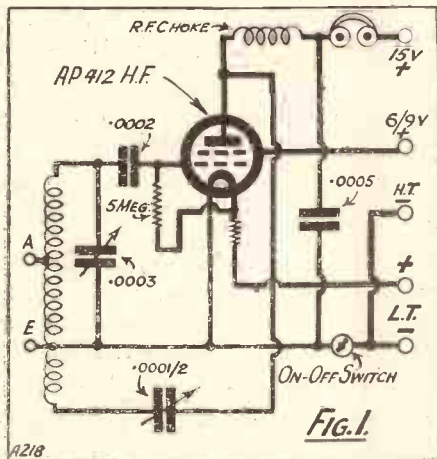
will be much easier to design and build the receiver you require in a compact and portable form. Of course, if you have a car as a means of transport, practically any receiver becomes a portable set, and with no limitation of weight and transportability an ordinary four- or five-valve receiver can be taken from home and set up anywhere with reasonable expectations of several transmissions coming in at loud-speaker strength on a small portable frame aerial.

Question of Weight.

In the majority of cases, where your own energy must be expended in transporting the set and all its accessories, it is necessary to find out how powerful a set one can construct for a limited weight. From past experience I can say that a portable set weighing more than 12 to 15 pounds is not a comfortable weight to carry for any distance, especially on a hot summer afternoon, when a heavy set is enough to damp the ardour of the keenest amateur.

However, placing a limit of say 12 pounds

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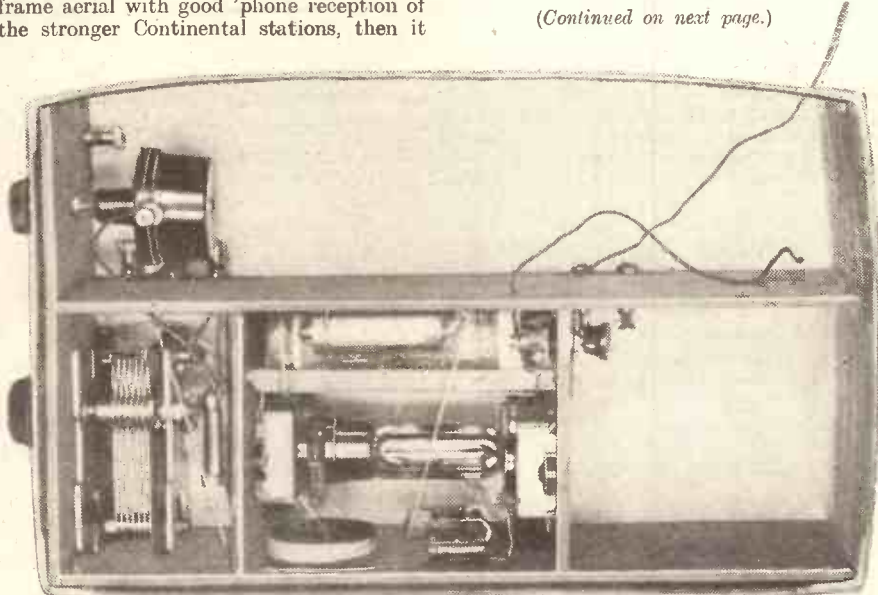


from a portable when testing it to the limit of its capabilities under all manner of conditions, the average amateur demands no more than pleasant entertainment during week-end rambles or the longer summer vacation.

Modest Cost.

Whether used for experiment or pleasurable relaxation the portable set is, in my opinion, the most interesting form of receiving equipment. Now that it is possible to construct a really portable outfit for a modest cost, no amateur should miss the opportunity of tasting the pleasure of owning and operating a portable.

Moreover, the large loud-speaker portable is no longer the technical monster it used to be. Once a seasonable affair, the portable set is becoming more and more popular as the set for everyday use all the year round. My object in writing this article is not to describe any particular set, but to provide data and advice in the hope that it will enable you to construct more readily just the type of receiver you require. By all means build yourself a portable receiver this season, for until you do you will never realise how



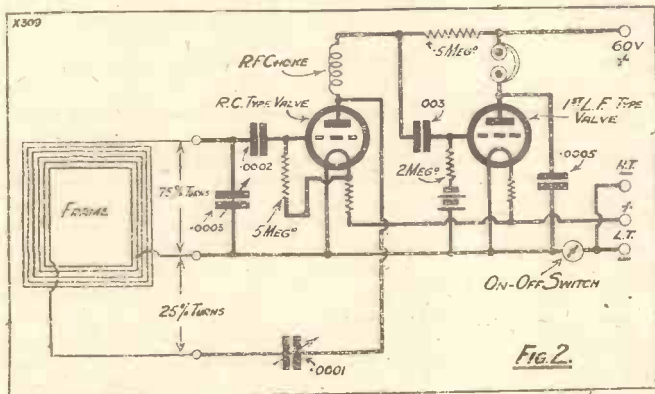
"This type of receiver can be built into quite a small case and including the frame aerial, and with all accessories the combined weight will not exceed about five pounds."

SIMPLE SUMMER PORTABLES.

(Continued from previous page.)

on the weight of the set, it now remains to find a suitable circuit for maximum sensitivity and plans for construction on portable lines. As there are certain to be many of you who do not want to build sets up to this limit of weight, I am going to begin with the simpler sets and progress to those which can be built round about this limit. This will enable you, I hope, to pick out the type of set which most suits your own ideas of cost, constructional effort, and portability.

I expect the more experimentally inclined amateurs will be most interested in one- and



battery as H.T. supply, so that there should be no excuse for any one-valve portable weighing more than three pounds.

Because of the small size and weight of the H.T. battery required with tetrodes, even of the power type, the light-weight loud-speaker portable is a more practicable proposition than it was a year or so ago. I shall deal with this interesting view-point in more detail later on.

An "All-in" Outfit.

If you intend using two valves, you may expect more interesting results from your portable, which will not be difficult to design or construct, because a two-valve circuit does not give rise to serious problems of compactness and weight restriction.

Of the two ways of using your valves the most advantageous is to employ them as regenerative detector and L.F. stage. This combination will give considerably more signal strength than an H.F. amplifier and detector, and incidentally an H.F. stage often causes trouble when a built-in frame aerial is used. The circuit must provide for effective reaction control for the reasons cited above, while the best form of intervalve coupling is undoubtedly resistance-capacity coupling.

With this method the weight of a transformer is avoided without any loss of amplification, provided an R.C. type valve is used for the detector stage. The second valve will be the usual first stage L.F. type. A representative circuit is given in Fig. 2, from which you will be able to gather all salient details of the set.

This type of receiver can be built into quite a small case, including the frame-aerial, and with all accessories the combined weight will not exceed about five pounds. In view of the fact that loud 'phone signals can be practically guaranteed up to 12 miles from a main station on the frame alone, this class of set is bound to be very popular. In my opinion, this constitutes the ideal portable set for one's own use; its versatility is amazing, while the interest and pleasure derivable from it can be quite exceptional.

Regarding Ranges.

Now the one- and two-valve classes of portable receivers for loud 'phone signals will cover a range of approximately 15 miles from your local station on the self-contained frame. Even on a good temporary aerial the best of two-valve sets does not give quite enough volume for open-air loud-speaker results, and where a full enjoyment of musical programmes is desired it is almost essential to make use of a more ambitious outfit containing 3 to 4 valves.

In my opinion it is well worth while "going the whole hog" and building the four-valve set, because the extra valve does make more sure of getting satisfactory results. The additional expense and trouble incurred is not very heavy, and the added factor of safety makes it doubly worth while.

More about this interesting subject will shortly be said in another article.

A TAPPED PLUG-IN COIL MOUNT.

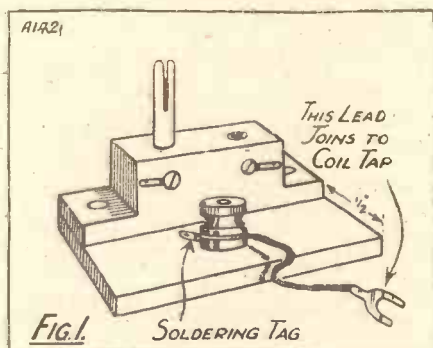
By H. J. B. C.

The benefits in selectivity secured by using tapped coils are too well known to be reiterated here, but the objection is often raised that if ordinary tapped plug-in coils are employed the neatness of the receiver wiring is marred by the flexible leads needed to make connection with the tapping points of the coils. These tap points are, for example, in an "X" coil, brought out to terminals mounted on the sides of the actual coil mount and to make junction thereto flexible leads terminating in spade tags are generally employed.

Apart from spoiling somewhat the neat straight runs of the ordinary connecting wire used in wiring up the other components, certain losses may be introduced, or interaction effects experienced if the flexible lead is haphazardly tucked away amongst the wiring. A much better plan has been adopted by the writer whereby the ordinary rigid wire can almost wholly replace the flex, and the scheme is made clear by a reference to Fig. 1.

Simple Construction.

Cut out a piece of ebonite about 1/2 in. wider than the fixed-coil holder and mount on this a terminal, the head of the holding screw being sunk into a recess on the underside of the ebonite. Underneath the holding nut make a connection with a short length of flex terminating in a spade tag at the other end, the length of this wire



being quite sufficient to allow the spade tag to be inserted under either of the terminal heads of the tap points on the coil mount.

The coil plug and small piece of ebonite can be held down together on the baseboard by screws passing through the holes normally provided in the coil holder, two holes having been drilled previously in the piece of ebonite immediately underneath these. Stiff wiring can now make connection to the additional terminal via a soldering tag or by holding it tightly under the terminal head, whichever is preferred.

The neat wiring and lay-out of the receiver is thus preserved and the short flex lead can be joined to the tap point desired. The idea is well worth a trial by those readers who take a pride in the internal appearances of their receiving sets, and who object to long flexible leads trailing over the baseboard.

two-valve sets. At least, I am myself. First of all we have the one-valve outfit, which raises hardly any problems of portability or construction. Of course, its range is rather small, but for a self-contained knock-about set it can be extremely useful and interesting, especially if a novel circuit is used. I could give you a large number of circuits, conventional and otherwise, any of which would form the basis of an interesting receiver.

A Useful One-Valver.

If your expenditure must be limited, by all means build a one-valve portable, choosing the most efficient circuit you can find, but do not rely on a frame aerial. This can only provide good 'phone strength quite close to the local station, and it becomes necessary to provide a temporary external aerial system to get worth-while results.

Whatever the circuit you may use, it is imperative that great importance be attached to control of reaction. Unless this is really smooth, good 'phone reception of distant stations cannot be expected. This is true of all portable sets where no H.F. stage precedes the regenerative detector. I can thoroughly recommend the Filadyne detector for the one-valve portable, because of its well-known sensitivity and ease of control. I am at present experimenting with a design for a new type of Filadyne portable of considerable efficiency and portability.

For a really light-weight set, one cannot do better than use a tetrode valve, thus saving very considerably in the size and weight of the H.T. battery. A representative circuit which is very reliable is given in Fig. 1. The Aneloy A.P. 412 H.F. tetrode works quite well on a 9-volt grid-bias

YOU can pay all kinds of prices for high-tension accumulators, and as no one maker possesses any particular secret which enables him to produce the same kind of high-tension accumulator at a much lower cost than his rival, we come once again to one of the fundamental laws of wireless—

you get what you pay for! One high-tension accumulator which is serving me very well in the laboratory costs ten guineas for 96 volts, while another—and a very satisfactory battery at that—costs about a third of this figure for the same voltage. Both accumulators have approximately the same capacity, but I would be prepared to wager that the more expensive will be as good as new long after the cheaper battery has been consigned to the dustbin.

Four Advantages.

The advantages of a good high-tension accumulator are:

1. Perfect silence in working (this advantage is shared by the good makes of dry batteries).
2. Very low internal resistance. This is an enormously important advantage and one which is not shared by any other form of high-tension supply.
3. Reasonable cost of high tension *per annum*. First cost is high but maintenance very cheap.
4. Constancy of voltage during discharge.

Point 1—that of silence—is, of course, desirable in every form of supply and particularly so when headphones are used. Point 2—very low internal resistance—is far more important than is generally realised. I have heard certain makers of dry batteries criticised because they have printed testimonials from users to the effect that by substituting their batteries for another make they have greatly improved the quality of the reception. "Quality," says the superior person, "depends on the circuit, form of coupling used, the quality of his audio-frequency transformers, and so forth, and it is ridiculous to suggest that the battery had anything to do with it."

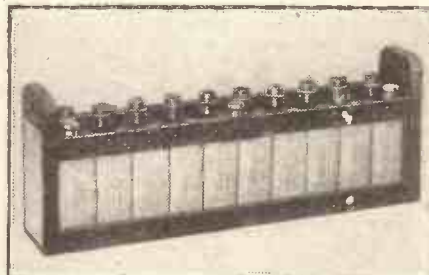
A Cause of Distortion.

This is where our bright friend is quite wrong. In almost every receiver with two stages of note magnification the overall amplification curve is influenced by audio-frequency reaction effects between stages. It is possible, for example, to have two low-frequency transformers which, when tested separately in the laboratory, will show a uniform amplification from the lowest notes given by the average loud speaker up to a frequency of 6,000 or 7,000 cycles, but when these two transformers are used together the amplification curve may have a tremendous peak at some point and, indeed, there may be so much reaction between the circuits that the whole receiver goes into audio-frequency oscillation. Long before the amount of reaction which is sufficient to produce oscillation is reached, distortion has occurred. This distortion may be advantageous, or otherwise, according to circumstances.



In this article, the second of a short series, the subject of H.T. accumulators is lucidly dealt with, and their advantages and disadvantages clearly brought forward.
 By FERCY W. HARRIS, M.I.R.E.

I have some data in front of me at the moment regarding a certain make of transformer which, when used in one stage, falls off badly above 3,000 cycles, but when used in a two-stage amplifier gives a perfectly good curve up to something over 5,000 cycles. The levelling-up is due to the effect of audio-frequency reaction! Now, the feed-back between stages is greatly influenced by the internal resistance of the high-tension supply device. The lower the resistance of your high-tension supply the less trouble it is going to give with feed-back between stages and the more generally satisfactory you will find it. A good high-tension accumulator has a negligible resistance, far lower than that of the best dry battery. Many sets which at present are distorting due to the battery resistance



A 20-volt block of H.T. accumulator cells.

would be improved in quality if high-tension accumulators were substituted. It is this feature which gives the high-tension accumulator so many adherents.

Now, let us look at the disadvantages—and they are by no means negligible. We can classify them roughly as follows:

Three Disadvantages.

1. High first cost compared with "dry" H.T.
2. Difficulties in charging.
3. Bulk and messiness.

So far as first cost is concerned, the reader is strongly advised not to buy "cut-price" high-tension accumulators. A poorly-made and badly-designed high-tension accumulator will give you all kinds of trouble. Single cells will sulphate, introducing high resistance, noises and a whole chain of special troubles; poor insulation will cause leakage and a rapid discharge; terminals

and lugs will corrode internally and break off; plates will break, short circuit and perhaps ruin a whole section; faulty containers will leak, acid will burn holes in your carpet and, generally, you will become an extremely unpopular member of the household.

Incidentally, every one of the troubles I have just mentioned has occurred to me with high-tension accumulators in their early days, but not one of them has happened in the last two years, although in this period I have used—and am still using—a number of different makes of high-tension accumulator. If you are, then, about to buy a high-tension accumulator, purchase one of the good reliable makes.

The Charging Difficulty.

The charging difficulty, in a very large number of cases, is the real objection to the high-tension accumulator. These devices can be very easily ruined in the charging process and, unfortunately, very few garages understand how to handle them. Although a good H.T. accumulator will hold its charge for a very long time, it should not be forgotten that it gradually loses the charge even when no current is taken from it by an exterior circuit owing to leakage and other causes. It is a good plan to charge your high-tension accumulator regularly every three months, whether it is used a great deal or not. If you possibly can, charge it yourself. If you have A.C. mains you can purchase for quite a reasonable figure a charging device for both your high tension and low tension, and if you are on 200 or 220-volt D.C. mains a charger can be constructed very simply, or purchased even cheaper than an A.C. charger.

If you already possess charging apparatus for your low-tension accumulator, it is possible to purchase one particular high-tension accumulator—the Tungstone—which is so made that the sections can be charged in parallel from your low-tension charger in a very few hours.

A Word of Warning.

A number of the large accumulator manufacturers who specialise in car batteries now also make high-tension accumulators, and these can be properly charged at their service stations which are fairly widely distributed. There are also a number of charging stations which really understand how to handle high-tension accumulators, and a few judicious inquiries among friends who know will probably bring you correct information. Beware, however, of taking a high-tension accumulator to be charged at an unknown charging station which simply advertises "Accumulators Charged."

The third point about messiness, bulk and weight, is not so important in some cases as in others. For example, if you charge your own, bulk and weight need not worry you, but, at the same time, you have to be more than usually careful about messiness for a high-tension accumulator when charging may spray acid, and if you forget to take out the vent plugs the acid may ooze up, creep down the side of the container, and reach the floor or carpet



POWER POINTERS

An Interesting Article by a Special Correspondent.

NATURALLY, it is beyond our power to prevent many of the disastrous happenings which are all too common in the radio world, for the merest chance may rob us of an old and cherished valve, while a faulty transformer may easily spell the ruin of a tried and trusted transformer, but it is surprising to note how many losses of this kind are due solely to the owners' carelessness, and it is with a view to decreasing the "death-roll" of good components that the following hints on the judicious use of power are given.

Battery Switches.

As longevity is more the exception than the rule among valves and batteries, these have, perhaps, the best claim to priority of mention. In these days of "dark emitters" it is more of a necessity than ever to incorporate an on-off switch in the filament circuit for, as the veriest tyro knows, although a steady current for some thirty-six hours may be good for the valve, it can hardly be expected to improve the accumulator.

Again, on the H.T. side, it is an excellent plan to connect a large fixed condenser across the H.T. battery, but many a time has the premature decease of the H.T. supply been traced to a faulty condenser. It must not be forgotten that this condenser is (generally) carrying the full force of the H.T. *all the time that the set is not in use*, as well as when it is.

Now for the actual valve. The first thing that I must say about this is to repeat the old, old injunction—don't change or substitute valves while the H.T. plugs are in position. Not only do you run the risk of burning out your valves by so doing, but also, given certain circumstances, there is every chance of an L.F. transformer "going west" at the same time. This danger is theoretically obviated if you incorporate an H.T. fuse of the 5 amp. variety, but it has been my experience that theory is less satisfactory than practice in this respect.

H.T. From the Mains.

The last, and perhaps most important, point which I would make in connection with valves and batteries is this—*don't* carry out internal adjustments with the aid of a screwdriver when *either H.T. or L.T.* current is flowing, and *don't* use an all-metal tool of any sort while you are wearing headphones, unless you first disconnect the H.T.

Now let us consider for a moment the possessor of a battery eliminator. He may usually be relied upon to follow the maker's instructions at first, and to observe his warnings, but after a time carelessness may set in, and here trouble usually begins.

take out the adaptor. It is all too easy to forget in the case of D.C. supplies that one side of the main is earthed, and the consequences of such forgetfulness may be far from pleasant.

Further Precautions.

A further point which is too often ignored is that the eliminator will not last as it should unless the mains switch is turned off when the set is not in use. This applies more particularly in the case of D.C. mains, as in a D.C. eliminator there is practically always a fixed condenser directly across the mains and, good though the component may be, it cannot be expected to stand up to a load of some 210 volts indefinitely without showing signs of wear and tear.

There remains but one type of power producer generally in use which I have not yet discussed, and that is the Leclanché type. Many constructors, despite the obvious disadvantages of this system, have found it one of the best when good results finally are obtained, but here again efficiency is frequently sacrificed on the altar of the "ham's" carelessness.

In the first place, it is the height of indiscretion to arrange the cells (H.T. or L.T.) in neat, orderly rows without any means of separating them. This is simply asking for trouble. Again, it is admittedly a tiresome business to grease all the metal parts which are exposed to "creeping," but it is very necessary if the cells are to last for any length of time.

Finally, I say as a last word of warning: Don't put your batteries in the set, on the set, under the set, or near the set, without first making sure that there are no loose wires hanging about, no accumulators engaged in "gassing," and no tools resting peacefully on top of the H.T. batteries.

SHORT-WAVE NOTES.

By W. L. S.

HAVING been unfortunate enough myself to be the victim of a most unusual trouble with my short-wave receiver, which took me nearly two days' hard work to discover, I can now place the story at my readers' disposal in case they should ever encounter a similar nuisance. It started by appalling crackling in the receiver when it was in an oscillating condition.

Removing the aerial was found to lessen the noise, but would not cure it completely.

Now the following warning should be read, marked, learned and inwardly digested, as it is the outcome of hard experience.

If it becomes necessary to alter any of the connections to the eliminator, turn the light (or power) switch off, and

This, of course, made me suspect the aerial, but I thoroughly overhauled and re-soldered the whole receiver because it really needed it badly! However, the crackles were still very much there, with or without the aerial. New valves were tried, a new grid condenser substituted, and still the noises continued. The H.T. was blameless; the noise certainly sounded exactly like a run-down battery badly in need of several microfarads to support it, but as the set was worked from the mains this was hardly a likely cause!

A Peculiar "Fault."

Eventually, thoroughly fed up, I examined the aerial. It is one continuous wire from the far end to the lead-in, and all the insulators were quite clean and free from cobwebs. However, to be on the safe side, a new length of wire was put up. Result: no crackles!

Quite mystified, I examined the ancient and dirty wire I had taken down, which was of the usual 7/22 variety, and found that, probably owing to the presence of a kink at some time, one strand had broken about half-way along the wire. It seems hard to believe, but all the appalling noises I had



Lord Stonehaven opening the new Ladies' Grammar School at Geelong, Victoria, his speech being broadcast through Melbourne.

been enduring had been caused by the two loose ends of this strand rubbing against each other intermittently! So great was the effect that the noise was still audible in the receiver with the aerial removed!

Another Fallacy.

The old belief that the 20-metre wave-band was essentially a daylight wave has been dispelled for good and all. 2 X A D is now at his very best on 21.9 metres at about 11 p.m., which is, of course, 6 p.m. by his time. This means that both ends are very nearly in darkness. Further, the more distant American stations, mostly amateurs, for all the short-wave broadcasters are well to the East of America, reach their best points later in the night, and it is evident that each set of Americans comes through best just as it is about to be shrouded in darkness.

W.I.K., the super-power station at New Brunswick, does not seem to adhere to any of these rules, however. The reason probably is that he is sufficiently powerful to come round the world both ways, and thus is often heard here at quite good strength when it is quite impossible to hear the slightest trace of any other American station.

THE "GRID-TAP" ONE.

(Continued from previous page.)

be obtained in improved selectivity without a tendency to lose strength noticeably, and we have here obviously a method of some promise for obtaining the extra sharpness of tuning which is so desirable in these days of alternative programmes, for if we incorporate this device in a circuit which is naturally of the more selective type, it may make all the difference in providing that very desirable power to cut out the local station in only a few degrees on the tuning dial.

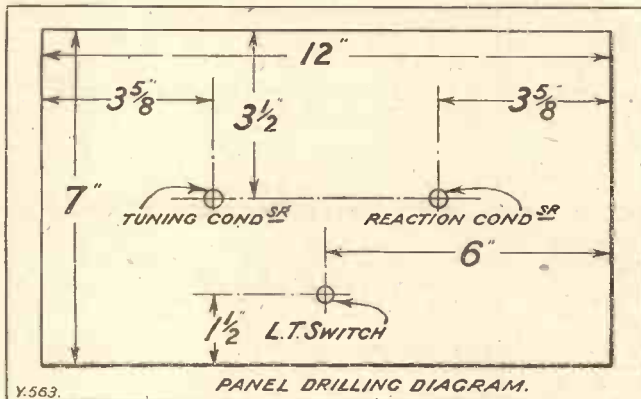
Circuit Notes.

This scheme of a movable grid tapping on the tuning coil has been incorporated in the set which is about to be described, in combination with a circuit of the more selective type. Actually, the set is really a straightforward one of the single-valve reaction type with a tuned secondary circuit to which the aerial is auto-coupled through one or other of several tapping points on the lower

end of the coil, and with Reinartz reaction. Such circuits are reasonably selective, as the reader is no doubt aware, but with the addition which we have just been discussing can be made selective enough to get rid of one's local station fairly easily when 5 G B is desired, unless you live very, very close indeed to your local transmitter, in which case you should, of course, use a wave-trap as well, such as the one described in "P.W." No. 271, under the title of "Preparing for 5 G B."

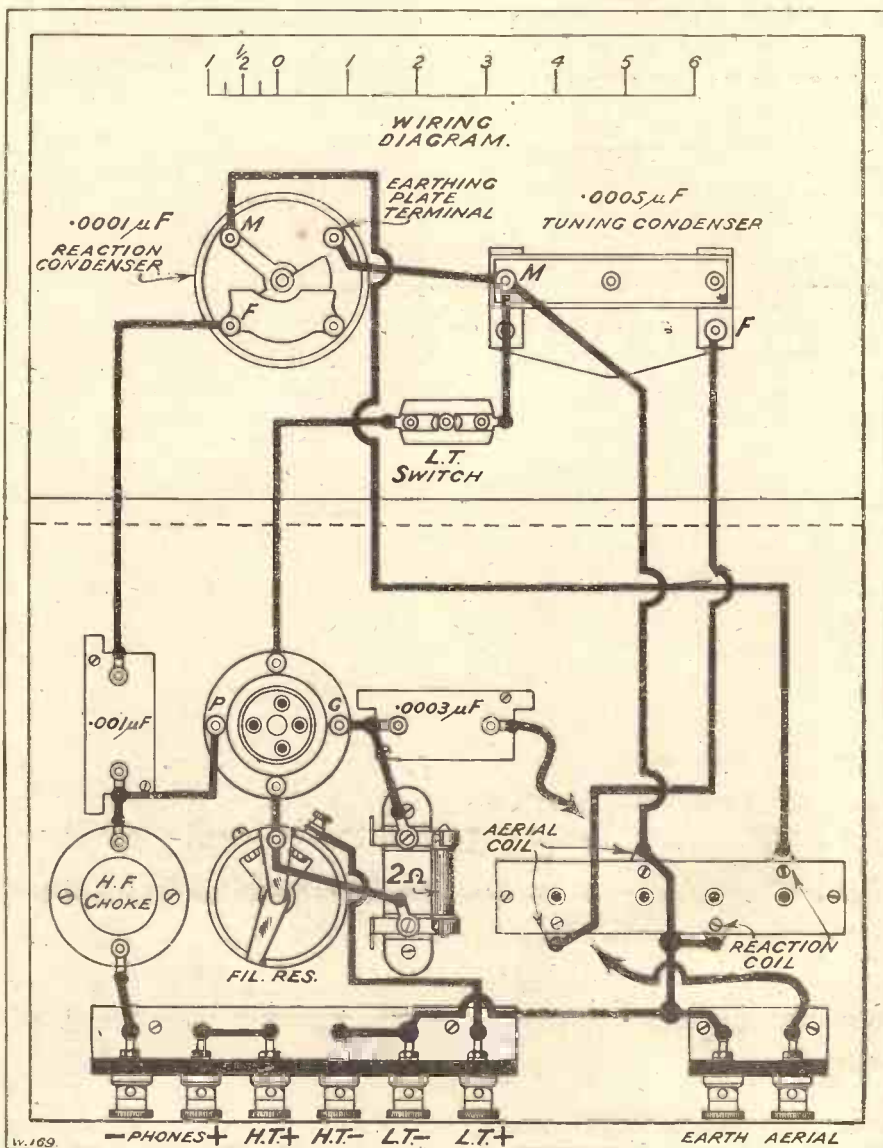
A combination of this sort, namely, a really efficient wave-trap with a sharp-tuning single-valver is capable of some really remarkable feats, such as bringing in Stuttgart quite clearly and without interference at a few miles from 2 L O, which is always regarded as a severe test for a selective combination, and is well within the powers of the "Grid-Tap" One.

Altogether, it is a very attractive little set, very sensitive and responsive to skilled handling, yet quite easy to operate, since it seems to possess no nasty tricks of any sort. It has performed extremely well on test,



and indeed showed very unusual promise, bringing in quite a string of foreign stations. It is strongly commended to the notice of those readers who are looking for something a little out of the way in one-valvers capable of results above the average, and at the same time free from any suspicion of freakishness.

The main features of the circuit will have been gathered from the explanations which have been given, and an examination of the



LIST OF COMPONENTS.

- 1 Panel, 12 in. x 7 in. x 1/8 or 1/16 in. (any good branded material).
- 1 Cabinet to fit, with baseboard 9 in. deep (Arterraft, Bond, Cameo, Caxton, Makerimport, Pickett, Raymond, etc.).
- 1 .0005 mfd. variable condenser, square law or S.L.F., preferably with slow-motion or vernier dial (Bowyer-Lowe in set. Any good make).
- 1 Miniature type reaction condenser of about .0001 mfd. capacity (Cyldon, Ormond, Peto-Scott, etc.).
- 1 On-off switch (Benjamin, Igranic, L. & P., Lissen, Lotus, etc.).
- 1 Special socket and 1 or 2 coil formers (see text) (Collinson Precision Screw Company, "Four-pin clip base, with Paxolin former").
- 1 Baseboard filament resistance.
- 1 Sprung valve holder (Benjamin, Bowyer-Lowe, B.T.H., Burndept, Burne-Jones, Lotus, Marconiphone, Pye, Redfern, W.B., etc.).
- 1 .0003 mfd. and 1 .001 mfd. fixed condenser (Lissen in set. Any good make, Clarke, Dubilier, Igranic, Mullard, T.C.C., etc.).
- 1 H.F. choke (C.D.M. in set. Igranic, Lissen, Ormond, R.I.-Varley, etc.).
- 1 2-meg. grid leak with holder (Dubilier, Igranic, Lissen, Mullard, etc.).
- 1 Ebonite strip, 2 in. x 2 in. x 1/4 in., with two terminals (Eelex in set. Other good quality indicating terminals are Belling-Lee, Clix, and Igranic).
- 1 Ebonite strip, 6 in. x 2 in. x 1/4 in., with six terminals.
- 2 Tapping clips.
- Wire, screws, pieces of flex, etc.

circuit diagram will make everything quite clear. Proceeding to practical matters, a glance at the photographs on these pages will show you the main features. The set

(Continued on page 354.)

A SEASIDE BROADCAST

A Link with your Holidays ahead—song, laughter, dance and jest.

There are holiday concerts to come, broadcasting with the sound of the sea in it. You want pure H.T. current for this, and you can be sure of getting it if you always use a Lissen New Process Battery in your set. For the Lissen Battery yields an energy which is clean and steady flowing, which is noiseless and long lasting, which is smoother than any other form of current available to you. The cells are big, they have a remarkably large oxygen content, they have a low internal resistance which remains low. Not only that, but there is a new process and a new chemical combination used which is embodied only in the Lissen New Process Battery. If you would like to hear your seaside broadcast clearly and distinctly all the time, no matter how far away the concert may be, use a Lissen New Process Battery. Ask for it at any one of 10,000 radio dealers. Say "Lissen New Process Battery" and show clearly by the way you ask that you mean to take no other.

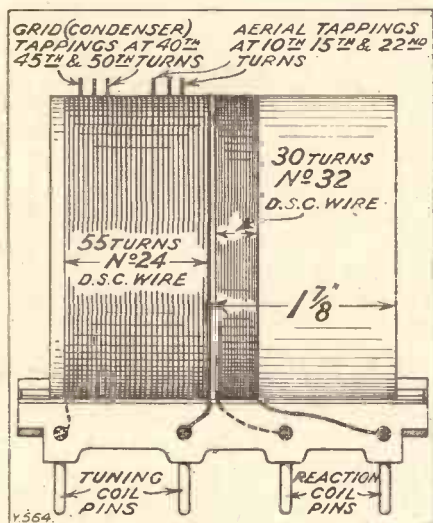
60 volts (reads 66) ..	7/11
100 .. (.. 108) ..	12/11
60 .. Super Power ..	13/6
9 .. Grid Bias ..	1/8
41 .. Pocket Battery	5d



THE "GRID-TAP" ONE.

(Continued from page 352.)

is built on the American system, with a vertical front panel carrying the tuning condenser, on-and-off switch, and midget-type reaction condenser. On the baseboard inside the set you will see the coil and socket, valve holder, grid condenser and leak, terminal strips, etc.



The photos and wiring diagram will make all this quite clear, and you should have no difficulty at all in laying out the components exactly as it was done in the original and wiring them up correctly. You will find that there is ample room on both panel and baseboard, and so you will be able to use absolutely any good, sound make of component, without any fear of difficulty in fitting the parts into their places.

Checking the Connections.

The wiring, too, is very simple, and the lay-out makes it very easy to carry out neatly and efficiently, because you will find on noting the points which are to be joined together that their positions are such that each wire naturally follows a neat, direct run nicely spaced from its fellows. As you solder each lead in place cross out the corresponding line in the wiring diagram on the last page, and you will be sure that you have forgotten nothing when you come to the end of the job. There is actually so little wiring in the set that you will probably find that about half an hour will see it all finished.

The winding of the coil is the only point requiring any detailed instructions. The original was wound on a special former produced by Messrs. Collinson Precision Screw Company, which is not merely very neat and of high efficiency, but makes the job extremely easy, since there is no actual constructional work involved, and all that you need to do is to wind the wire. (It only takes about a quarter of an hour to complete the coil for the broadcast band of waves.)

Winding the Coil.

This former consists of a 3-in. diameter tube of insulating composition ready

mounted on a supporting strip carrying four contact pins, from which it can easily be removed for winding purposes by undoing a couple of nuts. The contact pins are provided with special points at their bases for soldering the ends of the windings, and the whole job is a very easy one.

The former is supplied complete with a four-contact socket which is to be screwed down upon the baseboard, with a couple of little blocks of wood, ebonite washers, or other small supports to hold it up a little way above the wood. Of course, if you like such work, you could make the set a little more cheaply by constructing this former and base for yourself, with the aid of a piece of good insulating tubing (Becol, Paxolin, Pirtoid, Radion, etc.) 3 in. in diameter and the same length, and some strips of ebonite and valve legs and pins.

The tube carries two windings, both in the same direction and with a space of about $\frac{1}{8}$ in. between them. One, the reaction winding, consists of 30 turns of No. 32 D.S.C. wire, while the other (the tuned coil) has 55 turns of No. 24 D.S.C. wire. This latter is provided with two sets of tappings, located on the following turns, counting from the end nearest to the reaction winding: 10th, 15th, 22nd, 40th, 45th, and 50th.

Using the Clips.

The ends of the windings can be secured in the usual way by passing each through two small holes in the former, while the tappings can be made by twisting up loops in the wire at each point, scraping them bare when the coil has been finished. The first series of tappings is for the aerial clip, and you will find that the higher the clip is placed, i.e. on the 15th or 22nd turn, the louder the signals as a rule, while the lower tapping will give better selectivity. By the

way, if you are very near to your local station it will be as well to make another tapping at the 8th turn, so as to be able to get very sharp tuning if it should be necessary.

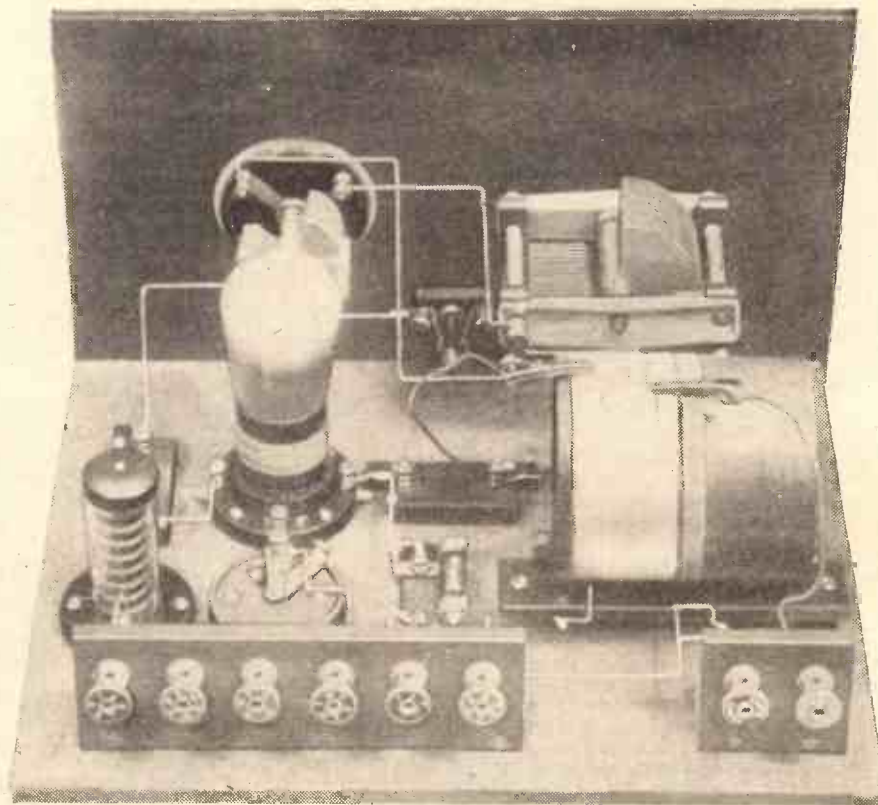
The second series of taps is for the clip on the end of the flex lead from the grid condenser, and you should start with this on the 50th turn, going lower to obtain higher selectivity later. Just how low you will be able to place this clip without losing too much strength will depend on the particular valve you are using, and other matters, so you must find out the best point by experiment.

How To Work It.

For the long waves you will need another former, wound as follows: reaction, 90 turns, tuned winding, 200 turns, with tappings at 60, 80 and 90, 150 and 175, all windings of No. 34 S.S.C. wire.

Operating the "Grid-Tap" One is simple. You will need a valve of the special H.F. type (D.E.L.610, Cossor 610H.F., P.M.5X, S.S.6075H.F., etc., in the 6-volt range, or equivalent 2-volters, if economy is desired), and the only adjustment requiring any care is that of the H.T. voltage to obtain the smoothest possible reaction control. Try all the tappings on your battery between 30 and 60 volts until you find the one which gives the smoothest and softest reaction adjustment. When you have located it, you will discover that with a suitable valve the set slides almost imperceptibly into oscillation, and you will then be ready to search for stations. It is safe to prophesy that you will be surprised by the number you will find!

By the way, it is not meant that you should actually let the set oscillate when searching: keep it just safely below the oscillation point.



Here is the finished set all ready to bring in the stations. Note the widely spaced wiring and well-separated components. You can attach any standard L.F. amplifier to this receiver.

A SELECTIVE CRYSTAL CIRCUIT.

The Editor, POPULAR WIRELESS.

Dear Sir,—Having recently had cause to construct a crystal set suitable for both 5 G B and 2 L O, I had some difficulty in eliminating London whilst receiving the higher-wave station, and attached is the circuit which I ultimately hit upon, and which might be of interest to you.

The circuit itself is not unknown, but the switching arrangement is, I believe, a trifle novel. With the aerial connected to tapping 13, by shorting the aerial coil from 13 to 25, a quick change-over was effected from Daventry to 2 L O, and also 5 G B came through without a suspicion of London in the background.

The coil was wound on a 3½-in. former, and all details are given on the diagram.

Wishing your paper every success.

Yours truly,
E. W. S.

E.18.

THE UNIDYNE.

The Editor, POPULAR WIRELESS.

Dear Sir,—As an owner of a "Unidyne" (see previous letters), I am greatly interested in any letter in "P.W." concerning same. Mr. Drysdale's letter (West Australia) is of special interest to me, and no doubt to others. I refer in particular to his statement that he uses "6 volts high tension in the last stage and 4 volts on the other two L.F.'s, and no H.T. on the Detector": a 4-valve Unidyne.

Of course, you will hardly need me to say that I am open to correction, but I am under the impression that you do not recommend more than one stage of L.F. for the Unidyne; and, also, that to constitute a Unidyne, no H.T. is used.

I employ a true Unidyne two-valver, to this I connect a two-valve amplifier, using in this, of course, the necessary H.T. I speak of my apparatus as a Unidyne two-valver with amplifier attached, and not a four-valve Unidyne. While being greatly interested in Mr. Drysdale's achievements, I feel bound to raise the above point.

Yours truly,
F. W. WHITE.

Dalston, E.8.

THE "ANTIPODES ADAPTOR."

The Editor, POPULAR WIRELESS.

Dear Sir.—Re the "Antipodes Adaptor," described by Mr. G. F. Kelsey in "P.W." March 24th, 1928. I constructed the adaptor during the early evening of the 30th March, and at 11.10 p.m. I connected it to my "P.W." O-v-2, and in less than ten minutes I was listening to W G Y on the loud speaker, reception being remarkably clear and very little fading.

I have since had W G Y every night last week, also on several occasions 2 X A F, K D K A. K D K A was not at all good until nearly 2 a.m. Several amateurs both in England and France can be tuned in with ease.

I certainly think if anyone wants to listen to American broadcasting they cannot do better than build the above adaptor. I have been a reader of "P.W." for 3½ years, and should like to thank you for publishing such a remarkable "set."

Yours faithfully,
D. ONSLOW.

P.S.—I have now built the adaptor with an upright panel and baseboard, and I think it goes just as well.

Sturry, Nr. Canterbury.

CORRESPONDENCE.

A SELECTIVE CRYSTAL CIRCUIT

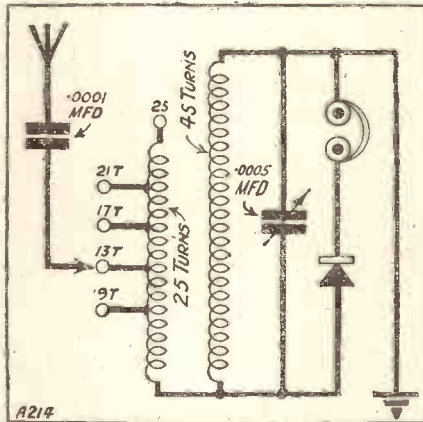
THE UNIDYNE—THE "ECONOMY" FOUR.

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 "ECONOMY" FOUR.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have built the "Economy" Four, and should like to tell you of my experience with same. First of all I must tell you that only four joints are soldered, the rest are screwed, and where wires join they are simply pressed together with pliers. At first I used a well-advertised valve, and was very much disappointed with the performance of the set.



The circuit recommended by E.W.S. Secondary, consisting of 45 turns 24-g. D.C.C. wire wound on 3½-in. former. Commencing from the bottom end and wound immediately on top of secondary, aerial coil is wound in same direction; consisting of 25 turns 24-g. tapped 9th, 13th, 17th and 21st.

After several adjustments I decided to scrap the valves and substitute Mullard's, as recommended by you. The result was that the set at once behaved itself, and faithfully performed all you claimed for it.

After a few weeks I altered the .0001 variable condenser for a .0003, and the set is now all that can be wished for. I assure you that it's no trouble to get every station with the greatest ease at loud-speaker strength and thoroughly recommend the circuit to anyone who requires a really "Economy" Four valve set.

Thanking you for publishing same, and wishing you every success.

Yours faithfully,
H. BURROWS.

Leicester.

ARE SOLDERING TAGS NECESSARY?

The Editor, POPULAR WIRELESS.

Dear Sir,—May I, through the medium of your valuable paper, be allowed to say that I entirely agree with A. C. R. on "Arc Soldering Tags Necessary?" My opinion is that soldering sets is an absolute waste of time. Furthermore, may I give a few of the results achieved on a "P.W." set, slightly altered, of my own hook-up? I can receive all B.B.C. stations with the exception of Plymouth at any time, using plug-in coils; also Madrid and at least a dozen other Continentals, all on loud speaker (two valves). By taking coils out and inserting Igranic short-wave coils, I receive K D K A every evening, and always at the same strength. Other stations received are W G Y, 2 X A F (loud speaker), 3 L O (Melbourne), Rocky Point, and Java, Dutch East Indies; also W R W.

There is not a soldered connection throughout the set. This, in my opinion, proves conclusively that soldering is not necessary in any set, and I believe that many sets would give far less trouble if they were not soldered.

Hoping I have not taken too much of your valuable space, and thanking you for the space, I remain,
Yours truly,

"REGULAR READER."

P.S.—May I say that I haven't found one circuit to touch "P.W." circuits for results?

Burton-on-Trent.

"SWINGING-COIL" REACTION.

The Editor, POPULAR WIRELESS.

Dear Sir,—In the current issue of "P.W." is an article on the construction of an H.F. choke. The author states that "Reinartz reaction is far superior in smoothness of action to the semi-obsolete swinging-coil system," and later says that an equal smoothness is "unobtainable" with the swinging coil method.

These statements, in the writer's opinion, are very much open to criticism, and he would like to know what other readers think.

The swinging-coil method has several advantages over the other types: Simplicity, efficiency, economy and range. How many H.F. chokes that are efficient on the long waves will choke on the short waves? The write has obtained excellent results with a 2-way coil holder on the very short waves, and considers that given a good coil holder (Lissen, Polar, etc.) the swinging-coil will equal if not surpass the other methods of reaction, at less than half the cost.

Yours faithfully,
J. C. G.

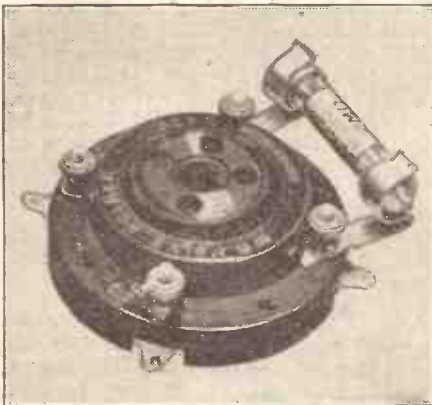
Great Crosby.

A GRID-LEAK MOUNTING.

PERHAPS it has never occurred to readers how many of the valve holders now on the market lend themselves admirably to the accommodation of the grid leak as a direct connection between the grid and L.T.+ terminals when using it as the detector. It is, of course, appreciated by all that the more direct are any connections in the grid circuit the greater the efficiency, and by mounting the grid leak direct on the valve-holder terminals it saves extra wiring or soldering. As the photograph shows, the grid leak is quite accessible and furthermore it does away with the necessity for a separate insulated holder to accommodate the leak and baseboard space is saved thereby.

Take the two clips usually supplied with the grid leak and by means of a pair of cutting pliers or a file shape the ends so that they slip over the terminal screws and

do not foul the valve-holder moulding. The pair of clips are held down rigidly by the nuts at the grid and L.T.+ terminal positions, and it is merely necessary to slip the cartridge leak in position as shown. The soldering tags to the valve holder are still quite accessible, and the method has been adopted in several cases and found to work splendidly.



A grid leak mounted directly on the valve holder.

FOUR USEFUL HINTS.

A wave-trap makes a good emergency receiver if a pair of 'phones in series with a crystal detector are connected across the ends of the coil.

Acid stains on a carpet may be removed by applying washing soda, baking powder, ammonia, or even soap flakes. The remedy should be applied immediately and plentifully until the gassing ceases and the acid is neutralised, after which the carpet should be thoroughly washed.

Quite a good scriber for marking panels can be made from a penholder, into the end of which a broken needle or gramophone needle has been firmly inserted.

Distilled water, and not ordinary tap water, should be used to replenish an accumulator when the liquid has fallen below the level of the top of the plates.

TECHNICAL NOTES.

By Dr. J. H. T. ROBERTS, F.Inst.P.

A NEW WIRELESS TRADE.

VALVE OVERLOADING—CAPACITY RATING, ETC., ETC.

A New Wireless Trade.

THE rapid development of electrical pick-up devices for gramophones, in addition to its influence upon gramophone reproduction and amplification and upon the combination of gramophones and radio receivers, is having another effect which, in its way, is very important especially from a commercial point of view.

There are in existence a very large number of gramophones of the older type, many of which have fallen into disuse owing to the fact that they are not able to compete technically with the present-day instrument. By the aid of the electrical pick-up, together with amplification and reproduction through the L.F. part of the radio receiver, these machines may be brought again into useful service, in particular the sound-amplifying chamber, which may be of an older and less efficient type, is replaced in the new arrangement by the radio loud speaker.

It is estimated that there are 7,000,000 phonographs of the old type in American homes, and many professional set-builders are now hard at work converting these old phonographs into modern electric reproducers. By means of two stages of low-frequency amplification and with power supplied from the mains an old gramophone may be completely transformed. I understand that dealers and amateur constructors are doing lively business and making a lot of money in fitting up gramophones with pick-up and amplifying arrangements in the way indicated.

Acid Care.

In order to obtain long life and satisfactory service from electrolytic condensers, rectifiers and suchlike devices it is essential that nothing but distilled water be added to the electrolytic cells as in the case of storage batteries. If ordinary tap-water is used the mineral content may set up chemical action which may seriously interfere with the efficiency of the unit.

In order to minimise evaporation of the electrolyte a small quantity of any thin mineral oil may be poured upon the surface: this will form a film which will retard evaporation. Ordinary paraffin oil poured on the surface to a depth of about 1-16th to $\frac{1}{8}$ in. is quite satisfactory. Vegetable or animal oils should not be used as they are liable to become oxidised and change their character completely. For example, olive oil or linseed oil are quite unsatisfactory as they become in time almost solidified. Ordinary paraffin oil, however, works perfectly.

Valve Overloading.

A large percentage of the distortion in most radio receivers is caused by overloading the valve in the last low-frequency stage. When general-purpose or semi-power valves are used the distortion may be reduced by substituting a power valve or by decreasing the volume. But where

power valves are already used, the distortion can usually be remedied by correctly adjusting the grid bias on the last stage.

The specification sheet (which is supplied with the valve or printed on the carton)

L.T. FROM THE GAS-WORKS!

A very interesting feature of a recent Exhibition was this Marconiophone receiver, which derives its filament current from a thermopile heated by gas. (The gas-pipe can be seen to the right.)

gives approximate values for grid-bias voltages suitable for various anode potentials. But in order to make sure that the valve is not being overloaded, it is useful to make an actual test by means of a milliammeter in the anode circuit of the valve.

Adjusting the Bias.

If there is no appreciable movement of the needle of the milliammeter when loud signals are being received, you may conclude that the grid is about correctly biased. On the other hand, if the needle of the milliammeter oscillates as the intensity of the signals is increased, this is an indication that the valve is overloaded and the grid bias must therefore be increased or decreased, as the case may be. If it is found impossible by any adjustment of the grid bias to prevent the needle from oscillating, this indicates that too much volume is being delivered from the amplifier.

A suitable milliammeter for these tests should have a range of 0 to about 25 milliamps and the maximum fluctuation of the plate current should not be greater than about 10 per cent of the total current. The actual value of the plate current for a given plate potential and also the correct grid bias will be found from the specification supplied by the makers.

Capacity Rating.

Readers often remark, in their letters on the subject of condensers, that the capacity of commercial condensers varies comparatively widely from the specified capacity. In this respect the accuracy of the capacity rating of condensers compares unfavourably with the accuracy of the rating of many other types of component.

Although condensers may vary from their rated capacity by as much as 10 to 15 per cent, this is as a rule of little importance in practice, and if it were necessary to adjust fixed condensers to within say 1 per cent of their rated capacity, the cost of the condensers would be very greatly increased.

(Continued on page 371.)

NEWS FROM SAVOY HILL.**FROM OUR OWN CORRESPONDENTS.****MR. CHURCHILL'S RADIO STUNT.**

SIR JOHN REITH FOR AMERICA?—SIR HENRY WOOD AND THE B.B.C., ETC.

Mr. Churchill's Radio Stunt.

WHEN Mr. Churchill finished his half-hour talk on the Budget on the night after his speech in the House, he had good cause for self-congratulation on the part he had played in getting the Cabinet to lift the ban on controversy. One wonders whether the astute Chancellor of the Exchequer had this occasion in mind from the beginning. Whatever may be the truth in this respect, there is no doubt that his broadcast was a big factor in lining up public opinion behind the Budget. There was singularly little objection from the other Parties.

Sir John Reith for America?

About a year ago it was stated in the Press that Sir John Reith had been invited to attend the opening in New York of America's "Broadcasting House"—the new

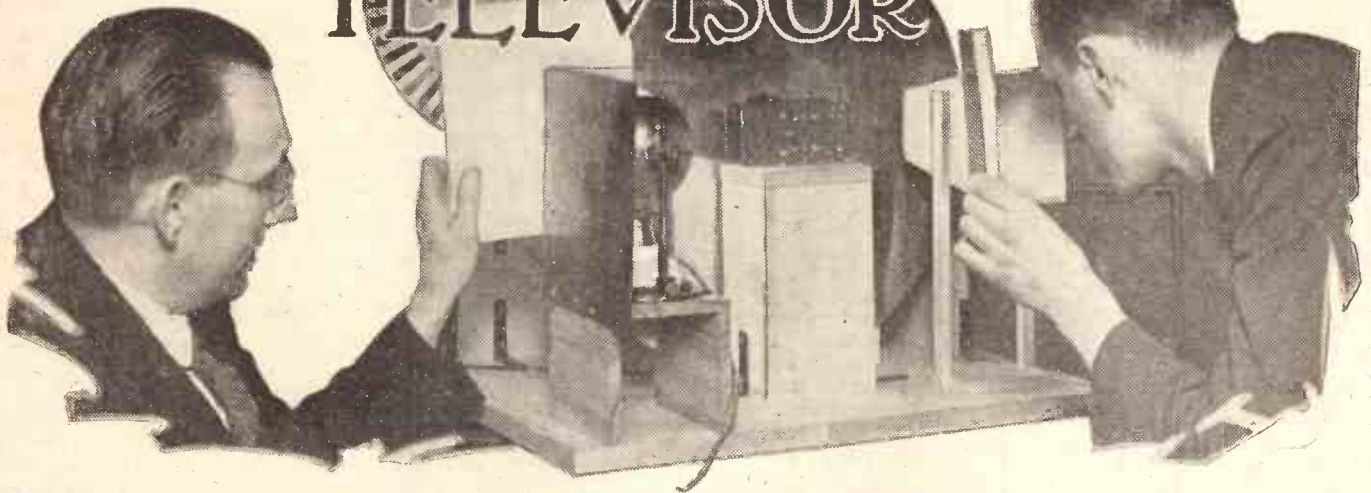
headquarters of the Radio Corporation of America. Although no confirmation was forthcoming from Savoy Hill, it was understood that if Sir John could have accepted an invitation would have been sent.

The position was left that if the Americans desired to have him he would be better able to go this year than last. And now it is again being stated in American papers that Sir John will tour the States this summer. Such a tour would undoubtedly be of advantage to all concerned. The Director-General of the B.B.C. is a splendid ambassador of a fine British organisation.

American Broadcasting has many points which the B.B.C. would do well to study. It would be still better if Sir John went at the head of a special mission, including such astute observers as Mr. Filson Young, Mr. A. Corbett Smith, and Mr. Cecil Lewis.

(Continued on page 370.)

"P.W." BUILDS THE "SIMPLE TELEVISOR"



WHEN it was learned that the "P.W." Research Department was to build the "Simple Televisor" described in the first number of our contemporary, "Television," in order that definite information as to the possibilities of the machine might be obtained, the prospect did not arouse any particularly joyous anticipations.

It was obvious that the mere assembly of the apparatus, crude as the method of construction was, would be no easy matter, since although full dimensions were given for the carpentry work, these would be of little help unless exactly similar components (namely, the driving motors for the discs) were used. However, it was desired to put ourselves as far as possible in the position of the average constructor, and therefore it was decided simply to buy a complete set of parts as sold to the public by one of the largest suppliers.

A "Demonstration."

A visit was accordingly paid to a certain large "departmental store," and a complete outfit purchased. A machine made up from the original design was found on exhibition here, and attempts were being made to demonstrate it to a rather sceptical crowd of visitors. Our representative accordingly waited over an hour in hopes of seeing something convincing, but during the whole of that time nothing even faintly resembling the original object was seen on the screen, despite the efforts of a succession of demonstrators. At intervals the currents from the amplifier were switched through a loud speaker to enable the visitors to "hear" what the "image" sounded like. Although the quality of the note heard gave our representative some valuable information as to just how much stability had been obtained in the amplifier, it did not seem to impress the crowd very much, and the only comment came from a puppy in the vicinity; he broke into loud lamentations at the first sound.

The Optical System.

The opportunity was taken of examining the machine closely, in view of the fact that the article in No. 1 of "Television" was only a first instalment, and gave no informa-

In accordance with "P.W.'s" policy of guarding the interests of experimenters and home constructors, the Research Department, under the guidance of Mr. G.P. Kendall, B.Sc., has for some time been engaged in constructing a Televisor as detailed in the pages of a contemporary. The result of the department's labours are clearly indicated in the following article.

THE EDITOR.

tion as to the adjustment of the optical system on the transmitting side of the machine, or the mounting and adjustment of the receiving Neon lamp and its concave mirror and image screen. Among other points observed, it was noted that only three stages of L.F. amplification were apparently necessary, not the extraordinary and well-nigh impossible number of five specified in the original article. Further, only about half the amount of H.T. originally recommended was in use, and the valves were of an ordinary large super-power type, not the special transmitting valve recommended for the last stage. This seemed to bring the scheme a little nearer the realm of practical politics, but even so it was obvious that the unfortunate dry batteries which were being used for H.T. supply were having a pretty hectic time, and could not be expected to run for many hours.

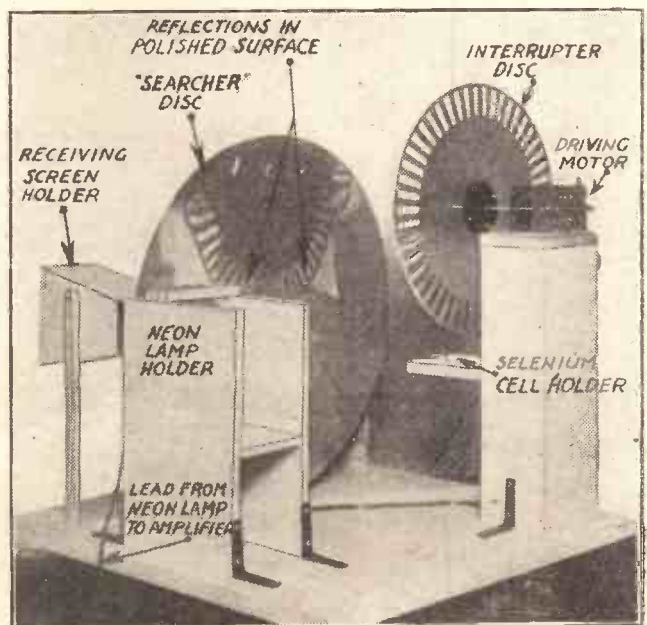
Eventually a complete set of parts was

secured (many of the essentials were "out of stock" and considerable delays followed) and the machine was built. Over the actual constructional period we will draw a veil. 'Twas a lurid time, for differences in sizes of components necessitated constant alterations in dimensions.

Early Difficulties.

While this was being done a three-stage amplifier (one resistance and two transformers) was built, and stabilised after a little difficulty, a special eliminator unit being constructed to feed it with H.T. from the mains (210 volts D.C.). Finally came the time for trying the completed apparatus, and two things immediately became very apparent, the first being that it was essential to enclose the projection lamp in a casing of some sort to protect the eyes of

(Continued on next page.)



When the machine was first finished great difficulties resulted from the fact that the discs were of polished aluminium. Note the reflections in the "searcher" disc.

 "P.W." BUILDS THE
 "SIMPLE TELEVISOR."
 (Continued from previous page.)

anyone working on the machine. The glare was extremely severe until this was done. (It was advised in the concluding article in "Television.")

The other difficulty arose from the fact that the two large discs were of bright aluminium, and all sorts of upsetting reflection effects took place. It was evident that these discs should be blackened before really satisfactory working could be expected. (This point is not mentioned in either the first or second articles describing the construction and operation of the machine.)

The first point was obviously to see that the selenium cell was working properly, and that the currents therefrom were being correctly amplified and would affect the Neon lamp. A little adjustment of grid bias and other matters soon produced the desired conditions, and it was then found that with the interrupter disc running the arrival of a beam of light on the selenium cell caused the Neon to light up brilliantly, showing that the correct control was being obtained.

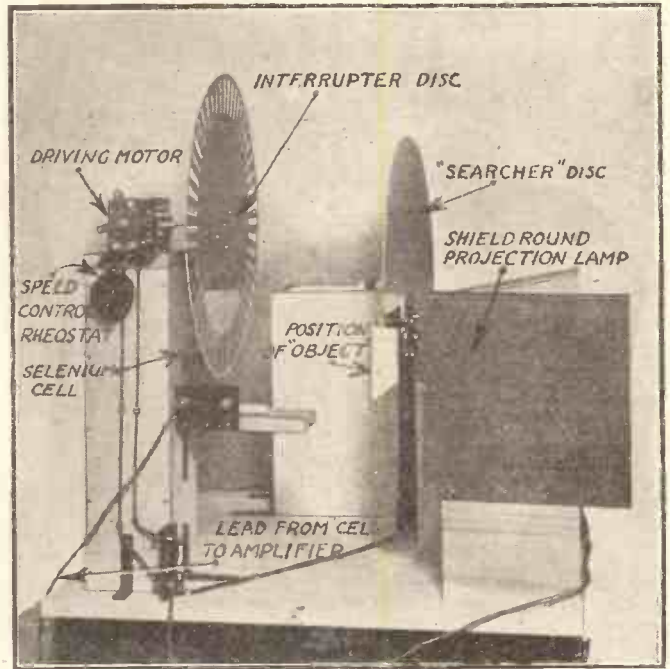
Real Snags.

It was at about this point that occupants of neighbouring rooms to the laboratory began to ask rather pointedly how much longer we proposed to run "that atrocious machine." The rattle and vibration from the cheap driving motors, the streams of glaring light, and the occasional roars and bellows from the checking loud speaker were proving so trying that it was a relief to turn to the alignment and adjustment of the optical system which focused the light on the selenium cell and formed the image.

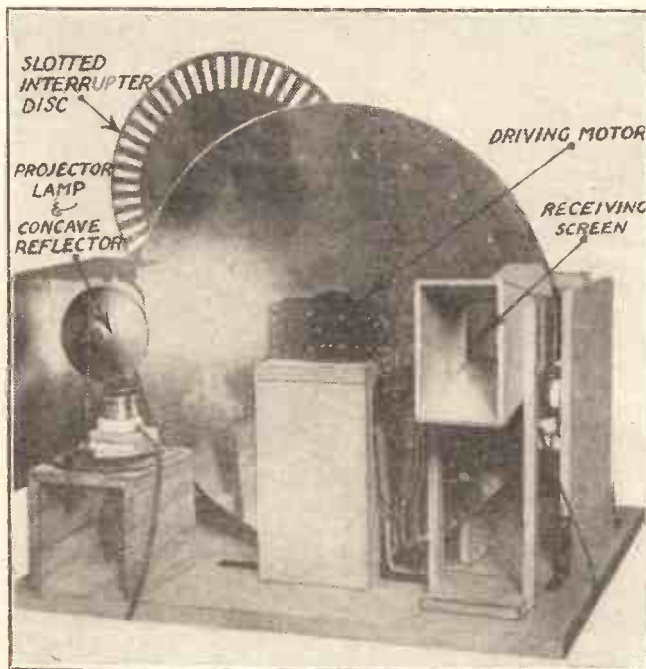
It was here that the really serious difficulties began to be encountered. It was soon realised that a considerable knowledge of elementary optics was needed

to enable the operator to discover what sort of converging beam was needed, and how to obtain that beam. A great deal of time was spent on this part of the apparatus, and we came to the conclusion that with this crude optical system it was impossible to produce satisfactory effects. The spots of focused light from the series of holes in the "searcher" disc wandered about and fell unevenly on the selenium cell, and they were confused by a second series of spots formed by the pin-hole effect of the perforations in the searcher disc. At no time did we succeed in producing a recognisable image on the receiving screen, and it was decided to await the publication of the second article before proceeding further.

This concluding instalment has now been examined, and the following points noted with much interest. The first paragraphs of the article are devoted to describing "certain improvements" in the optical system which, it appears, are intended to overcome the difficulties which we had noted, these difficulties being fully admitted by the writers. It seems pertinent to enquire why, if these defects could be discovered (and must inevitably be discovered) in the course of a few hours testing, they were not eliminated before the publication of the first article? The necessary modifications are of a very simple nature, and would be suggested by anyone with a very elementary knowledge of optics.



At first everything was made movable, and only screwed down after adjustment.



Even with a partial screen round the projector lamp the glare was terrific.

Incidentally, it does not make it any easier for the constructor that the necessary alterations and adjustments are described in terms which will only be understood by persons with some optical knowledge. Further, there is no detailed drawing showing the modifications, and no photograph of the machine in its final form.

Another point which strikes us as surprising is to find that not merely will the machine only reproduce silhouettes or shadows, but the object to be reproduced must be cut in a distorted form to allow for the imperfections of the apparatus.

In passing, we observed that the constructor is advised that he should, when test-

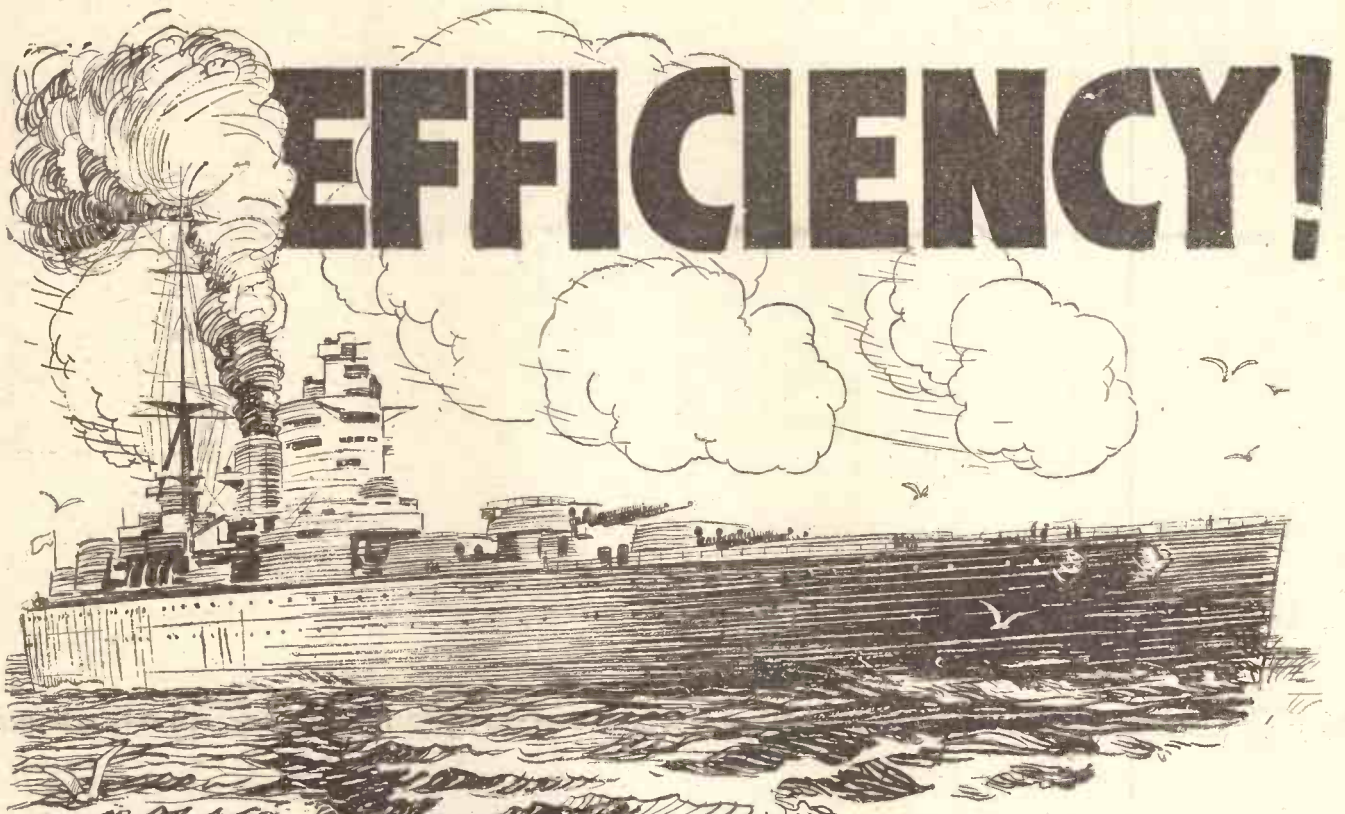
ing the apparatus, "adjust the filament rheostats so that the amplifier does not oscillate." This seemed rather strange when we discovered that the official amplifier design given in the same issue does not use adjustable rheostats, but employs fixed resistors!

These latter, however, are perhaps minor points in comparison with the complete absence of any detailed instructions whatever for the mounting of the receiving screen, the Neon lamp, the concave mirror employed therewith, or for the adjustment of the mirror in relation to the lamp.

Those Volts !

In the same issue appears a description of a suitable L.F. amplifier for this machine, and we were much interested to note the preliminary statement that "since the publication of our last issue, further development has made possible a considerable reduction in the H.T. voltage required," in view of our own attitude towards the original recommendation of 600-700 volts on the last valve. From this preamble it might be imagined that a special preamble had been developed, but the amplifier actually proves to be of the simplest and most ordinary kind, with three transformer stages, one being heavily damped with a resistance to secure a false effect of stability. In passing, it may be observed that the article revives and solemnly repeats a very ancient fallacy which we thought had died a natural death some years ago, being that "By this means (two valves in parallel) it is possible to feed almost double the energy into this last stage without any fear of over-loading" (the italics are ours).

We had hoped that some practical methods might be suggested of overcoming one of the greatest difficulties in connection with an amplifier like this, namely, a source of H.T. supply capable of giving the necessary large currents between 200 and 300 volts, but on this point the author has apparently no observations to offer. It is indeed a difficult problem where no mains are available, and an expensive one to solve.



H.M.S. Rodney, sister ship to H.M.S. Nelson, the most powerful battleship in the world.

EFFICIENCY!

EFFICIENCY is undoubtedly the **KEY-NOTE** IN ANY BRITISH WARSHIP—it is evident in every aspect—every detail. **SIMILARLY**—the Siemens Radio Battery conveys an impression of efficiency which is fully borne out by its performance in actual use. Steady Persistent Service at a high level of efficiency is the most striking feature of these batteries.

COMPETITIVE TYPE

SMALL CAPACITY

No. 1200	60 volts	8.6
No. 1202	100 volts	14.0

If you use a POWER VALVE use a "POWER" BATTERY

LARGE CAPACITY

"POWER"	60 volts	15-
"POWER"	100 volts	25-



INSIST ON

SIEMENS

RADIO BATTERIES.

SIEMENS BROTHERS & Co., Ltd., WOOLWICH, S.E.18.

For your
FLASH LAMP
use
A SIEMENS BATTERY.
Size No. 324.
4½ volts.

IT is an old and true saying that there is never smoke without fire, and consequently the row which broke out the other day between the West-End Managers' Association and the B.B.C. may be paralleled with the old proverb. The trouble seems to have been that the B.B.C.'s dramatic critic, in a recent dramatic criticism broadcast to listeners, is alleged to have stated that there are no good actors in London, and that listeners would be well advised to go to the Moscow Art Theatre Company, now playing in London, for a lesson in acting.

We have heard a good deal about the B.B.C. censorship department, and how certain officials spend their entire time in correcting authors' manuscript for broadcasting, and in deleting paragraphs which may give offence or annoyance, as the case may be. How is it then, that the B.B.C.'s dramatic critic is allowed to broadcast a statement so utterly futile, fatuous and absurd, and so calculated, not only to cause the B.B.C. considerable anxiety and annoyance in connection with its relations with the West-End Managers' Association, but also to give listeners an entirely erroneous impression of British acting in this country?

Misleading.

If the B.B.C.'s dramatic critic is going to do this sort of thing it is about time he was changed, and somebody more competent engaged. It may have been that the B.B.C.'s dramatic critic broadcast this criticism in a spirit of levity, but we should have thought that by now, and certainly since the classic example of Father Ronald Knox, it was well known that broadcasts of this nature are very apt to be misconstrued.

In any case, the very suggestion that the best acting can only be seen by a visit to the Moscow Art Theatre Company probably misled many thousands of potential theatre-goers who were visiting London over the Cup-Tic period.

It is, of course, the fashion these days to run down the British theatre and to praise everything and anything which has its origin abroad. But, luckily, a good deal of publicity has been given to this incident, and the West-End Managers' Association have quite rightly lodged a very strong complaint. To begin with, the B.B.C. dramatic critic is not invited to theatrical premiers as a B.B.C. critic and the B.B.C. criticisms as broadcast are certainly not asked for by the theatrical managers.

A Widespread Demand.

Consequently, it might justly be said that it is adding insult to injury when a rival concern like the B.B.C. allows its dramatic critic to broadcast remarks which are not only fatuous but at the same time distinctly misleading.

We can only hope that the B.B.C. will see that such a stupid mistake does not occur again and, further, that they will respect the ever-growing and widespread demand that more intelligent dramatic criticism should be broadcast in future from 2 L O and other stations.

* * *

The question of the Regional Scheme again cropped up in Parliament a few days ago, and it was interesting to note that in the reply of the Postmaster-General to a question in the House of Commons regarding

THOSE BROADCAST CRITICISMS.

The Regional Scheme and the
P.M.G.—A Parliamentary Question
—Television Truth from New York
—The Baird Patent Deal.

By THE EDITOR.

a Regional Station for the north of England the answer indicated that the B.B.C. had submitted no such specific proposal to the Post Office authorities. The facts are, of course, that the B.B.C. has asked for permission to carry on with the construction of one Regional twin-wave station to operate on high power, and rumour has it (on good grounds, we believe) that this particular station is intended for the south-eastern district of England and will, in all likelihood, be built at Potter's Bar.

In direct contradiction to the Postmaster-General's reply, the B.B.C. state that they have also submitted a general scheme for the approval of the Post Office, and that this scheme has been in the hands of the authorities of the Post Office for at least six months. The situation with regard to the Regional Scheme is becoming more and more farcical, and at the same time the relations between the B.B.C. and the Post Office on this particular question are becoming more and more strained.

A Public Demand.

In our last issue, one of our broadcasting correspondents (who is extremely well informed on such matters), stated with considerable truth that Captain Eckersley is rapidly—to use a colloquialism—becoming “fed up” with the business. The Regional Scheme has hung fire long enough. Some critics are inclined to lay all the blame on the B.B.C. but, as a matter of fact, they have done everything within their power to get some sort of a decision out of the Post Office authorities.

But the dilly-dally attitude of the Post Office still continues and exaggeration and misapprehension continues to exist, much to the detriment not only of the popularity of broadcasting but to the detriment of the wireless trade in general.

If the Post Office intends to ban the Regional Scheme for good and all, then it had better say so and relieve the tension of a situation which is rapidly becoming impossible. The wireless public, which numbers now over two and a half million, and which, incidentally, provides a nice little revenue for the Post Office authorities, is entitled to a definite answer in connection with the Regional Scheme, and unless one is forthcoming very shortly we have knowledge of a growing dissatisfaction which will result very much to the discomfort of those who persist in flatly ignoring the direct questions and the just demands of broadcast listeners.

* * *

A copy of the “New York Times” has reached us which contains a public warning

with regard to television, and as this emanates from a country which, as a rule, indulges in the most exaggerated statements with regard to scientific invention, we quote from it, not only because it confirms the policy of POPULAR WIRELESS with regard to television, but because it is a pleasing and unexpected example of how “the truth will out.”

In the course of a long article, the “New York Times” says: “Super-enthusiasm of scientists is responsible for many erroneous popular beliefs regarding television and other radio developments far from ready for general public use, according to the Radio Manufacturers' Association. Television, the Association contends, is ‘far off’; probably five years at least, and only then as a separate, distinct and costly apparatus and not as an attachment to radio broadcast receiving sets

Baird Developments.

On top of this, it is interesting to note that an announcement has appeared in the Press that an American Syndicate has acquired certain patent rights with respect to the use of Mr. J. L. Baird's television apparatus. A dinner was given in London recently to celebrate this event, and Sir James Percy, Director of the Baird Television Company, said the Syndicate had made a very satisfactory deal and one which would cement the old world with the new. This event, he said, was a big event for the English-speaking peoples and the name of John L. Baird would one day go down in history with the names of Bell, Edison and Kelvin.

Another member of the Syndicate said: “We are going to let the world know that television is not a term; it is a fact. Television is squalling, but it will soon be walking and it will be a great big baby like the Bell Telephone.”

Time Will Show.

We do not propose to make any comments on this matter, as it is outside the policy of POPULAR WIRELESS to pass any criticisms except on matters purely technical or matters connected with the policy of the B.B.C. We can only remind readers of our already well-known views on the matter, and the views of such men as Sir Oliver Lodge, Dr. Lee de Forest, Dr. J. H. T. Roberts and others.

Whatever the activity of financial groups in connection with television development, it is now a generally accepted fact among scientific men of repute, and men who have taken the trouble thoroughly to investigate the scientific and the commercial practicability of television systems, that television in the home, or any television service designed as a public utility service, must inevitably be delayed until some new principle in connection with television systems has been discovered. So far that system is unknown. It might be discovered to-morrow or it might not be discovered for fifty years.

Only time can show the truth of the criticisms passed in this journal and of the soundness of the policy we have advocated in connection with television. In other words, we can but repeat that very well-known political slogan, “Wait and See”—a slogan, by the way, the last word of which has a meaning particularly apt when expressed in connection with television.

PHILIPS H.T. UNIT MODEL 372 GREATLY REDUCED IN PRICE



The new price of Philips H.T. Unit Model 372 shows a reduction of 20/-. In addition the special model for 25 cycles (type No. 3008) is also available at the same price, and therefore offers the most remarkable value for a Unit of its kind on the market.

NEW PRICE £6 : 10 : 0

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APPARATUS TESTED

GAMBRELL EFFICIENCY COMPONENTS—"SURE-A-LITE" H.T. BATTERIES—AN EDISWAN ACCELERATOR—AN EXCELLENT METER.

Traders and manufacturers are invited to submit wireless sets and components to the "P.W." Technical Department for test. All tests are carried out with strict impartiality in the "P.W." testing-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.

GAMBRELL EFFICIENCY COMPONENTS.
MESSRS. GAMBRELL BROS., LTD., recently sent us samples of several of their productions. One or two of these incorporate recent improvements of interest. For instance, the Neutrovernia condenser, which has been subjected to several improvements of note during its history, once again is modified. This time the design has been slightly altered with a view to eliminating any possibility of breakdown of insulation at the zero setting.

In its modern form the Neutrovernia will stand a pressure of about 2,000 volts at any point of its adjustment. It is so important that there should be no breakdown in the neutralising condenser in a number of circuits, that as a precaution a fixed condenser is often placed in series. With a Gambrell Neutrovernia, this would appear to be quite unnecessary, as it has a very ample margin of safety. The price of the Neutrovernia is 5s. 6d., and in that it is an excellently made component, and

provides a directly proportional capacity change by rotation of its knob throughout its entire adjustment, it is good value for money.

A Neutrovernia indicating dial is available for use with the Neutrovernia. The price of this is 1s. 8d. In order to fit it, no further panel drilling is required as it can be connected directly to the condenser. A very attractive feature is that it is of the direct reading type, that is to say, the capacity of the Neutrovernia can be directly read from the dial.

The well-known Gambrell coils are now fitted with a new type of plug which is a very great improvement on the old type. We congratulate Messrs. Gambrell on the progressive nature of their policy.

"SURE-A-LITE" H.T. BATTERIES.

We recently received a "Sure-A-Lite" Supra 66-volt H.T. Battery for test. Its retail price is 7s. 11d. It is sent out in a sealed box, and it cannot be used until the seal is broken. Consequent to the breaking of the seal the lid can be removed and a protective sheet of oiled paper dispensed with. When the lid is replaced the holes in this provide access to the sockets. The lid then acts as an efficient dust cover. The battery has a hard black compound filling, and the sockets are deep and take wander plugs snugly.

It is plain that the individual cells in this battery are larger than those in most other kinds of a similar type, and that, therefore, it probably has a correspondingly greater life. We have had it on periodical discharge for some three weeks and we have

(Continued on page 364.)

WARNING INCOMPLETE WIRELESS RECEIVING APPARATUS

The attention of Marconi's Wireless Telegraph Co., Ltd., has been drawn to the practice, increasingly adopted by manufacturers of and dealers in broadcast wireless receiving apparatus, of advertising and selling apparatus (e.g., apparatus involving resistance capacity coupling) which is assembled and wired and needs only some addition or additions, frequently small, to constitute an instrument covered by Marconi patents. If no Marconi royalty is demanded by the seller upon the sale of such apparatus, the purchaser often infers that no Marconi royalty will become payable when he converts the apparatus into a complete instrument and uses it. This inference is erroneous.

The Company desires to warn all whom it may concern that the fact of no royalty being demanded by the seller does not mean that no royalty is in such circumstances payable by the purchaser. Some sellers adopt the practice deliberately with a view to avoiding liability on their part to pay Marconi royalties, but in any case, if the purchaser converts the apparatus into a complete instrument he is liable to pay a royalty for its use to the company as he also is if he makes the complete instrument

by purchasing and assembling a number of unassembled or partly assembled parts.

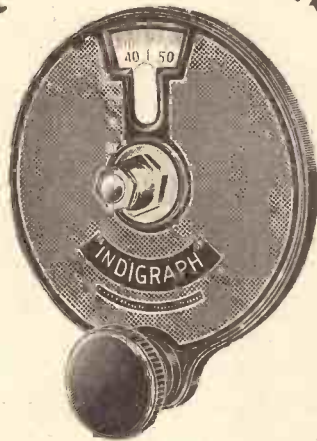
Owing to the increasing prevalence of the practice above mentioned the Company hereby gives special notice that both on its own behalf and on behalf of its Licensees it intends to protect its patent rights by every means possible and that if necessary it will take legal proceedings.

IMPORTANT NOTICE

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, has obtained from BROMLEY ELECTRICAL & WIRELESS SUPPLIES, consequent upon a sale by the latter of a GRAHAM-FARISH 3-VALVE COUPLING UNIT COMPLETE WITH RESISTANCES AND VALVES, an Undertaking not to repeat the infringement of the Marconi Company's rights in Letters Patent No. 168893 and 127014, and payment of a sum in respect of damages and costs.

WARNING is hereby given both to dealers in and users of Wireless receiving apparatus that for the maintenance of its patent rights the Marconi Company will in case of need take legal proceedings against infringers.

Do Not Accept Substitutes



The Igranic "Indigraph" Vernier Dial

Velvet smooth, dead accurate control of tuning, calibration that can be illuminated and a refined appearance has made this the dial used on all sets which show the pride of their constructors. It is the inevitable choice of the discriminating.

Price 7/6

Send for List No. R87.

WARNING

LETTERS PATENT NOS. 240983 and 263531

The attention of the Public and the Trade is called to the above Letters Patent which protect the popular "INDIGRAPH" DIAL manufactured and sold by IGRANIC ELECTRIC COMPANY of Bedford and London.

There are on the market certain infringements of these patents and actions have been taken against some of the principal infringers. THE PUBLIC AND THE TRADE ARE WARNED that the owners of the patents—IGRANIC ELECTRIC COMPANY, LIMITED—intend to restrain all infringement of their rights, and care should therefore be taken to purchase either the genuine "INDIGRAPH" DIAL or DIALS made by legitimate licencees under the patents.

Reputable manufacturers desiring to make and sell dials of this character are advised to apply for Licencees.



149, Queen Victoria Street,
LONDON, E.C.4

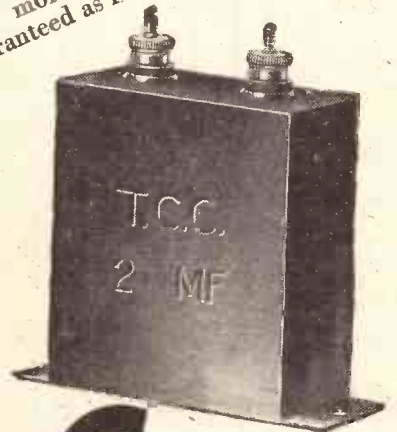
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Reliable & British

Rigorous and individual factory tests ensure the unfailing reliability of T.C.C. Condensers. For nearly a quarter of a century these All-British Condensers have enjoyed a reputation for utter dependability. Fixed condensers are one of the smallest items in the cost of your receiver. Is it worth while to jeopardise the success of your set by buying cheap, inefficient condensers in order to save a few pence on its total cost? T.C.C. Condensers may cost a trifle more than others, but they are guaranteed as reliable as the Union Jack.

Specified for the
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"MELODY MAKER"



T.C.C.

To Telegraph Condenser Co., Ltd., Wales Farm Rd., N. Acton,
London, W.3.

I enclose 1d. stamp. Please send a copy of "How to build your High Tension Eliminator for A.C. or D.C." to:

Name.....

Address.....

P.W. 5/5 28

APPARATUS TESTED.

(Continued from page 362.)

certainly found it capable of effective recuperation. It appears to be a good battery and should give reliable service with the smaller types of receivers. Each battery is guaranteed, and should a purchaser find a defect in it, he can get it replaced. The agents for the Sure-A-Lite Supra battery are the Battery Company, 92, Hurst Street, Birmingham.

AN EDISWAN ACCUMULATOR.

The Edison-Swan Electric Co., Ltd., recently sent us one of their BW22 accumulators, 6-volt 20-amp. hour capacity. This type supersedes the XW type recently referred to in these columns. The price, however, is the same, namely 30s., for the particular model sent us. The terminals appear to be heavier and the plates of a more robust nature. Since it was placed in commission the battery has been subjected to a period of hard work. So far, it shows no signs of distress whatever, and there is every indication that its life will be a long and useful one.

The BW range of Ediswan accumulators is a very comprehensive one. Actually the batteries consist of separate 2-volt cells, but when these are purchased in twos or threes to obtain 4 or 6 volts, connecting links are supplied. There are seven capacities available, running in equal steps of 10 ampere

hours from 10 amperes to 70 ampere hours. The prices of 2-volt cells increase in 2s. steps from 8s. to 20s., the 70-ampere hour capacity type, however, retailing at 23s.

AN EXCELLENT METER.

We recently received a Feiranti three-range meter. It is of the portable type, PR3A, and gives measurements to 15 milliamps, 7.5 volts, and 150 volts. It will be seen that this covers practically every requirement of the average amateur. It enables L.T. and H.T. voltages to be

checked, grid-bias volts to be measured, and anode current to be ascertained. For a multi-range instrument its precision is remarkable. Tested against our separate standard calibrated instruments we discovered a pleasing accuracy on both voltage ranges. On the milliamp range there was an equal freedom from error. It is a soundly designed, and thoroughly well-made instrument. It is indeed the best meter of its kind we have had brought to our notice, and we have no hesitation in recommending it to our readers.

THE "P.W." "ECONOMIST" UNIT.

Messrs. E. K. Cole, Ltd., of Leigh-on-Sea, manufacturers of the well-known and efficient "EKCO" H.T. units, point out that the "Economist" H.T. Unit, which was described in our April 14th issue, incorporates a circuit similar to the one covered by their patent 262567. They add:

"We would add our thanks for the perhaps unintentional compliment derived from the similarity in "Economist" to our trade name "EKCO" and our well-known slogan "For Efficiency—EKCONOMISE!"

"EKCOS" IN GLASGOW.

E. K. Cole, Ltd., of Leigh-on-Sea, also inform us that owing to the considerable increase in their business from the North they have opened a depot in Glasgow in addition to their depot in Manchester. The Glasgow address is 75, Robertson Street.



Captain Bert Hinkler, A.F.C. (nearest to microphone), broadcasting a talk through 3L0, Melbourne, immediately after his arrival at Bundaberg, Queensland, at the conclusion of his record-breaking flight from England in sixteen days. This talk was relayed by telephone line nearly 1,500 miles to Melbourne for broadcasting. 3L0, Melbourne, sent a special staff of experts with speech input and amplifiers to Bundaberg for the purpose.

THE UNIQUE

VARIABLE FRICTION BRAKE

What the Experts say!

"... the moving vanes of the J.B. variables can be tightened by means of the ingenious friction devices incorporated in their movements. There is a small round-headed screw on each which takes up the pressure applied to the spindle by a small collar."

—"POPULAR WIRELESS."

Both S.L.F. and Log. Plain models are equipped with this unique Variable Friction Brake.

Prices of J.B. S.L.F. & Log. Plain Models: .0005 mfd., 11/6; .00035 mfd., 10/6; .00025 mfd., 10/-; .00015 mfd. (S.L.F.), 10/-; .0001 mfd. (Log.), 10/-.

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WIRELESS CONSTRUCTOR ENVELOPES

Envelope No. 1.—THE "RADIO" THREE. A famous loud-speaker set which you can build in an hour or two—no soldering and a wide range of components to choose from.

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In these envelopes you will find every detail of the set simply explained, photographic reproductions and diagrams are included, as well as a full-size Blue Print.

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The "Brown"
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Price . . . £4 10 0



In the Argentine (land of the "Pampas")

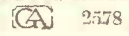
On the great cattle ranges the "Brown" Loud Speaker is treasured beyond price, it brings laughter and song to lonely lives. In the cities too it is known and valued, for the Argentines are a musical people; the best

only satisfies their taste. All the world over the "Brown" sets and maintains the standard of Loud Speaker reproduction. Wherever perfection is required, there is a "Brown."

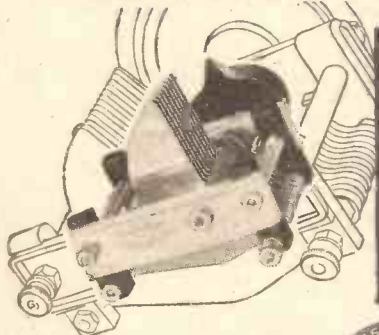
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The Loud Speaker on which the sun never sets!

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**Something new
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PRICES:
Supplied with pointer knob and drilling template.

'00015 mfd.	6/-
List No. 312.	
Also supplied in three other sizes.	
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'0002 mfd. 313.	6/3
'00025 mfd. 314.	6/6

Illustration shows the "Elfin" compared with the Bowyer-Lowe "Popular," itself a compact instrument.



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The smallest and lightest condenser model made—the '00015 mfd. weighs only 2½ ozs., and with fully extended vanes occupies only 2¼" x 1¾" x 2" behind panel.

A precision instrument of quality, a miniature logarithmic condenser. Specially designed for reaction control or for tuning-in sets where space is at a premium.

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FORMO
L.F. TRANSFORMER
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PRICE REDUCED to 8/6
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All Editorial Communications to be addressed to The Editor, POPULAR WIRELESS, Tallis House, Tallis 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.

The constructional articles which appear from time to time in this journal are the outcome of research and experimental work, carried out with a view to improving the technique of wireless receivers. 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.

QUESTIONS AND ANSWERS.

WHAT IS A MICROMICROFARAD ?

STUDENT (London, S.W.9).—"I understand that a microfarad is a millionth part of a farad. Is a micromicrofarad a millionth part of this millionth part ?"

Yes, a micromicrofarad is a millionth part of the millionth part of a farad. Consequently, a condenser of two micromicrofarads is really a condenser of '000002 (five 0's 2 mfd.).

HOW LONG WILL A COIL BE ?

E. B. W. (Westminster).—"I like winding my own coils, but I am often puzzled to tell how long a particular coil will be. For instance, suppose I wind 250 turns of No. 30 enamelled wire upon a cardboard tube former. How can I find exactly how long that former should be in order to take the winding ?"

Any electrician's handbook or table will tell you the exact diameter of various types of wires. For instance, the diameter of No. 30 enamelled wire is given as '017 in., which is the thickness of one turn of the wire. Consequently 250 turns will be '017 multiplied by 250, which is equal to 4'25 in.

This is the exact width which would be occupied if the 250 turns were laid on perfectly close to one another, but as it is almost impossible to wind wire so perfectly, it is necessary to allow just a little extra to cover the small accidental spaces. For the winding given above, the theoretical length would be 4'25 in., and we should allow instead of 4½ in. say 4¾ in. The small margin will enable you to begin and finish the wire by fixing to the former.

HOW FAR DOES OSCILLATION CARRY ?

L. M. (Horley, Surrey).—"My set is an ordinary one-valve detector, using a D.E. 2 L.F. valve with 50 volts H.T. I know that it will cause interference if I bring the reaction coil right up close to the aerial coil, but what I wondered is how far would such disturbance be likely to spread ? Do you think it could be heard several miles away ?"

Much depends upon the aerial-earth system, but we expect that a valve of the type you mention would create powerful interference up to a mile or two, and would be heard quite distinctly at ten miles or so upon sensitive receiving apparatus.

"TOO MANY STATIONS" ON "PROGRESSIVE" FOUR ?

K. L. C. (Barnsley).—"I wish to thank you for the splendid 'Progressive' Four circuit.

"I have built this four-valve set as shown, but owing to cost of up-keep and too many

(Continued on page 368.)

The CRYSTO-BAR

50/-
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Wireless Receiver — an epoch-making New Wilson achievement — is an up-to-date Crystal Set combined with the Microphone Bar Amplifier.

It will make wireless cheaper and better for you. Only one or two inexpensive dry cells of 1½ volts required to give loud speaker results equal to a two-valve set.

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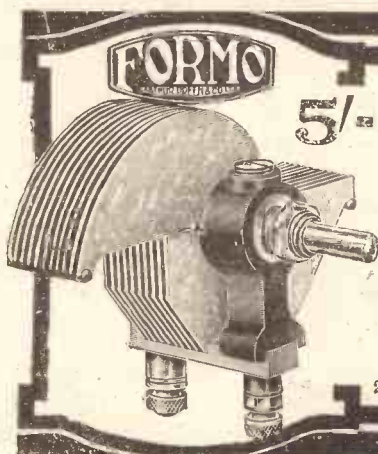


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'00035 and '0005

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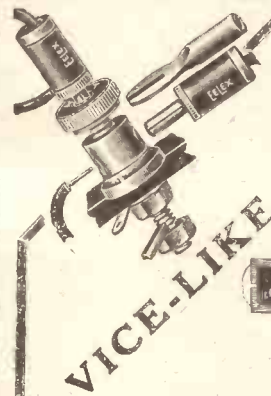
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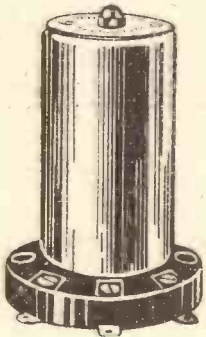


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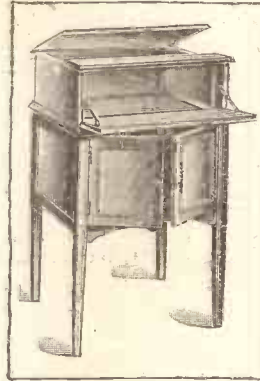
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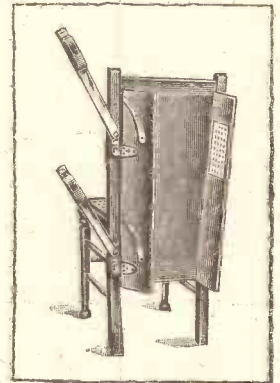


The wireless cabinet illustrated on the left, is but one of the many styles and sizes in the workshops of V. C. Bond. Whether you choose a cabinet from our designs or commission us to build you one, you are sure of expert workmanship and solid construction.

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RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from page 366.)

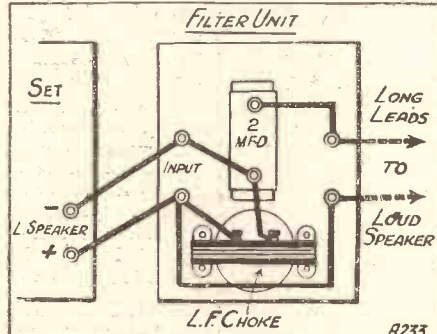
stations on the top of each other, I have cut out the H.F. valve and reorganised my baseboard!

"A minor improvement I have made is an 18-gauge wire from the '0003 variable, running on the baseboard to an extra terminal near the coil. I then have just two short flexes from the back of the cabinet.

"The coils I have fixed with two wander plugs each, and the flexes have red and black plugs fixed respectively. It is then a simple matter to change over. The coils are wound with yellow waxed tape, puttee fashion, to cover the tappings and wire.

"I can with this three-valver receive 15 stations on loud speaker very clear and strong, 5 G B as strong as Daventry 5 X X, London,

WHAT IS WRONG?



The above diagram is supposed to represent the connections of a loud-speaker output (filter) circuit, but it is incorrect.

Next week the correct diagram will be given, and to test your skill we shall continue to publish diagrams in which mistakes have been inserted. The correction will be published the following week.

No prizes are offered, but by following this series and trying to solve the problems week by week the reader cannot fail to learn a lot about radio circuits.

Belfast, Madrid, Manchester, Paris, Hilversum, Seville, Leipzig, Bradford, Toulouse, etc., and a lot of German stations.

"I find reaction perfect and that varying the number of turns to suit my aerial on experimental coils does the trick for station grabbing.

"I think that anybody who cannot get all they require with this set ought to retire from wireless and buy a gramophone. My aerial is only 15 ft. high, 3 ft above the roof of my bungalow none clear, and 45 ft. long, L-shaped.

"Would it be possible for you to let readers interested in the 'Progressive' Four have details of a short-wave coil to suit this set, for I am a late sitter-up.

"Wishing your paper and 'Modern Wireless' (which I would not be without) every success, and hope you can oblige with the above request."

As the "Progressive," in either its 1-, 2-, or 3-valve form, is a "straight" circuit, ordinary short-wave tuning and reaction coils can be used for it and will give completely satisfactory results.

As H.F. amplification is not generally attempted upon short wave-lengths, the best plan is to cut out the H.F. valve and take the aerial to the grid coil in front of the detector, which then acts as the first valve of the set.

The requisite size of reaction coil as compared with grid turns will vary a little with different valves, and according to the H.T. used, etc.; but such variations will be slight, and in general it may be said that any short-wave coils of suitable dimensions can be incorporated in the "Progressive" set and will give good results.

(Continued on next page.)

NO SOLDERING



One of the many outstanding advantages of the Belling-Lee terminal is that no soldering is required. The terminal is fitted with a transverse slot with clamping nut, which eliminates this tiresome task.

Make your set distinctive by fitting Belling-Lee terminals. Made with 50 different engravings.

Prices: Type "B"—Standard large insulated model. Polished black bakelite. 9d. each. Type "M"—As type "B" but smaller and with only the engraved top insulated. Rest nickel-plated brass. 6d. each. Type "R"—Cheap competitive insulated model with rotating name. 3½d. each. All types Guaranteed.

BELLING-LEE TERMINALS

Belling & Lee, Ltd., Queensway Works, Ponders End, Middlesex.

THE LITTLE CELLS THAT SATISFY.

Eton Primary H.T. Battery P.I. Porous Pot Cells, S1 and S2 Sac Cells. All complete

	1-cell	6-cell	12-cell	30-cell
P.1	6½d.	3/3	5/9	14/-
S.1	6d.	3/-	5/3	12/-
S.2	4½d.	2/6	3/10	9/6

Send 1½d. stamp for booklet giving full particulars to:—

THE ETON GLASS BATTERY CO., 46, St. Mary's Road, LEYTON, E.10

RADIO PANELS

7 x 6 1/3	9 x 6 1/7
8 x 6 1/4	11 x 8 2/3
10 x 8 2/1	12 x 8 2/6
10 x 9 2/4	12 x 9 2/10
12 x 10 3/4	14 x 10 3/5
14 x 12 4/4	16 x 9 3/6
14 x 7 2/7	21 x 7 3/7
16 x 8 3/2	24 x 7 4/4
18 x 7 3/2	30 in. thick



Thoroughly Recommended for the Corsor "Melody" Money back Guarantee.

Megger Test Infinity. Maker "21" x 7" Panel, 3/7

Panels cut to any size. Call, write, or phone Clerkenwell 7853 for quotations. Samples and prices post free to Trade.

CROSSONIA CO. (Dept. F), 10, South St., Moorgate, E.C.2
Agents:—John Henry Smith, 139, Anlaby Rd., Hull; L. H. Helyar, 82, Chamberlin Rd., Norwich; A. Stredwick & Co., 27, The Mkt., Chatham; Boynton & Co., Ltd., 34, Bradford St., B'ham.

To All Advertisers

PLEASE note that communications concerning advertising in **POPULAR WIRELESS WIRELESS CONSTRUCTOR MODERN WIRELESS**

must be made to **JOHN H. LILE, LTD.**, 4, Ludgate Circus, London, E.C.4
Phone: City 7261)

and NOT to the Editorial or Publishing Offices.

RADIOTORIAL QUESTIONS AND ANSWERS *(Continued from previous page.)*

A Streatham reader ("S. R. P.") described his experiences upon the K D K A wave-length (with easily-constructed home-made coils) in these columns a few weeks ago.

See "P.W.," No. 304 (March 31st issue), page 200. In this particular instance a 14-turn bare wire coil was used, and the aerial connections, etc., were set out in detail. If lower wave-lengths are desired, the coil should be a little smaller than the one mentioned above, the tapings, etc., being in the same relative positions.

Alternatively, you could build the "Antipodes Adaptor" (recently described in "P.W."), which can be plugged into the detector valve's socket, thus converting the set into a short-waver.

A USEFUL H.F. UNIT.

F. E. (Newcastle, Staffs).—"What I should like is an H.F. unit to put in front of my 'Cossor Melody Maker.' Can it be done, and if so where can I get particulars?"

An H.F. unit capable of being added easily to your present set is described in the April issue of "Modern Wireless" (price 1s. 6d. at any booksellers). The unit is called "The M.W. Station Getter."

THE AERIAL SERIES CONDENSER.

"XRAYSER" (York).—"Having seen it stated so often in 'P.W.' that a series condenser in the aerial circuit improves selectivity while decreasing signal strength somewhat, I was surprised to find upon trying same that while selectivity was increased signal strength was increased; also when .0002, .0003 mfd. were used in series (using the parallel condenser .0005 in set also as usual) (D. and L.F. usual 2 valve).

"Experimenting with serial condensers in the aerial I find that signal strength seems to improve until I have altogether .0006 mfd. in."

"At first I thought it might be due to the fact that aerial was screened (standard length), but on raising same to about 40 to 46 ft. high, I find that while, of course, signals all come in better, yet they still come in strongest with .0003 to .0006 in the aerial. I have tried both air-spaced and mica types, but find both have same effect.

"Formerly I used a 150-coil aerial for 5 X X ; now 250, with a much smaller reaction coil (swinging type), and curiously enough the long waves seem to benefit by the change as much as the short ones.

"The set (D. and L.F.) and aerial are both undoubtedly efficient, and with two D.E.L. 410 valves, using 60 and 70 volts. It can put Hamburg on a small loud speaker at great strength at times. Though I have been reading 'P.W.' for six months, I have never seen an article dealing with aerial series condensers, and I would like to know, under circumstances given above, what capacity condenser in the aerial should give best signal strength and be most practical?"

Unfortunately the effects of adding a series condenser are so complicated that it is impossible to give a definite value, or even to give a practical formula by means of which the correct value to use can be found.

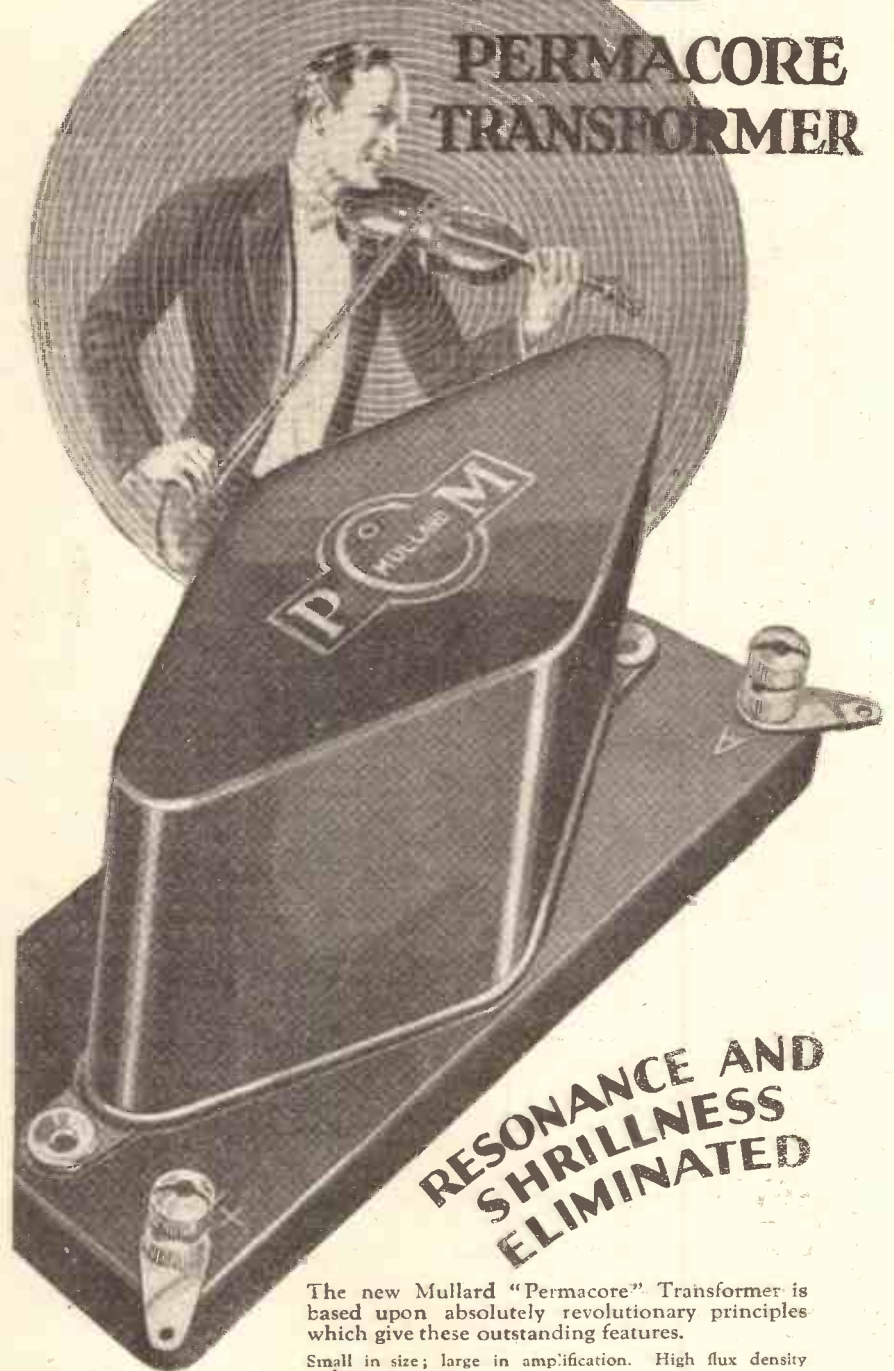
The only method of finding which is the best value to use is to experiment with different values, and to note which gives best results. The easiest method of doing this is to connect a variable condenser of about .0005 mfd. maximum capacity in series with the aerial lead, adjusting this between maximum and minimum positions until the most satisfactory setting has been found.

The reason that this condenser's correct value for best results cannot be calculated accurately is that there are too many unknown or variable factors to be taken into account—for instance, the natural wave-length of the aerial circuit, its self-capacity, the degree of coupling between the aerial and the grid coil, frequency of reception, the degree of damping introduced by the associated circuit (which will vary with different valves, grid-leak connections, etc.), and the various reaction factors, etc.

When using a variable condenser in series with the aerial lead, as described above, it is not uncommon to find, as you have done, that on certain stations the strength of reception as well as the selectivity is improved; but, nevertheless, the statement that extra selectivity is generally gained only at the expense of volume is correct, because this is in line with general experience, despite exceptions under certain conditions.

The MULLARD

PERMACORE TRANSFORMER



**RESONANCE AND
SHRILLNESS
ELIMINATED**

The new Mullard "Permacore" Transformer is based upon absolutely revolutionary principles which give these outstanding features.

Small in size; large in amplification. High flux density without saturation.

All shrillness eliminated.

Gives life to every note.

Silver primary, nickel secondary; windings that will not deteriorate.

NO RESONANT PEAK.—The windings of the Mullard Transformer have been so selected that no resonant peak occurs at about 8,000—10,000 cycles as is usually the case. The primary is wound with silver, the secondary with nickel, causing the elimination of resonant peaks.

The iron in the Mullard Permacore allows the use of a high flux density in a circuit of exceedingly small dimensions.

The new wonder Mullard Transformer is the finest L.F. Transformer ever produced.

Obtainable from all Radio Dealers.

25/-

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MASTER · RADIO**



You know them. They just want to try something in your set. Ping! An awkward hand has hit your valve.

A Benjamin Valve Holder would have saved you the cost of a new valve. For this valve holder is sprung on 4 one-piece springs. Strong springs but delicate. Springs that absorb the slightest vibration or the greatest shock.

Fit Benjamin Valve Holders in every stage of your receiver. But be sure the valve holders are Benjamin, because no others will so efficiently absorb shock and disperse microphonic noises.

BENJAMIN
VALVE HOLDERS
2/-
THE BENJAMIN ELECTRIC LTD.,
Brantwood Wks., Tariff Rd., TOTTENHAM, N.17

NEWS FROM SAVOY HILL.

(Continued from page 356.)

Sir Henry Wood and the B.B.C.

Musical friends of Sir Henry Wood state that he is gravely disturbed at the treatment he is receiving from the B.B.C. Trouble has arisen over the arrangements for the "Proms" this year. Savoy Hill have been anxious to strengthen the orchestra: Sir Henry will not brook interference with arrangements which are the outgrowth of thirty years progressive endeavour.

Something like a deadlock has been reached. If the threatened storm breaks it will be one of particularly acrimonious violence.

More Puccini Coming.

A great treat for listeners last summer was the broadcasting, under the direction of Mr. Percy Pitt, of the Puccini operas, "Madame Butterfly," "La Bohème," and "Tosca." Two more operas by this composer, "Manon Lescaut" and "The Girl of the Golden West," will be broadcast in May and June respectively, and the libretto of these will be available to listeners in the ordinary way. "Manon Lescaut" will be given from 5 GB on Monday, May 14th, and from 2 LO and all other stations two days later (Wednesday, May 16th).

The story attracted several other opera composers, including Balfe, Massenet and Auber, and the principal characters in Puccini's are practically the same as in the favourite "Manon" of Massenet, except that in the last act, Manon's faithful lover, des Grieux, joins the convict ship, which is deporting Manon to Louisiana, as one of the crew, and she dies in his arms in the far country and not on the weary road to Le Havre, as in Massenet's adaptation of the story.

The Prince of Wales.

All stations are broadcasting the ceremony of opening the Royal Tweed Bridge at Berwick, which the Prince of Wales is to perform on Wednesday morning, May 16th. The proceedings begin at 11 o'clock, and are expected to last until shortly after noon and will include a full commentary on what takes place.

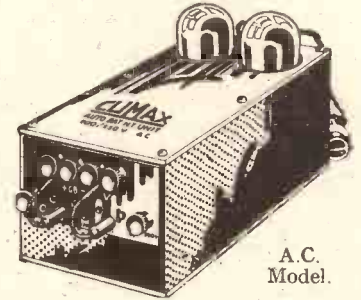
The Prince of Wales will be met at the station, where a Royal Address will be read and to which he will reply, and the actual ceremony of opening the bridge will consist of speeches by H.R.H., the Chairmen of the Northumberland County Council and of its Bridges and Roads Committee.

The new bridge, which is of ferro-concrete construction, has been built to accommodate the ever-increasing traffic between England and Scotland, and is supplementary to the old bridge built 293 years ago.

It will be the third bridge of importance across the famous river, the other being the well-known Border Bridge opened by Queen Victoria in 1850.

There are still living in Berwick one or two old people who were present on that occasion to whom the compliment has been paid of being invited to the ceremony on May 16th. The arrangements for the broadcast have been made by the Newcastle Station.

H.T. from the Mains



A.C. Model.

CLIMAX H.T. SUPPLY UNITS

Study these special features of Climax Auto-Bat H.T. Units and then the prices.
10 H.T. Tappings with one fixed and two variable voltages. Insulated sockets, insulated wander plugs, insulated terminals. Earthed metal cases. Safety first design. Shock proof. Fireproof. Large guaranteed output. No mains noise. Same simple control as with ordinary H.T. Battery. Very attractive finish.
CLIMAX AUTO-BAT D.C. MODEL. 100/250 volts. Output approx. 200 volts max. on 200/250 volts mains, and 100 volts max. on 100/125 volts mains. 50 milliamperes max. Price **34/-**
CLIMAX AUTO-BAT A.C. MODEL. 200/250 volts. 40/100 cycles. 100/125 volts. 40/100 cycles. Output approx. 150 volts max. H.T. at 50 milliamperes. Price £4 plus royalty 12/6 net, plus 2 D.U.10 rectifying valves at 15/- each. Complete £6 2s. 6d.

Obtainable from all radio dealers.

CLIMAX

A YEAR AHEAD

CLIMAX RADIO ELECTRIC LTD.,
Quill Works, Putney, London, S.W.15.

HEADPHONES REPAIRED 4/-
Transformers 5/- Loudspeakers 4/- All repairs remagnetised free. Tested, guaranteed and ready for delivery in 24 hours.
Discount for Trade. Clerkwell 1795.
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D-XELLENT!
DX IN PLUG COILS
From No. 25 1/- to No. 500 4/-
DX SHORT-WAVE SET
4 Coils Nos. 3, 5, 7, 9 .. 7/6
"P.W." Test Report, March 10:—"The fact that one of the first stations tuned in was 3 LO of Australia is ample proof that the coils are efficient."
If unable to obtain send P.O. 7/6.
DX COILS LTD., LONDON, E.8.

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"POPULAR WIRELESS"
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EASY PAYMENTS
LOUD-SPEAKERS, HEADPHONES,
H.T. ACCUMULATORS. Anything Wireless
Send a list of the parts you are requiring, and we will send you a quotation on monthly payments.
H. W. HOLMES, 29, FOLEY STREET,
Phone: Museum 1414. **Qt. Portland St., W.1.**

TECHNICAL NOTES.

(Continued from page 356.)

The breakdown voltage of a condenser on the other hand, is very important, especially where the condenser is to be used with "mains-units" or eliminators, and, consequently most reputable manufacturers of condensers of this type rate them very conservatively—in other words, they make a very generous allowance for overload.

If a condenser which is thought to be defective is connected in series with an electric lamp across the mains it may be found that the lamp lights up, in which case the test indicates that the condenser is completely short circuited internally—the lamp used should, of course, be one suited to the mains voltage.

Leaky Condensers.

More usually, however, the condenser is not actually shorted but is only leaky, and in such a case the lamp would not light up. If a leaky condenser were used as a bypass across the dry H.T. battery, even though the leak were quite small, in view of the fact that the leakage current would be running continuously, the life of the H.T. battery would be considerably shortened. In order to test a condenser for leakage, a simple plan is to charge up the condenser by connecting it momentarily across the electric mains or across an H.T. battery and then short-circuiting the terminals of the condenser. A spark will be obtained, depending for its brightness upon the capacity of the condenser and the voltage to which it was charged up. Now repeat the test, but leave the condenser, say, two seconds before short-circuiting it, and notice if the spark is appreciably less.

Repeat again, leaving the condenser this time four seconds between charging up and discharging, and so on. If the condenser is compared in this way with another condenser of the same type which is known to be satisfactory, there will be little difficulty in deciding whether or not the suspected condenser is leaking.

A really first-class condenser will retain almost its full charge for several hours. In making tests of this kind care should be taken to handle the terminals of the condenser only by means of insulators such as short ebonite rods; this is partly to avoid discharging the condenser through the fingers, which would, of course, render the test entirely useless, and partly to obviate the danger of an electric shock to the operator.

Replaceable Rectifiers.

I see that one of the American manufacturers has lately put on the market a type of eliminator in which rectifiers of a special type are used. These gradually wear out in use, but after they have lost their efficiency they are simply removed from the instrument and replaced by fresh ones in precisely the same manner as a grid-bias battery.

"Motor-Boating" in H.T. Eliminators.

One of the problems with which the user of a high-tension eliminator is sometimes confronted is the effect known as "motor-boating." This is a form of low-frequency oscillation, and is due to the high internal

(Continued on next page.)

WE ARE OPEN

ALL DAY SATURDAY
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ALL DAY EVERY DAY
Hours: 9 a.m. to 9 p.m.
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Sunday morning: 11-1.

EDISWAN NEW THREESOME

List of Components.
Three Coupling Units,
Tubular Fixed Condenser,
Multiflex Cable and Plug,
-0003 Variable with 8 M. Dial,
2-way Geared Holder Wire,
Red and Black Flex. The lot post free **42/-** nett.
EBONITE PANEL, 5-ply Baseboard, **2/6**
(These two with above kit only. Post 6d.)

Ediswan Valves, 10/6 each.
Power, 12/6.

MULLARD MIKADO

Component Parts:
Ormond Logarithmic -0005, Ditto -00035, Two 4 in. Dials, One Igranic "Type G" L.F. 3/6 to 1, Four Engraved Terminals, One on-and-off Switch, Two strips, 2 by 1 1/2 in. Connecting Wire, Six-pin Base, Mullard -0003, Mullard 2 meg. Two Lotus valve holders, Red and Black Flex, Two Spade Terminals, Five Plugs (2 B 3 R).

£3:14:0

MULLARD VALVES, P.M. 1, 10/6; P.M. 2, 12/6.
MASTER 3-COILS B.B.C. 7/6; LONG WAVE, 8/6.
* When purchasing above you can buy 100 volt H.T. for 5/-, L.T. 2 volt 45 amp for 3/11. (Both Best British Make) POST 1/6 for Batteries.

BURNE-JONES (MAGNUM)

H.F. Choke, 7/6. H.T. Auto Fuse, 0.5 bulb, 1/6. Standard Wavetrap, 15/- Screening Box for same, 5/- 1928 Solodyne Coils (3), 45/- (including Bases), Ditto for Long Wave (no Bases), 45/- Balibrated Rheostats, 6 or 30 ohms, 3/- -00025 Neutralising, 5/- Coil Plug on Base, 4 Terminal, 1/9. Spl. Primary H.F. Transformers, S.S. Ditto, Aerial Coils (6-pin), for short and long wave, stocked.

LISSEN

Valve Holders, 1/-; Fixed Con. 1/-, 1/6; Leaks, 1/-; Switches, 1/6, 2/6; Latest 2-way Cam Vernier, 4/6; Rheostats, 2/6; B.B., 1/6; Lisencola, 13/6; L.F. Transformers, 8/6; 100-v. H.T., 12/11; 60-v. H.T., 7/11; Coils, 60 X, 6/4; 250 X, 9/9.

ORMOND COMPONENTS

YOU CAN ALWAYS GET THEM HERE!
LONDON'S LEADING DISTRIBUTORS!

IMPORTANT

We stock Igranic, Climax, Ever-Ready, Hellesen, Siemens, Formo, Ferranti, Wearite, Ormond, J.B. Benjamin, Lotus, Mullard, Dubilier, Lissen, Lewcos, Utility, Magnum, Peto-Scott, Peerless, Burndept, Pye, Marconi, McMichael, Cosmos, Carborundum, R.I. - Varley, Gambrell, Brown's Sterling, Ampions—in fact, everything it is possible to stock.

MULLARD MASTER THREE

No solder—only 20 wires to connect. COMPLETE SET OF COMPONENTS. 2 Term strips 2 1/2 x 2, Lewcos Base, 2 J.B. condensers, Climax H.F. choke, Master Three Coil, 3 Pye Valve Holders, Magnum Brackets, 4 Terminals, Spade Terminals, Wander Plugs, Bulgin Switch, R.I. Unit, R.I. L.F. Transformer, Mullard -0003, 2 meg. Leak, Flex, Screws, &c. AND THREE MULLARD P.M. VALVES ABOVE KIT **£6:17:6**

FREE GRID BIAS, 9 VOLTS 100 VOLT H.T. (BRITISH) with above ALUMINIUM PANEL, 18 in. x 7 in. Handsome Oak Cabinet for Master Three, 15/11 with kit of parts, carriage 2/-.

MULLARD TOREADOR 3

-0005 and -00035 S.L.F.; 2 Ormond S.M. Dials, 1 bush; 1 Six-pin Base; 3 Valve holders; P.M. R.C.C. Unit; 1 L.F., 2-5-1 (Pye); 2 2-mfd. Mansbridge; -0003 and 2-meg. Leak; Climax H.F. Choke; 9 Marked Terminals; L & P. On-and-off Switch; Brackets, 3 Plugs, Flex; Unit Wire. **£4:18:3**
List Price
FOR YOU CAN BUY with above parts: Aluminium Panel, drilled, best quality; Baseboard, 18 x 10; Ebonite Washers. **2/6**

MASTER 3 COILS B.B.C. 7/6

Long Wave, for Toreador 8/6 L.T., 2 volts, 45 amps, 6/6 (with parts only). H.T., 108 volts, British, 10/- (with parts only). Mullard Valves, 10/6 & 12/6 (Power) (Super Power, 20/-)

The Cossor "Melody Maker"



COMPONENTS FOR SAME.

Post **£4:10:0** Kit Extra.
2 Ormond -0005; 2 Do. S.M. Dial; 6 T.C.C. Condensers, -001, -002, two -0003, -0001, 2 Grid L.K. Clips, B.B.; 1 Var. B.B. Rheostat; 3 Grid Leaks, 25, 3, 4 meg.; 3 Lotus V.H.; 1 Ferranti A.F. 3; 2 Panel Switches; 1 Cossor Melody Wound Coil; Terminals, Name Tabs, Glazite, 9-v. Grid Bias (all as specified).

NOTE

Drilled High-grade 21 x 7 Polished Panel, with Radion Strip, FREE with above kit. COSSOR VALVES FOR ABOVE
210 D 410 HF 610 HF 10/6 EACH
210 RC 410 RC 610 RC 10/6 EACH
210 P 410 P 610 P 12/6 EACH
COSSOR MELODY MAKER CABINET, 21 x 7, as shown above, in oak, with baseboard, can be purchased for 12/6 with above. Carriage 2/-.

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Mr. Percy Harris has issued a new Envelope and Blueprint, price 1/6 (deduct 1/6 buying parts). All parts with Terminals.

ORIGINAL COMPONENTS. ALTERNATIVE COMPONENTS.

2 Ormond S.L. Variables, with Friction Gear; 3 Coil Sockets; T.C.C. -0003 and Clips and 2-meg. Leak; 3 Benjamin Valve-holders; 3 Fixed Resistors and Bases; On-and-off Switch; Geophone 1st Stage L.F.; Igranic 2nd Stage L.F.; Engraved Strip, with Terminals and Nuts; 2 B.L. Terminals for Front Panel; 1 Gross Pinch-on Spades; Rubber Flex.
NETT CASH 34/- (Usually 98/6.)
NETT CASH 57/6

A GOOD CABINET, oak, American type, hinged lid, 16 x 8, with baseboard for 9/11 to callers only at this price. IF BY POST CABINET IS 12/6.

BRITAIN'S FAVOURITE THREE

ORIGINAL COMPONENTS. SECOND SELECTION.
Ormond 0005 and 00025 Log Mid-line Condensers, 12/- and 13/- each. 7-ohm Panel Rheostats, 2/-, 3 B.R. Valve-holders at 1/9, 2 Single Coil-holders, -0003 Fixed and Series Clip and Dubilier 2-meg. Leak 5/-, H.F. Choke 5/-, R.C. Dubilier Unit 7/-, R.I. Transformer, 25/-, 7 Terminals at 5d. (5/3), 2 strips 4 by 2, TOTAL 81/6. Sent post free for 74/6 nett.
16 by 8 PANELS, GRADE "A" 3/11 nett, with parts. 16 by 8 by 10 ins. AMERICAN CABINETS (OAK), HINGED LID AND BASEBOARD. SPECIAL PRICE WITH ABOVE KIT OF PARTS ONLY. 15/- NETT. Post 1/- for Cabinet.

K. RAYMOND,

27 & 28a, LISLE STREET, LONDON, W.C.2
Come to Leicester Square Tube.
IMPORTANT.—This address is at the back of Daly's Theatre. Be sure it is RAYMOND'S. Phone: Gerrard 4637.

Callers bring your lists.

Special quote for sets of parts over 25/-.

BESURE TO COME TO RAYMOND'S SPECIAL OFFERS

Special Indoor Aerials, phosphor bronze wire, ebonite separators, 12 ft. x 8, making total 100 feet, 4/11. Post 3d.
BE SURE YOU READ "Wireless Constructor" and "Modern Wireless" for latest sets. (See my advertisements in same.)
Bulgin Short-Wave Chokes, 8-80 metres, 3/- each. Post 6d.
Wearite R.F. Chokes, 5/6. Short-wave do., 4/6. Post 3d.

Dr. Nesper Bronze Finish Horn Type Speaker, worth 35/- Now selling at... **21/-** Post free.

Dr. Nesper 35/- Cone Type Loud Speaker. Special price, fine 25/- value. Post free.

Radio Micro (Dario) R.C.C. Unit, 4 terminals, all enclosed **5/6**

Double Reading (0-6, 0-120) Voltmeters for H.T. and L.T. A very special offer... **5/11** Post 6d.

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N. & K. Pattern Lightweight, Grand value, 4,000 ohms... **5/6** Post 6d.

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"Hegra" Cone Units, with fitting at back for Cabinet... **9/6** Post 6d.

Ormond Latest On-Off Switch, a beautiful job... **1/3** Post 3d.

S.L.F. Variable Condensers, ebonite ends -0005, -0003, a really wonderful offer. Each **2/11** Post 6d.

Lissen Electrical Pick-off, the finest at the price. Without adapter, 15/- With adapter, **16/6** Post free.

Triotron Valves (latest). Power 6/3, G.P. 4/3. (20/- worth free).

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SPECIAL LINES FOR CALLERS ONLY (as supplies limited)
16 by 8 by 9 in. Oak 8/11 (Radiano Three)
18 by 7 by 10 in. Oak 12/6 (Mullard)
21 by 7 by 9 Oak 12/6 (Cossor)

Complete with baseboard. These for Callers ONLY.

BRITAIN'S "FAVOURITE 2"

Ebonite Panel 14 by 7 in., -0005 Ormond S.L.F. and S.M. Dial, Igranic 6 ohms, Lissen 2-way, 2 Lotus Valve Holders, -0003 and series clip, 2 meg. Leak, B.T.H. or R.I. and Varley L.F. Transformer, -0005 Fixed, Strip 4 by 2, Eight marked Terminals, G.B. Clips, Two Wander Plugs, Square Wire.
THE ABOVE LOT 45/- nett cash, post free
With Lissen or Telsen Ace L.F. **37/6**

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TECHNICAL NOTES.

(Continued from previous page.)

impedance of the eliminator. It is apt to be more particularly troublesome when the associated amplifier is of the resistance-coupled or impedance-coupled type.

The cause of this low-frequency or motor-boating oscillation may be approximately explained in the following way:

When a signal is being received there will be a varying current flowing in the plate circuits of the various valves. Assuming the amplifier to be transformer-coupled, this varying current flows through the transformer primary of the second amplifying valve. The current flows from plate to filament (that is, the positive current) in the valve, and finally completes its circuit by flowing through the source of high-tension supply. If the H.T. supply is of high internal impedance, the varying current flowing through it will cause a varying voltage across its terminals, and the greater this impedance the greater will be the liability to variation.

Detector Variations.

Now, if the detector is supplied from the same H.T. source, a part of this varying voltage, resulting from the flow of current in the second stage, will be produced across the primary of the first transformer. This varying voltage will be stepped up and impressed upon the grid of the first amplifying valve, when it will appear again, much magnified, in the primary of the second transformer. A further magnification will take place when the cycle is again completed.

The remedy for this condition obviously consists in preventing the interaction. In many cases this may be done by means of proper condensers and resistances, but owing to the peculiarities of individual circuits the correct values and placing of these components may not be easily discovered by the average set user.

Separate Supply for Detector.

It is in some cases well worth while to consider the use of a separate H.T. dry battery for the detector valve (usually this battery need not be more than about 45 or 60 volts), thus isolating the detector plate circuit from the plate circuits of the amplifying valves. Owing to the very small current required by the detector valve, a dry high-tension battery so used will give many months of service. Tests have shown that quite a medium-size H.T. dry battery will give 5,000 milliamp. hours at a discharge rate of even 5 milliamp. for an average of two hours a day. This gives a total of 1,000 hours, which is at least a year of normal service.

Ideal Supply.

Of course, if you use what is after all (in my opinion) the ideal form of H.T. supply, namely an H.T. accumulator, you get not only the very best possible conditions for faithful reproduction, but you have an H.T. supply which is of virtually zero impedance and all "motor-boating" and other troubles vanish. It is true that an H.T. accumulator requires a little attention if it is to be kept at concert pitch; but, in my opinion, there is no source of H.T. supply which, so far as results are concerned, is to be compared with it. For short-wave work, as you know, an H.T. accumulator is practically essential.

RADIO ODDS AND ENDS.

The plans for the electrical plant at Poldhu (the Cornish station which first spanned the Atlantic by wireless), were worked out at University College, London, by Prof. J. A. Fleming.

The Croydon aerodrome employs two wireless operators constantly on duty during the hours of flying.

When an aeroplane asks for its position to be communicated to it, this is done by means of bearings taken by the three wireless stations at Croydon, Lympne, and Pulham.

A magnifying lens mounted close to the tuning dial is of great assistance for short-wave work.

There are nearly forty different types of flash-lamp bulbs now on the market.

PANEL LIGHTING.

When a set is placed in the dark corner of a room, the advantages of a flash-lamp and switch permanently mounted upon the panel and wired across the L.T. battery should not be overlooked.

The humming noise due to electric light or power mains can often be reduced by reversing the windings of either the primary or the secondary of the low-frequency transformer.

The time signals sent out from the Rugby high-power station are used by ships all over the world to correct their chronometers. (The signals are sent out at 6 p.m. and 10 a.m. daily on a wave-length of 18,740 metres.)

Gramophone pick-ups, by means of which music from the record is amplified by the set and reproduced by the loud speaker, are highly successful even with an old gramophone, provided that the sound-box is O.K. and that the turntable is operated by a reliable motor.

SHORT-WAVE RELAYS.

On account of the great success of short-wave relays most of the famous American broadcasting stations, including K D K A, W G Y, W R N Y, W L W, W A A M and W H K, are now broadcasting their programmes on short wave-lengths as well as upon the ordinary wave-length band.

The French are experimenting with short-wave wireless at the bottom of the sea, and tests were recently carried out on a submerged submarine in the Bay of Biscay, good strong signals being picked up by amateurs in this country when the vessel was submerged.

Difficulty in obtaining smooth reaction control in a short-wave set can usually be overcome by connecting the filament end of the grid leak to the slider of a potentiometer connected across the L.T. leads.

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L. H. Thomas describes "A Pilot for the Short Waves"—a simple heterodyne wave-meter for locating short-wave stations, and C. P. Allinson contributes a valuable article on Moving-Coil Loud Speakers; while Percy W. Harris offers many practical ideas on
"DESIGNING A PORTABLE SET."

Other interesting features include, "Is Your Grid Bias Right?" "Hints for the Handyman," "The Tetrodyne Circuit," "Television Notes of the Month," "Radio Abroad," "Valve Varieties," "A Remedy for Fading," "Operating 3 S W," "Radio and the Gramophone," etc., etc.

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