POPULAR WIRELESS, February 5th, 1927. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

FOUR BLUE PRINTS FOR READERS!

Popular Wireless

Every Thursday PRICE 3d.

No. 244. Vol. X. INCORPORATING "WIRELESS" February 5th, 1927.

2/- Gift FREE!

Some Of The Special Features In This Issue.

HAS NEUTRALISING MISLED US?—By PERCY W. HARRIS, M.I.R.E.

Parallel or Series. Keeping It Secret. Makeshift Valves.

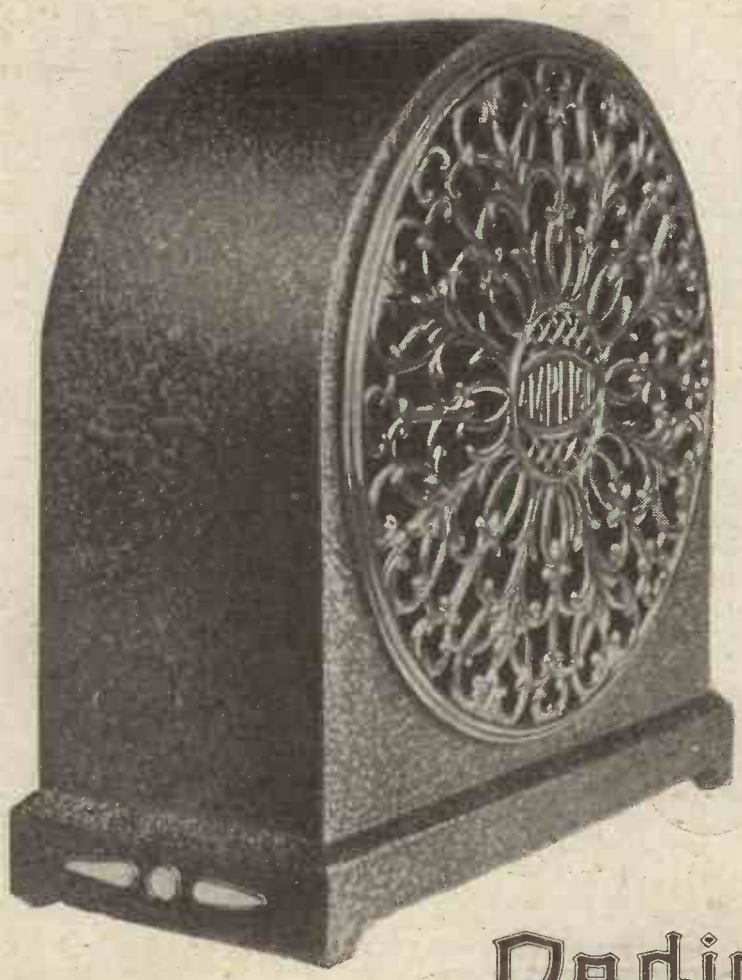
HOW TO BUILD THE "SELECTIVE" THREE.

Some Neutrodyne Troubles—By Capt. H. J. Round, M.I.E.E.

What Constitutes a Loud Speaker?

IS THE TRANSATLANTIC RADIOPHONE A SUCCESS?

Get a good loud speaker!



JUST as it pays to get a good pair of shoes, a good hat and good clothes, so does it pay to get a good loud speaker. It will last, it will look well always, it will give enduring satisfaction, and though it may cost a little more in initial outlay it will prove to be an economical investment in the long run. Good loud speakers, moreover, are not necessarily expensive—the world-famous AMPLION is obtainable in 21 different varieties at prices ranging from 38/- to thirteen guineas and every Amplion carries with it a service guarantee which infallibly ensures satisfaction.

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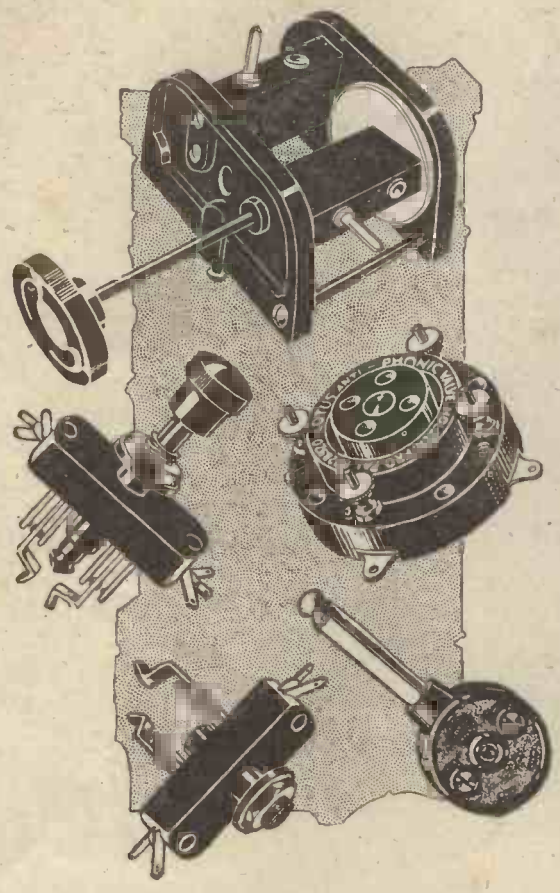

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Holds the heaviest coil securely in position and prevents fading away of volume. Vernier movement reduces speed of moving coil block by eight times. Made for left or right hand.

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Designed to occupy the minimum space, being only 1¼ in. deep. Of the finest Bakelite, they have nickel-silver springs and contacts of pure silver. Soldering contacts can be made to suit any wiring. One-hole fixing.

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Others from 2/- to 3/-.	
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Price, 2/-.

FROM ALL RADIO DEALERS.

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GARNETT, WHITELEY & CO., LTD.
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These three valves are designed to work perfectly together on a small 4v. accumulator or dry battery.

B.5 H. **14/-**
Filament Volts ..... 2·8
Filament Current ..... 0·06 amp
Anode Volts ..... 40 to 120
Amplification Factor ..... 17·5
Impedance ..... 55,000 ohms

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With the introduction of the new B.5.H. Valve, there is now available a complete range of super-efficient valves for 4 volt batteries. The B.5.H. Valve is intended for the H.F. stages, the B.5 for detector and early L.F. stages, and the B.6 for the final L.F. stage.

These three valves provide a combination of incomparable efficiency and economy for multi-valve sets using 4 volt accumulators or dry batteries. A 3 valve set for example, equipped with one of each of the three types would require a *total* filament current of only 0.24 of an ampere, and could be operated for over 80 hours for a single charge on a 4-volt 20 ampere-hour accumulator.

If you use, or wish to use, a 4-volt battery you will get the finest possible reception at the lowest possible running cost by equipping your set with one or more of the valves illustrated above.

B.T.H. VALVES

2704

The British Thomson-Houston Co. Ltd.

The Radio Mail

Published periodically in the interests of Valve Users

A Sensational Valve Test

Cossor Valves hurled from aeroplane to prove that new Kalenised filament is practically unbreakable

When the cat becomes entangled in the leads to your Receiver—writes our Special Correspondent—and brings the outfit crashing to the floor, don't despair You won't find it necessary to replace three or four costly valves—at least not if you are using the ones I saw subjected to a most amazing test at Edgware a week or two ago.

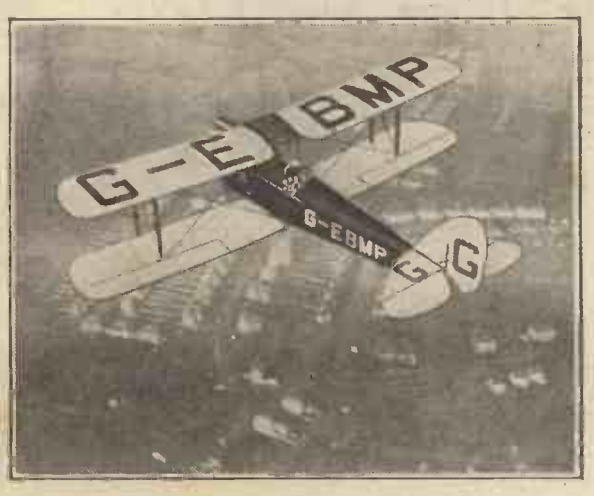
In company with Mr. Sissons Relph, of *Amateur Wireless*, Mr. Wheatley, of *Popular Wireless*, and Mr. Thompson, of *Wireless World*, I was invited to witness an unusual kind of test. It was nothing short of dropping valves from an aeroplane in full flight It seemed a new sort of a joke—one usually reserved for the first of April. I was loth to go—the whole thing appeared to be so incredible What else could one expect to find but a few fragments of broken glass? However the voice on the 'phone was insistent "Please come—the others have promised—and we know you'll only kick yourself afterwards for missing the most thrilling valve test you are ever likely to see" That fixed me! As a journalist I am all out for thrills!

On arrival at Highbury we were duly taken around the works and invited to choose a dozen Stentor Two valves from among a huge stock ready for despatch We were then asked to insert them into the ordinary kind of folding carton and after sealing them to number the boxes for ready identification. I should mention that no cotton wool or corrugated paper was used to protect the valves On arrival at Stag Lane Aerodrome the parcel of valves was handed to Captain Barnard with instructions that they should be thrown overboard at a height of not less than 500 feet. As there was a spare seat in Captain Barnard's "Moth" my friend Mr. Relph, of *Amateur Wireless*, accepted the opportunity of seeing what Edgware looks like from the air.

They climbed into their seats, a mechanic gave a few preliminary turns to the propeller. "Contact," cried Captain Barnard, and with a roar the machine dashed forward. In a few minutes it was back over our heads. "Look out—here's the first one," someone exclaimed, as a small object was seen to be falling rapidly to the ground. There was a general rush to pick up the first valve ever to be thrown out of a 'plane. The box was badly dented, but the seal was intact, and vigorous shaking failed to disclose whether there was anything loose within. "Here's another," was the shout, and glinting in the bright sunlight—tumbling over and over in its mad plunge earthwards was another little blue and yellow box. This time luck was against it. There was an ominous rattle as the carton was shaken—the pilot told us afterwards that this box crashed against the tail 'plane. And so at regular intervals these wonderful little Cossor Valves were showered down upon us. Like the parable "some fell on stony ground and some by the wayside"—three did fall on a concrete road and one landed with a resounding crash upon a corrugated iron roof.

But all—except one—were retrieved and taken—under strict supervision—back to Highbury Mr Thompson, of the *Wireless World* made himself responsible for their safe custody. I don't think that the great Mr Maskelyne himself would have been able to have substituted new valves without Mr Thompson's knowledge!

On arrival at the works, the seals are broken and the valves removed. As we surmised, the one which struck the tailplane is badly smashed And now everyone is keyed up with excitement. One by one the valves are inserted into a socket—a switch is moved, and the needle swings over to say "All's well." *Every filament is intact* It is incredible Even the valve which is smashed also registers a bull's eye. Eleven unbroken filaments out of eleven valves—well might we be proud to think that this amazing test took place in England. Surely British valves are the best in the world. As *Popular Wireless* in their issue of January 8th remarked in commenting upon this test, "It now remains for some manufacturer to agitate a valve in a cocktail-shaker and then try it with a steam-roller!"



The De Havilland "Moth" carrying out the Test

Flashes from the Test

Captain Barnard himself was so sceptical that the aeroplane test would not succeed that he bet a member of the aerodrome ground staff that at least half the valves would be smashed to pieces. Captain Barnard is now half-a-crown poorer!

* * * * *

There is no truth in the rumour that A. C. Cossor, Ltd., are proposing to perform the same test with five hundred valves over Trafalgar Square.

* * * * *

Nor do they propose to utilise this method for delivering valves to their wholesale depots.

* * * * *

In deference to the wishes of the passenger Captain Barnard was earnestly requested not to loop the loop!

* * * * *

After reading details of this test in *Popular Wireless* one man wrote us that as he found a Cossor bright emitter on the refuse heap at the Welsh Harp which gave him good service for two years, he intended searching the aerodrome at Edgware for the missing one. And his name wasn't McPherson either!

How long should Valves last?

—the filament has the last word every time!

In the early days of Broadcasting we were lucky if valves lasted six months. If perchance one gave a whole year's service it was something to be shouted from the house tops. Now science has taken a hand in the game, and has given us a filament which will last for thousands of hours

Interviewed at the works of A. C Cossor, Ltd., the Chief Research Engineer gave our representative some details of this new Kalenised filament. "It is fundamentally different," he said, "to other types of filament inasmuch as it operates practically without heat. In the past the chief trouble with filaments has always been their brittleness due to the constant contraction and expansion whenever the current is switched on and off. Because the Kalenised filament never contracts or expands its nature does not alter. It is as pliable after 2,500 hours as on the first day it is made."

"Then," presumably," asked our representative, "it does not lose its emission." "No," he answered, "because the electron stream is given off by the Kalenised layers and not by the metal core itself. The metal core serves merely as a conductor of electricity There is another point, too, which ought not to be forgotten. And that is the wide latitude of working voltages enjoyed by this marvellous new filament. A year or two ago every receiving set was embellished with a rheostat knob for every valve. Delicate filament control became a fad Non-technical people were scared off wireless—they couldn't understand the array of knobs. Now we are much more sensible. Any receiver fitted with Cossor Valves needs only an On-and-Off Switch. It doesn't require any variable rheostats—the Kalenised filament in a Cossor 2-volt Dull Emitter starts giving off its electron emission at 1.2 volts and reaches its maximum at 1.8 volts. Even a fully charged accumulator won't harm it—although of course it won't give any louder results."

The Curse of Microphonic Noises

Science discovers a new remedy

There is nothing more irritating than to use a valve afflicted with microphonic noises. Let anyone walk across the room—or touch the table on which the receiver is placed—and immediately there is a warning "Ping!" from the loud speaker Microphonic noises can come from a variety of causes—but there are two principal ones. A very common reason is a badly designed mounting system within the valve. Sometimes the grid—or the anode for that matter—is not sufficiently rigid. It can move—very imperceptibly, of course, when any vibrations are set up. But generally the fault lies with the filament. Stretched taut as a violin string, the average filament is very apt to vibrate—and once set in motion these tiny vibrations, unseen of course by the human eye, continue for quite a long time

Now a new method of filament manufacture has been discovered which ends this curse. It is embodied in the new Cossor Kalenised filament.

Imagine, if you will, a glass tumbler struck a sharp blow by a spoon A clear musical note is set up due to the vibrations of its edge. But bind it with string or paper tape and what happens? It is as silent as the grave. The vibrations are damped out. This simple parallel will show why the Cossor Kalenised filament is free from all suspicion of microphonic noises.

The wire core is surrounded by kalenised layers of non-metallic material. The vibrations are smothered at their source.

This exclusive Cossor feature is particularly important in power valves, and it is interesting to note that technical experts have—without a single exception—commented strongly upon the exceptional purity of tone of the new Stentor Power Valves.

Popular Wireless

Incorporating "Wireless."

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RADIO NOTES AND NEWS.

The Human Touch—An Irish Yarn—Valve DX.—Another Kind Offer—"Poor Old Jo(e)"—Night Schools Up-to-date—Weather Reports—The Fleetway 'Flu.

The Human Touch.

THERE is no denying that a fine old squawk has been set up about the abolition by the B.B.C. of nunks and nannies in favour of ordinary ladies and gentlemen in spattees and pullovers. But I am not sobbing my heart out about the murder, either on my own account or that of the youngsters, because I really don't believe that anything like a majority of them care twopence. As for the kids in my house, the only time they will listen to the wireless is when someone wants them to go to bed. Yet I think this gesture of the B.B.C. is destructive of "the human touch" and is therefore a bad sign. (We believe the Uncles and Aunts are shortly to be reinstated.—Ed.)

"Fascimile" Telegraphy.

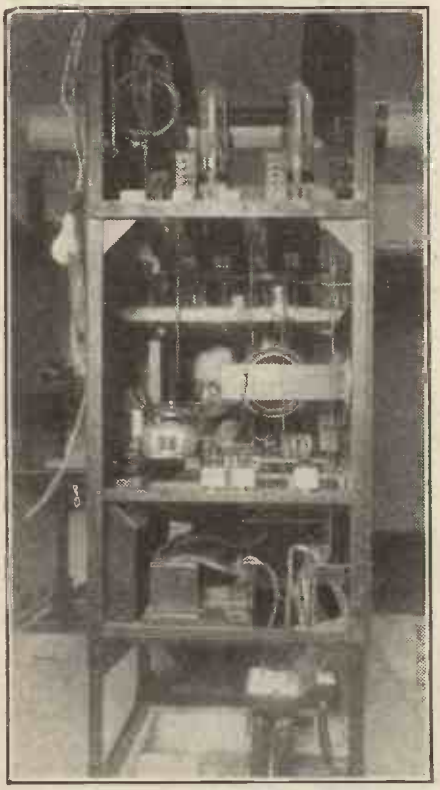
MARCONI'S latest, a system which permits the transmission of telegrams in facsimile, rather knocks the bloom off the joke about the old lady who would not accept a telegram as genuine, on the score that it was not in her son's handwriting. That reminds me of This Week's Bonehead, who wouldn't believe his loud speaker because, he said, "Electricity can't have a Yorkshire accent and a sniff."

An Irish Yarn.

ALL you fellows who have been doing critical work with crystals might as well put up the shutters, for you cannot beat this. The Rev. Dr. Ellison, of Armagh Observatory, writes to a Belfast newspaper and states that on January 3rd, about noon, the Observatory sent 2,500 feet of wire into the air by means of a kite, and "earthed" it. When it was "earthed" it was connected also to a seven-and-sixpenny crystal receiver, and "*all the North American radio stations were heard with as much ease and loudness as Daventry would be on a set of several valves.*"

Benjamin Franklin, the Radio Fan.

SO now we know that all the B.B.C. has to do in order to give successful transatlantic relays is to get a crystal set and tie it to an "earthed" wire 2,500 feet



Part of the transmitting gear at the station WRNY, New York.

long, with most of the feet up in the air. The learned doctor gravely continues; "The experiment was, of course, a repetition of that of Benjamin Franklin a century and a half ago, when he drew down lightning from a thunder cloud." Guess and calculate that the American broadcasting people will be tickled to death to know that their programmes sounded like Ben's lightning. Knights of the C.W. are hereby advised that they need not in future report any "pick ups" nearer than Japan. I can't chronicle such small beer in these columns (Ha !).

An Interesting Hint.

THE reader who sent me the cutting from Belfast, and whose superhuman restraint in refraining from comment thereon I admire, tells me that he made the "wave-trap" described in "P.W." for January 8th, and takes off his hat to it. He adds that by turning the switch to the third position and inserting a "permanent" crystal and a pair of 'phones between the terminals E1 and E2 a very useful receiver results, and the valve batteries can be cut out during S.B. transmissions, thus saving current without removing the trap from the set proper when anything specially good is being broadcast by the local.

Transmitting Note.

MR. R. H. LAUDERDALE announces that he is now working telephony and C.W. on 170 metres and 45 metres; call sign G 2 D L, and would welcome reports sent to 3, High Street, Penge, London, S.E.

Mr. C. O. Jervis, 59, Kingsdown Road, Leytonstone, E.11, reports that he has heard 5 O N Wanstead at 11.30 a.m. and 7 p.m. on January 16th. No doubt 5 O N will be glad to know his signals got so far and finally escaped from Mr. Jervis' loud speaker and 2-valve set.

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

Valve DX.

THE first reader to report long-distance broadcast reception, following my recent query, is F. H. B., of Shepherdswell, near Dover. With a 5-valve set on January 16th (2.50 a.m.) he got strong signals from W I A B (Miami, Florida), and the racket continued till he closed down at 5.15 a.m. Yeh! Not so bad. *And* the next, please!

Another Kind Offer.

MR. P. D. WALTERS, 58, Carlton Hill, St. John's Wood, N.W.8, has heaps of back numbers of "P.W.," dating back to No. 1, and will be pleased to send not more than two copies each to persons who will enclose sufficient postage, stating volumes and numbers required. The offer applies only to numbers prior to December 1, 1926.

Rough on W.S.

A WRITER of a letter to the daily Press says that "the only plays that are effective over the wireless are the classics. Comedy is completely lost." Surely this gentleman, notwithstanding he writes from the Forum Club, is a candidate for some of the educational talks! Am I dreaming, or did that second-rate author, Shakespeare, write some excellent comedies? And is not "She Stoops to Conquer" a classic? Moreover, I am doubtful whether we could not call even "Charley's Aunt" a classic.

"Poor Old Jo(e)."

SO the Jo'burg broadcasting station has had to close down for lack of funds. This is, I believe, the first tragedy of its kind. Even broadcasting cannot live without money, and the Jo'burgers seem to have forgotten the fact. That's the worst of "diamond rushes," they take folks' minds off the joys of jazz and the uplift of the ukulele. But—perhaps the burghers are not so patient as we are on a diet of chamber music, keyboard exercises and compulsory education.

Night Schools Up To Date.

AND talking of that, what about this?—as the ostrich said to the hummingbird who bragged about its egg. I have before me two dainty little booklets issued by the B.B.C.—goodness knows why they do these things. One is all about its transmissions to schools, and I note therefrom that on March 7th some of our young hopefuls will have their education interrupted by a talk on "The Mangrove Swamps of the Rufiji Delta." This, mark you, to a pack of young rascals who probably couldn't tell you the postal rates to Spain and Japan, or draw a map of Lancashire.

The other is a programme of the talks for *us*, up to April. Oh, joy! "How Foreign Offices and Embassies Work," is one subject. The answer is, "Eleven till three." Another is "Some Architectural Problems of To-day." How to fit the garage in without pushing the fowl-house over. What?

A Surprising Pump.

AT last month's exhibition at the Physical Society, Mullard's had an extremely interesting show, but, valves apart, the best item was the wonderful Holweck Molecular Pump, which is used for obtaining the high degree of vacuum required for valves. This gadget runs at a speed of 4,000 revs. per minute, and the clearance between the rotor and the stator is only *1·5-thousandths of an inch*. Still, that's pretty generous for molecules, anyway. The degree of exhaustion obtainable with this pump is 0·000015 mm. The amount of air left in the valve after an interview of that nature is about half that to be had in a third-class smoker on a Cup-tie day.

"Our Committee."

THE most hopeful sign I have seen since January 1st is the formation by the B.B.C. of an advisory committee consisting of representatives of the chief "listeners'" organisations. It shows that, at any rate, the B.B.C. "means willing." But it is to be hoped that the committee is, in the average, of a good medium-brow quality. Just suppose it were packed with Chamber Music Charlies!

SHORT WAVES

Broadcasting Query.
Is listening lessening?—"Sunday Pictorial."

* * *

We listened some time to a programme drawn up by the blind, but came to the conclusion that it was really better suited to the deaf, and switched off.—"Yorkshire Telegraph and Star."

* * *

Sir Walford Davies' suggestion that the angels may hear our broadcast programmes seems a complete answer to the question, "O Death, where is thy sting?"—"Star."

* * *

"How much do you charge for your rooms?"
"From ten pounds per month up."
"But I'm only a poor Scotch broadcaster."
"In that case it's ten pounds per month down."—"South African Wireless Weekly."

* * *

When constructing a wireless set, the thing to remember is that it is the relative connections which need to be got right.—Daily Paper.
Especially if they happen to be rich maiden aunts!

* * *

A well-known singer who was recently broadcasting from the Albert Hall remarked afterwards how successful the concert had been, and asked if her voice had filled the hall. Someone was heard to remark that he was sure it had, for he had seen several people leaving to make room for it.

* * *

Safety First.—The new wireless telephone to New York costs five pounds per minute. Scotsmen with weak hearts are advised to send postcards as usual.—"Sunday Pictorial."

* * *

"Do you believe in auto-suggestion?"
"Is that the system where you keep on repeating, 'Every day I get better and better,' and you get well if you're poorly?"
"That's it."
"Well, I believe in it. Every day for the last three months I've said to myself, 'Some day I'll get a summons for not having a wireless licence,' and sure enough it came yesterday."—"News of the World."

An Athletic Knight.

QUITE naturally, the Scotch newspapers sang more lustily than any others when Mr. Reith, of the B.B.C., was created knight. One of them, in an anthem intended to glorify Scotch brawn (not edible), reminds its readers that Sir J. C. W. Reith once walked from Glasgow, up Ben Lomond and back, all in one day. Splendid! But I'll bet he uses the lift at Savoy Hill. Anyway, why did he walk up Ben Lomond? That's not the way to England. I suppose he found it out on top, and that accounts why he walked back the same day.

Rugby Radio.

NO, not the "white elephant" housed by the Post Office in Warwickshire and which has trumpeted "all over the globe." I refer to the broadcast description of the England and Wales match. It was as tame a bit of oratory as one could hear in a day's march round the Bands of Hope of Golder's Green. I put on an old sweater, pushed the furniture back, and prepared to die of excitement, but it might have been a game of draughts. We must take lessons from America in this particular form of sport reporting.

Weather Reports.

WHAT is the use of the B.B.C. giving us all this jargon of the meteorologist in its weather reports? What the precise significance of a "secondary depression" moving across Iceland in the direction of Yarmouth is, I am left to imagine. Similarly, waves of high or low pressure don't mean much to the ordinary man; weather, to him, means rain, hail, snow, fog, or sunshine, but chiefly rain.

I vote for the plain, unvarnished prophecy, and no camouflage about depressions. The weather supplies the depression.

Revenge by Radio.

I SEE that Professor Low has been receiving letters from people who imagine that they are being persecuted and injured by wireless. I have received at least a dozen such letters during the past ten years, and they are sad or funny according to the way one considers them. The queerest case I know is that of a ship's carpenter, who told me that people in Rio follow him all over the world by radio and blacken his brass buttons by the same means.

They also hit him in the back when he bends down. A clear case of lumbago. However, I know he turns up periodically at Marconi House for a "cure," and he has implicit faith in Senatore Marconi's power to effect that.

The "P.W." Flu.

THE Editor tells me that they are having quite a merry time at the "P.W." offices just now owing to the "mild attack" of 'flu that is visiting this country. Quite a number of the Technical staff are down with it, including Mr. G. P. Kendall and other members of the Queries Department, so p'raps readers will be kind to them if they do not get their replies as promptly as they might during the next week or so.

ARIEL.

IS THE TRANS-ATLANTIC RADIOPHONE A SUCCESS?

By **GORDON SELFRIDGE**
(in an exclusive interview with "ARIEL").

IT seems difficult, indeed, to get anyone to express a concise opinion upon the present and future working of the Trans-atlantic Radiophone. Fortunately, the poor thing hasn't a past as yet, and so is immune from blame on that score. On the whole, prominent business men and others to whom the new service would, if successful, be of the greatest use, do not seem to have been in any tremendous hurry to test it, and out of a dozen kings of commerce whom I approached with the object of getting them to give an account of their chat to the U.S.A., I was surprised to find that not one had yet done so.

The last call I made was upon Mr. Gordon Selfridge. Mr. Selfridge (I thought) is probably the most go-ahead business man in London; Mr. Selfridge is the head of a store that is as well-known in America as it is in this country; furthermore, Mr. Selfridge *is* an American. Who more likely than he to have taken the earliest opportunity of ringing up one of his business friends in the States?

And yet:

"Although I send a great number of cables to America every week," Mr. Selfridge told me, "it has not yet struck me to use this new telephone system."

"But why?" I asked. "Surely to a man like yourself who has to be constantly in touch with the U.S.A., the telephone would be infinitely easier than cabling and, in addition, save you any amount of valuable time. It takes some hours before a reply to a cable you send to America can reach you; on the radiophone you can get your answer at once."

Too Much Time Wasted.

Mr. Selfridge smiled a trifle sardonically.

"You get your answer at once when you ask your question," he said, "but how much time do you lose while you're waiting to put it? Of course, as I say, I've had no actual experience of the service, but I have a shrewd suspicion that it has very much the same vices as other systems of telephone communication.

"Only this morning, for instance, I wanted to ring up Paris. My secretary and myself between us put in a good half-hour's work getting through and, that accomplished, neither my correspondent nor myself could hear what each other said! After shouting in vain at each other for about ten minutes we had to give it up and settle the matter by telegram. Of course, it doesn't necessarily follow, but if it takes

A recent photograph of Gordon Selfridge.

half-an-hour to get through to Paris, which is a matter of hundreds of miles away, what about America, which is thousands?"

"Then you haven't much faith in this new invention?"

"On the contrary," was the reply, "I think it has boundless possibilities. Undoubtedly it is a step in the right direction. America and Britain are the two greatest commercial nations in the world to-day, and for the good of the trade of both it is absolutely essential that we should have some means of instantaneous communication. The present system of cabling is, I admit, somewhat slow, but at least one can get on with other jobs while waiting for a reply, in the sure certainty that that reply will eventually come along. It seems to me you might sit with your ear glued to the telephone for a whole day and then not be any farther forward.

"But, from the very inception of broadcasting, I've been looking to wireless to provide us with some means of quick intercourse, and I believe this radiophone is that means in its very early youth."

"Then," I asked, "what do you suggest will have to be done before the trans-atlantic 'phone becomes a real, practical, everyday proposition? The service may be rather slow in working at the moment, but the remedy for that can be only a matter of time."

Secrecy Essential.

"That's quite true, I grant," answered Mr. Selfridge, "but there are other matters that every business man will take very strongly into account. The question of secrecy is a very important thing indeed. 'Tell the world' is a fine business slogan, but one doesn't necessarily want to follow it all the time. Under the present conditions, while a man is putting through a big contract with someone on the other side, his biggest business rival might 'listen-in' to every word that is being said and get in before him. And that's a risk that very few would care to take. Make the service secret, and you remove one of its greatest drawbacks. And when you have done away with all these obvious faults, the one which looms most important of all in most minds will, I suppose, remove itself."

"And that——"

"——is the question of cost," Mr. Selfridge finished. "Fifteen pounds is a good deal of money to spend on something that may or may not be satisactory when you get it. But, no doubt as the service improves and becomes really efficient—which I am convinced it will—more and more people will use it, with a consequent reduction in the charge for a call. But the question is, can the majority of people afford to try out the radiophone at fifteen pounds a try-out? I don't think they can, and it's a pity, because it looks to me as if the system is more suited to domestic

(*Continued on page* 1400.)

WHAT CONSTITUTES THE IDEAL LOUD SPEAKER?

Are we rapidly approaching the ideal in loud-speaker design? Our contributor is of the opinion that we are, and that, moreover, the ideal will be British made when it does arrive.

By A. J. BOYINGTON.

THE other day I was privileged to hear two of the latest achievements in acoustics. The first was one of the newest gramophones which—to one who still held lively recollections of the old-time phonograph, with its cylindrical records and the nasal travesty of music it produced—was a revelation.

The second shock was provided by one of the latest loud speakers. And here, again, if contrast were needed, one had only to recall the tin-trumpet-and-Brown's-earpiece combination which served one in that capacity for the old Hague concerts. We are indeed progressing rapidly toward the ideal loud speaker.

A Vital Factor.

But what constitutes the ideal? The loud speaker is certainly one of the most important factors in that perfect reproduction—or acoustic synchronisation, as it is sometimes called—for which we are all striving. At the same time, one must admit, it is the single component which usually falls lamentably short of the needs of the occasion. More imitation science is quoted in relation to the loud speaker than in almost any other portion of the radio receiver field, while the most extravagant claims are made even on an amazingly slim foundation.

The loud speaker, in fact, can be regarded as the "neck of the bottle" as far as sound reproduction is concerned. Even assuming that the various functions performed in turn by the transmitter and the receiver are in acoustic synchronisation, if the loud speaker is not also in accord the whole programme is spoiled. It is tantamount to having an opera, with inspired music fitted to a beautiful libretto and staged with most effective settings, sung by incompetent performers—the faulty rendition ruins the whole.

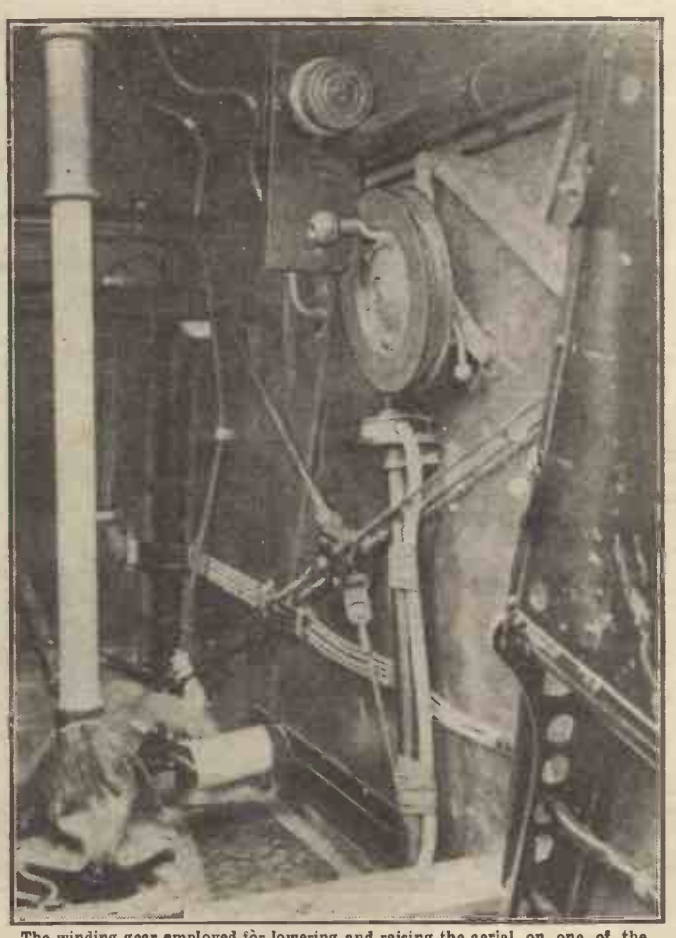
Three Conditions.

The ideal loud speaker, therefore, must fulfil three definite conditions. First, it must be omnitonal: in other words, it must reproduce every tone in the audible scale from the highest to the lowest—from the top shrill note of the soprano or the highest squeak of surprise, to the lowest rumble of the *basso profundo* or the deepest bourdon of the organ.

Secondly, it must be equitonal. It must not show a preference for certain tones or groups of tones whilst arbitrarily suppressing others. Even reproduction over the whole musical scale must be its aim. And lastly, it must have what may be termed sonority, or the quality of giving full volume without distortion—a condition upon which natural reproduction primarily depends.

To return to the first requirement: if the lower tones are missing (which has been the case with the majority of loud speakers until recently), a thin, metallic, and unnatural effect will be produced, highly reminiscent of that happily obsolescent phonograph. On the other hand, if the higher tones are disregarded, speech will develop a booming quality and become unintelligible, the higher-pitched musical instruments will be lost, and the general effect will be of echoing hollowness as though the studio were in a large vault.

The medium register of tones, of course, is rarely—if ever—omitted even in the worst models. Such a defect would be absolutely fatal, as it would cut out all intelligible speech and reduce musical reproduction to a mockery.



The winding gear employed for lowering and raising the aerial on one of the latest British air-liners.

Uneven Reproduction.

A failure to fulfil the second requirement gives rise to a series of somewhat similar faults, though not in so extreme a measure. An instrument which is not equitonal spoils the smooth flow of music. Certain notes are exaggerated to the point when they seem to fairly "pop out" at the listener in a manner at once distracting and inartistic, while the slighted or omitted notes are no less disconcerting in their effects.

Thus, the various notes comprising a single musical chord receive different treatment, and the result is a strange and inharmonious jangle. Or a scale played, say, on the piano, will not hold uniform quality from note to note—some will sound stressed and others softened. In vocal reproductions this means the loss of those delicate intonations and shades which are more than half the charm of speech or song. Evidently, then, the ideal loud speaker must be equitonal.

Suppressed Volume.

Sonority, or volume, does not have such a pronounced influence on natural reproduction as the foregoing. Nevertheless, its good or ill effects are very noticeable. Have you not noticed that reducing the volume below a certain optimum point causes the lower musical notes to drop out? This necessarily upsets the "balance" of the various instruments when an orchestral piece is being rendered, noises in the room appear more pronounced, and a decidedly inferior effect is produced.

If the case is reversed and the loud speaker overloaded with volume, the effect is deafening and oppressive. Every instrument has its happy medium—the point is reached when the volume is neither too low to be pleasantly audible nor so loud as to make ordinary conversation impossible. If too low, the attention of the listeners will wander and interest in the programme will be lost. If too high, the owner of the receiver will either be forced to apologise to his friends for peculiar and unnatural tone effects, or to his neighbours for being a nuisance.

Given an efficient and correctly operated receiver the majority of modern loud speakers approximate very closely to these three essentials. Moreover, it is worthy of note that our own engineers and manufacturers have been responsible for the most outstanding progress towards the ideal instrument. It is a feather in the cap of the home radio industry that the world's finest loud speakers are British-made, and one may venture to predict that when the ideal instrument arrives it will bear the same reassuring label.

The Selective Three

This exceptionally efficient three-valve receiver, specially constructed for "Popular Wireless," will enable constructors to cut out their local station and receive other transmissions without trouble, many stations being heard at good strength on the loud speaker.

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

THERE are many methods adopted by different constructors in efforts to secure the desired degree of selectivity which will enable them to tune in that station "just a little farther away" at the expense of the local station. Any suggestion of distance generally lends to a receiving set a certain air of superiority over those designed purely for the nearby station, since there is always the satisfaction that a choice of programmes is thereby made possible.

It has become more or less a generally accepted fact that one stage at least of high-frequency amplification is necessary if any sort of DX work is desired. This does not necessarily imply that the controls of the receiving set should be many or unduly complicated, and the exercise of a little ingenuity always enables the constructor to overcome possible troubles in this

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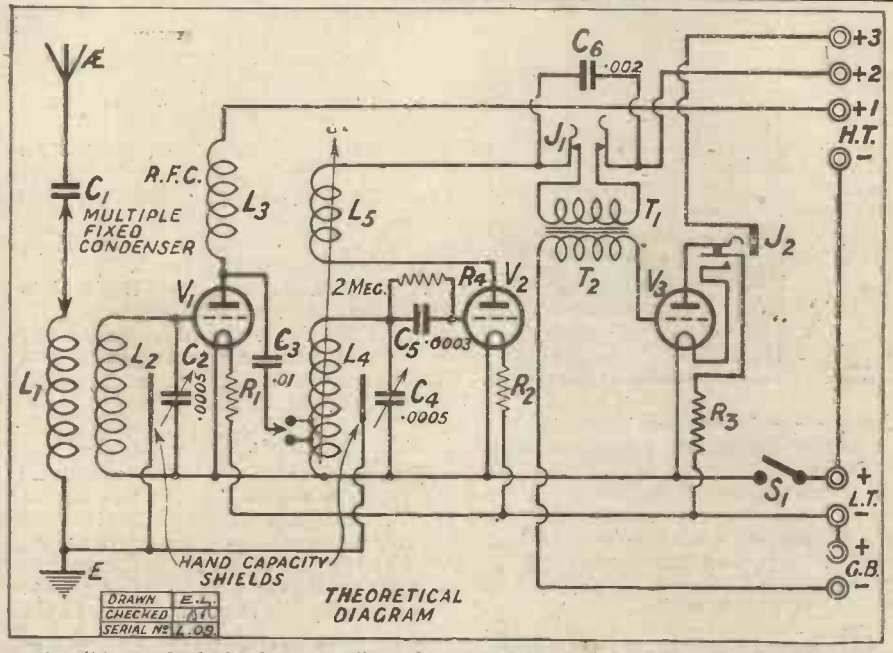
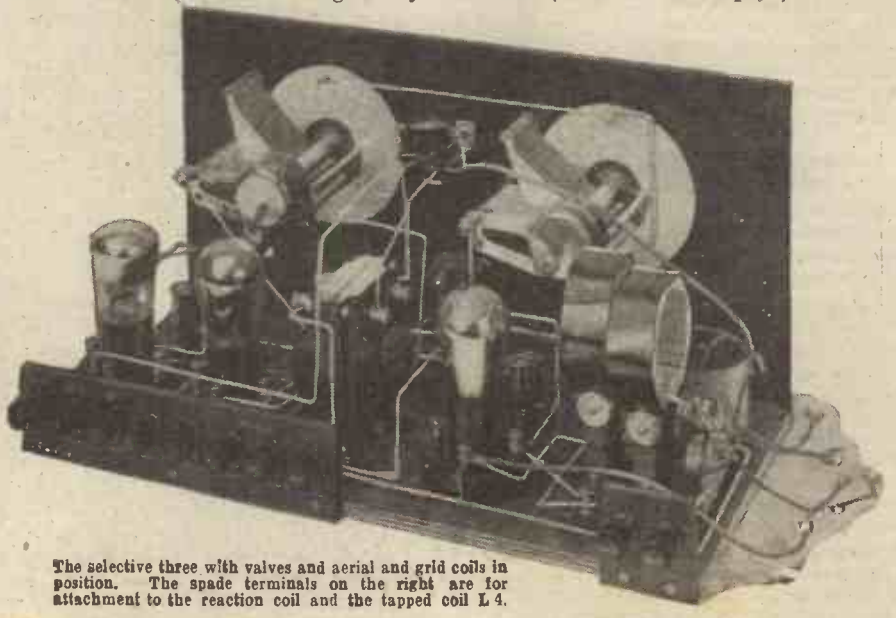


APPARATUS AND COMPONENTS REQUIRED.

- 1 Trolite panel (wavy pattern), 16 x 8 x ¼ in. (F. A. Hughes & Co., Ltd.)
- 1 Mahogany cabinet with base-board to take above panel, and 8 in. deep (The Arteraft Co.) ..
- 2 ·0005 S.L.F. variable condensers with slow-motion friction-drive (Ormond Eng. Co., Ltd.)
- 3 Anti-microphonic valve holders (Igranic Electric Co., Ltd.)
- 1 Two-coil holder (Lotus), (Garnett, Whiteley & Co., Ltd.)
- 1 "Success" H.F. choke (Beard & Fitch, Ltd.)
- 1 L.F. transformer, type AF3 (Ferranti, Ltd.)
- 1 2 meg. "Dumet ohm" grid leak (Dubilier Condenser Co. (1925), Ltd.)
- 1 ·0003 fixed condenser with grid leak clips (Dubilier Condenser Co. (1925), Ltd.)
- 3 Fixed resistors with screw bases (Burndept Wireless, Ltd.)
- 2 Baseboard mounting single coil sockets (Beard & Fitch, Ltd.)
- 1 ·002 fixed condenser (Watmel Wireless Co., Ltd.)
- 1 ·01 fixed condenser (mica) (Telegraph Condenser Co., Ltd.)
- 1 Multiple fixed condenser (·0001 to ·0015) (C. A. Vandervell & Co., Ltd.)
- 1 Double-circuit jack, closed (The Formo Co.)
- 1 Single-circuit jack, open, with filament control (The Formo Co.)
- 2 Plugs (one for telephones and one for loud speaker) (The Formo Co.)
- 10 Insulated terminals marked Aerial, Earth, Grid−, Grid+, L.T.−, L.T.+, H.T.−, H.T.+1, H.T.+2 and H.T.+3 (Belling Lee, Ltd.)
- 2 Ebonite terminal strips, 8 x 2 x ¼ in. and 2 x 2 x ¼ in. (Burne Jones & Co., Ltd.)
- 1 Filament switch (Igranic Electric Co., Ltd.)
- Quantity of Glazite for wiring-up, length of rubber-covered flex, 1 spring clip, 11 spade terminal tags, five ordinary terminals and 2 ebonite strips, 2⅛ x ¾ x ¼ in. and 2⅛ x ¾ x ¼ in.



The selective three with valves and aerial and grid coils in position. The spade terminals on the right are for attachment to the reaction coil and the tapped coil L 4.

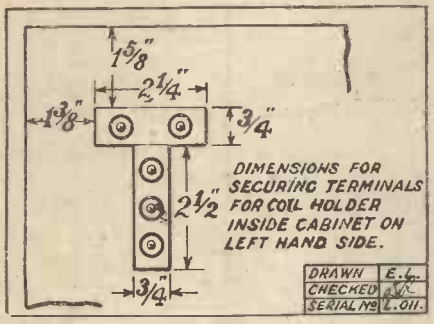
THE SELECTIVE THREE.

(Continued from previous page.)

direction. Too many knobs to handle are apt to make the inexperienced a little dubious as to his capabilities for manipulating the set with a fair measure of success.

Easy to Control.

The three-valve receiver to be described in this article is the outcome of a desire to provide a piece of apparatus which, while retaining a reasonable degree of flexibility, is not difficult to control.



There are only two condenser dials to tune in addition to the magnetic reaction control, the employment of fixed resistors obviating the necessity for adjusting any filament rheostats. By suitably choosing the coils the two condenser readings can be made to match so that the searching for and logging of different broadcasting stations is materially assisted.

A glance at the theoretical diagram of connections will make clear the scheme followed in designing the receiver. The reaction coil L_5 in the anode circuit of the detector valve has a magnetic coupling, which can be varied, with the grid coil L_1 of the same valve. This allows the strength of the received signals to be controlled, and, as is usually the case, the most sensitive condition is just off oscillation point.

To compensate for the constants of different aerials at varying frequencies, the aerial coil L_1 may be tapped, or better still, use should be made of the multiple fixed condenser C_1, and L_1 can then be an ordinary plug-in coil of suitable size.

The Circuit.

The coil L_2 has a tight magnetic coupling with L_1, and is tuned by a ·0005 condenser. The H.T. of V_1 is applied to the anode via a high-frequency choke L_3, and the high-frequency currents pass through the fixed ·01 condenser, C_3, to the coil L_4, which is tapped fairly close to the filament end. Another ·0005 condenser, C_4, tunes this tapped coil, and the signals are rectified by the aid of the usual ·0003 condenser and 2 megohm grid leak.

The primary winding T_1 of the low-frequency transformer T_1 T_2 is connected in the anode circuit of V_2 through the medium of a double-circuit (closed) jack J_1, while in the anode circuit of V_3, the low-frequency amplifying valve, there is a single circuit (open) jack, J_2, with filament control. By this means the telephones can be plugged into J_1, if the use of only two valves is desired, and the third valve is not switched on until the plug is inserted into J_2, the filament circuit of V_3 then being automatically closed.

A ·002 shunting condenser is placed in parallel across the outer springs of J_1, for although with the Ferranti transformer employed a condenser is incorporated in the component it will be necessary when only two valves are in use.

Constructional Details.

Turning attention now to the components and materials required for the construction of this receiver, a complete list is given together with the maker's names. Of course, other components of sound quality, such as are advertised in the columns of this journal, can be employed without detriment to the final results, but care must be given to any possible alteration in lay-out when departures are made from the list.

Ensure correct panel alignment by

The use of a wavy panel greatly enhances the appearance of the set.

mounting the panel and terminal strips against the baseboard edges when the baseboard is inside the cabinet. Screw the necessary components to the baseboard approximately in the positions shown by reference to the photographs and wiring diagram, since the lay-out is quite compact. Now attach the two-coil holder on the left-hand side of the cabinet.

In order to prevent the detachment of the leads to the coil blocks of this holder when withdrawal of the set from its cabinet is desired, I have mounted inside the cabinet, immediately behind the holder, five terminals, as shown in Fig. 1 (*a*), the method of securing the terminals to the ebonite strips being indicated clearly in Fig. 1 (*b*).

Short, flexible leads can now be soldered to the terminal shanks *before* screwing to the side of the cabinet, the right lengths

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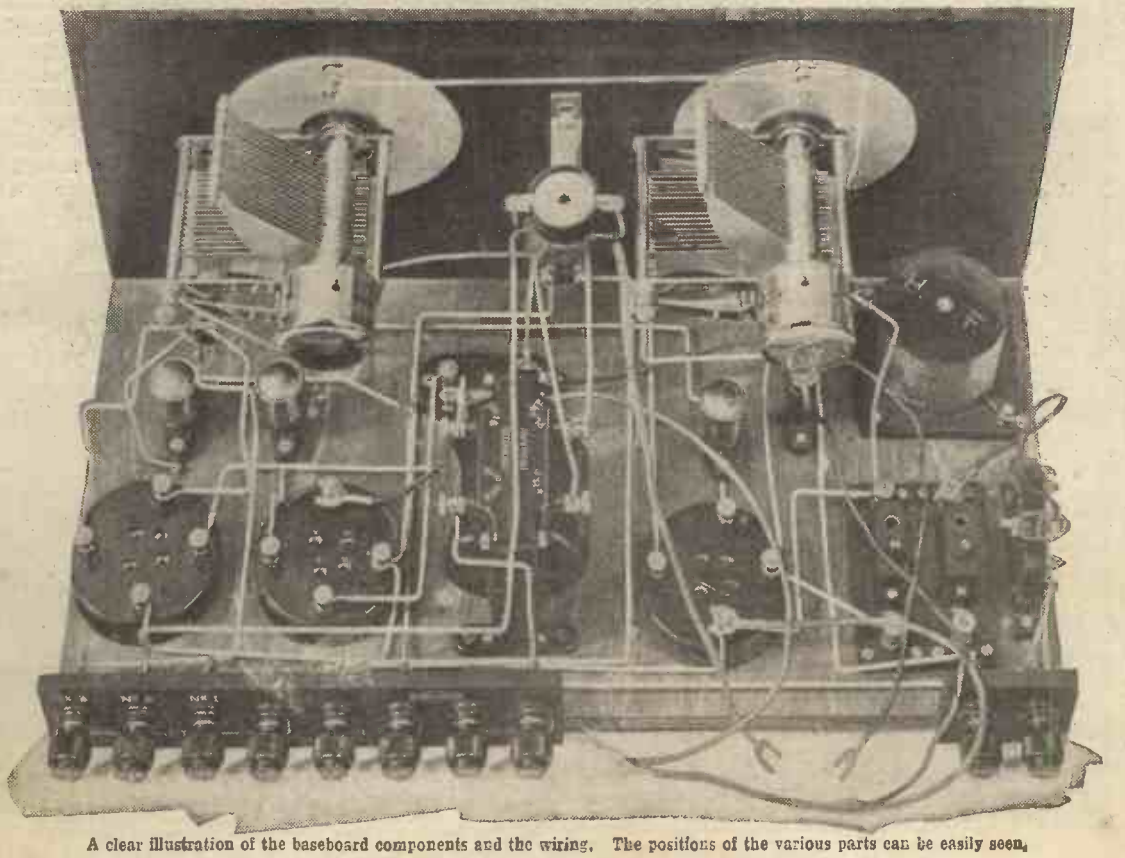

A clear illustration of the baseboard components and the wiring. The positions of the various parts can be easily seen.

THE SELECTIVE THREE.

(Continued from previous page.)

being afterwards cut off and inserted under the screws of each coil block, with one lead for attaching to the tappings on the fixed coil. Flexible leads terminating in spade tags may then be attached to the necessary points on the components as indicated in the wiring diagram. To prevent possible trouble on test, the wiring, on completion, should be carefully checked.

Insert the valves in their respective holders and then test in the usual manner, which is now so familiar to readers of this journal, to see that they light correctly and that the insertion of the separate H.T. plugs into their sockets does not cause any increase in brilliancy when a small voltage is applied.

Necessary Coils.

All is now ready for the aerial test. Since the aerial is not tuned a tapped plug-in coil can be used for L_1, with C_1 cut out of circuit, but it is preferable to use an ordinary plug-in coil and try various capacity values with the series multiple fixed condenser to find the best combination.

On an aerial of average size and efficiency 10 miles north-west of London, the best coil and capacity combinations for the ordinary broadcast band were found to be: C_1 = ·0002, L_1=40, L_2=60 or 75, L_4=60 or 75 Lissen "X" and L_5=50. On the higher wave-lengths satisfactory results were given with C_1=·0004, L_1=200, L_2=250, L_4=250 Lissen "X," and L_5=150, or, of course, the equivalents in lettered coils in both cases.

Many efficient valve combinations are possible with this receiver. The first two valves may be of the high impedance type, such as the H.310, H.512, D.E.2 H.F., A.R. ·06 (red line), etc., while the last valve

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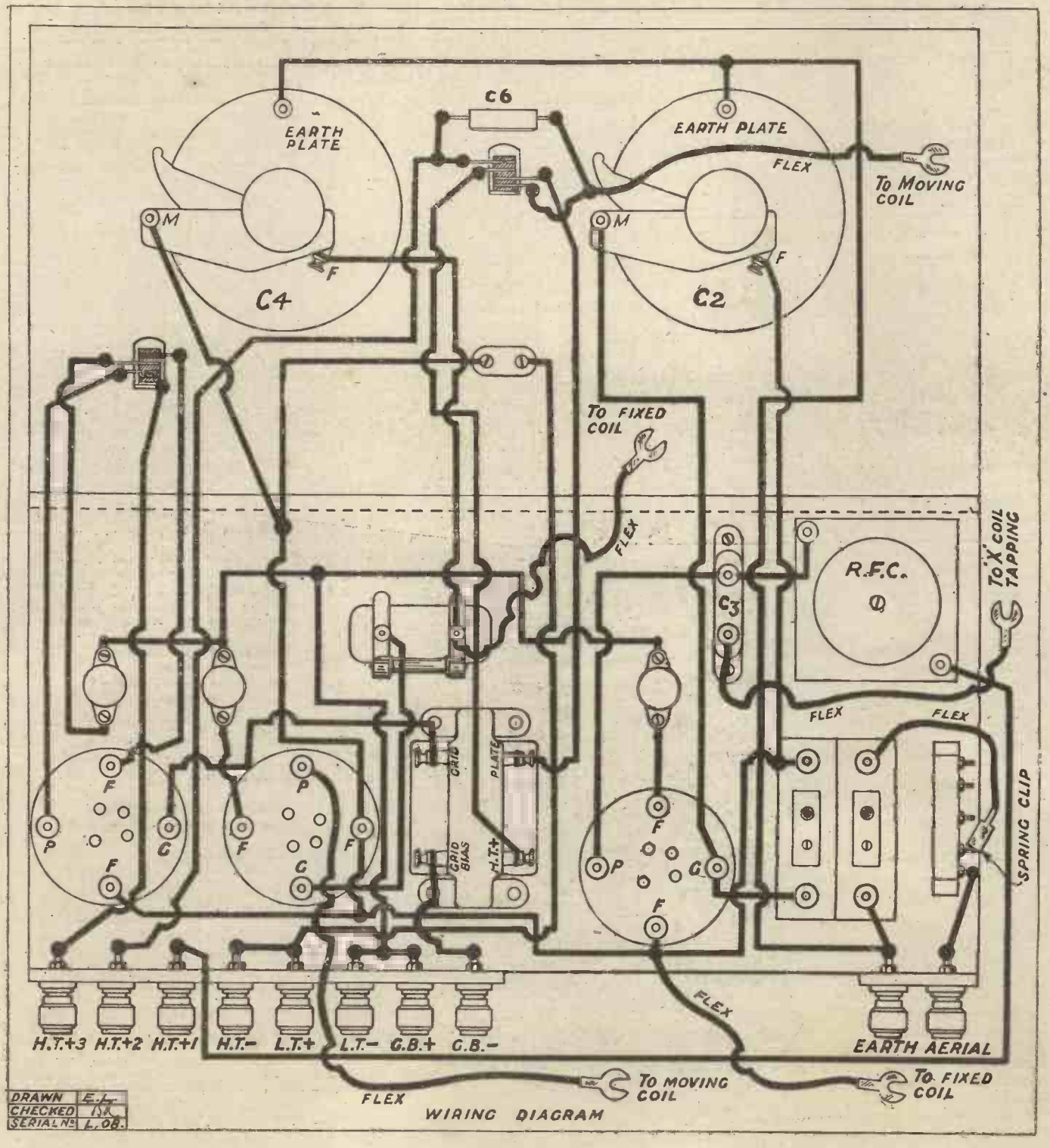

THE SELECTIVE THREE.

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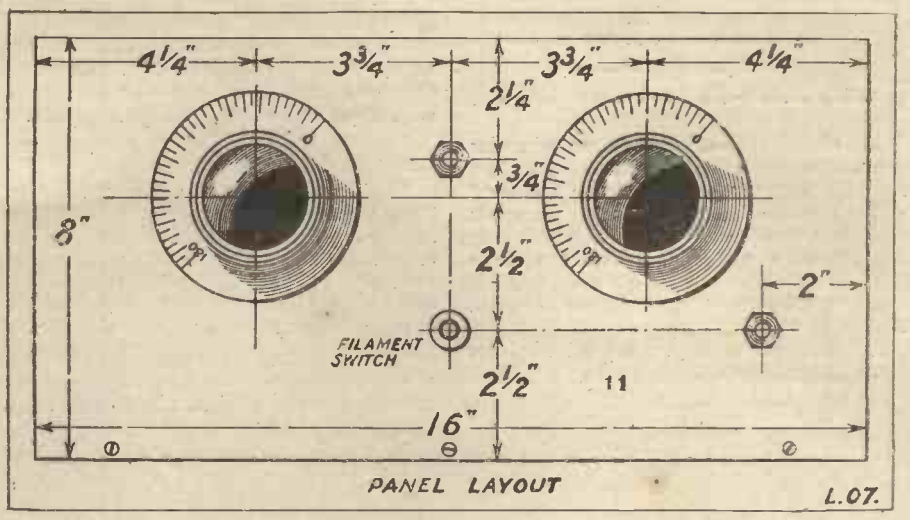
must be of the special L.F. low impedance type typified by P.M.4, L.525, D.E.5, B.4, etc.

As for high-tension values, these should be of the order of 80 to 90 volts for V_1, 40 to 50 volts for V_2, and 100 to 120 volts for V_3, but reference should be made to the valve data sheets to determine the makers' recommendations, especially for the grid-bias voltage on the L.F. valve.

During tests on the receiver, the following stations were among those heard on the loud speaker at moderate to full strength: Newcastle, Dublin, Manchester, Bournemouth, London, Voxhaus, Frankfurt, while on the long-wave side there was Hilversum, Daventry, Radio-Paris and Königswusterhausen. Several other Continentals were heard, both on the telephones and loud speaker, but were unidentified, while 2 LO gave moderate loud-speaker strength with two valves.



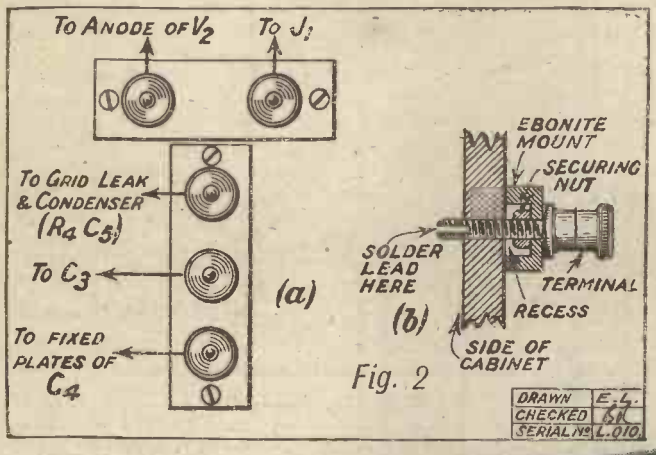


Fig. 2

end of grid leak and condenser and other end of this to fixed plates of C_3.

L.T.+ to one side of switch, the other side of same being joined to moving plates of C_1, and thence to the remaining filament terminals of V_1, V_2 and V_3 valve holders.

P. of V_3 to spring of J_2 and socket of J_2 to H.T.+3.

G. of V_1 to moving plates of C_2, and fixed plates of C_2 to socket of L_2 coil holder and thence to positive filament terminal of V_1 valve holder.

Join together hand-capacity shields of C_2 and C_1 and thence to earth terminal.

Join long spring of J_1 to H.T.+2, spring making contact with this long spring to H.T.+ terminal of transformer, plate terminal of which to spring making contact with short spring of J_1. Join C_6 between short and long springs of J_1.

Join flexible lead between socket of L_1 coil holder and one capacity tag of C_1, one end of the lead terminating in a spade tag and the other in a spring clip.

Join flexible lead with spade tags between remaining side of C_3 and "X" coil tapping terminal of L_4.

Join flexible lead with spade tags between F_1 terminal of V_1, which is joined to moving plates of C_2, and pin terminal of L_4.

Join flexible lead with spade tags between junction of R_1, C_4 and C_5 and socket terminal of L_4.

P. of V_2 to one terminal of L_5 by flexible lead with spade tags, and flexible lead must now be joined between remaining terminal of L_5 and short spring of J_1.

Wire terminals of two-coil holder according to Fig. 2.

POINT-TO-POINT CONNECTIONS.

Join aerial terminal to 000 of C_1 and earth terminal to pin of L_1 coil holder.

Pin of L_2 coil holder to G. of V_1 valve holder.

Join together one end of each fixed resistor R_1, R_2, and R_3, and thence to L.T.— terminal.

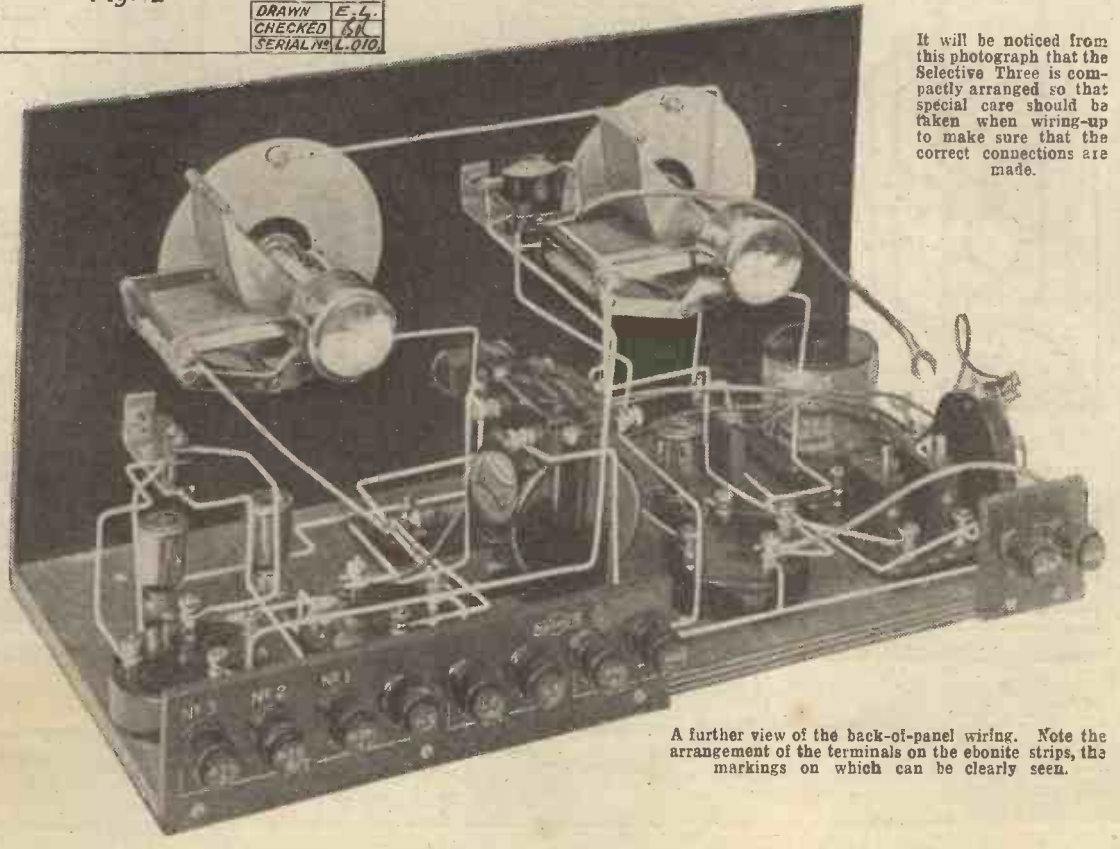
P. of V_1 valve holder to one end of C_3, thence to one end of choke, the other end of choke being taken to H.T.+ 1.

F. of V_1 valve holder to remaining end of R_1, F. of V_2 valve holder to remaining end of R_2, and F. of V_3 valve holder to top lug of jack J_2, the next lug being taken to remaining end of R_3.

L.T.+ to H.T.— and L.T.— to G.B.+.

G.B.— to grid-bias terminal of transformer and grid terminal of same to G. of V_3.

G. of V_2 to one



It will be noticed from this photograph that the Selective Three is compactly arranged so that special care should be taken when wiring-up to make sure that the correct connections are made.

A further view of the back-of-panel wiring. Note the arrangement of the terminals on the ebonite strips, the markings on which can be clearly seen.

SOME NEUTRODYNE TROUBLES.

The generation of what are known as parasitic oscillations in neutralised circuits often causes troubles that are difficult to trace. In this article our contributor explains what happens, and how these faults may be remedied.

By Capt. H. J. ROUND, M.I.E.E.

WHEN an alternating voltage is applied to the grid of a valve an alternating current can be obtained in a circuit attached to the plate of that valve. As is well known, there is a very considerable magnification of energy in this arrangement. It seems at first sight that there should be no limit to the amount of amplification possible with a single valve, because it does not waste energy to charge and discharge the grid of a valve, if there is sufficient grid bias on the valve so that the grid circuit is non-conductive. Of course, actually, the circuit that is attached to the grid of the valve cannot be made without resistance losses in it, and the voltage that is applied to the grid must be considered as being produced at the expense of these losses in the grid circuit, and the true energy magnification of the valve is the ratio of the amount that can be obtained from the plate circuit divided by the amount used up in the grid circuit. Even if this limitation could in some magical way be removed there is another difficulty in the way of getting great magnification. The grid is not completely isolated from the plate, even when the valve filament is switched off. There is a capacity between this grid and plate, so that any alternating energy that is

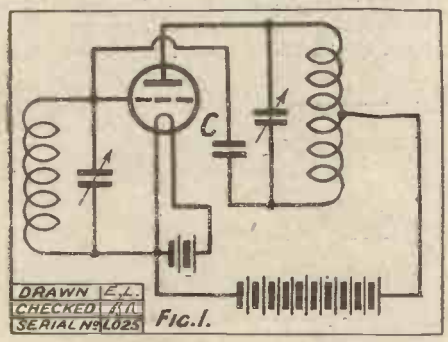


FIG. 1.

in the plate circuit must necessarily have a voltage on the plate, and this voltage will induce current into the grid circuit.

Preventing Oscillation.

I mentioned before that the energy magnification is the ratio of the input to the output and it is easy to see that if the output circuit can put back into the input circuit, through the valve, more energy than was originally put into the input circuit, something curious is going to happen, because, obviously, what is being put back will go through the valve again and be magnified, and the process will go on indefinitely; in fact, as we know now, the valve circuits will oscillate.

Two ways in general have been used for preventing this action happening. One is to never let the valve magnification be big enough to put back in the grid circuit sufficient to make the system oscillate, and

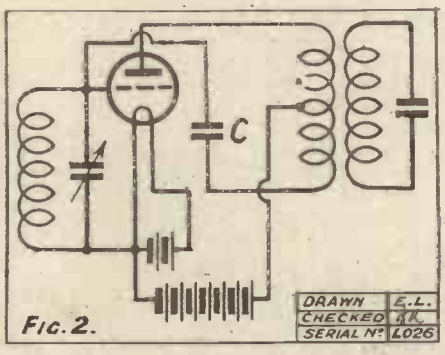


FIG. 2.

this is usually accomplished by putting in the circuits of both grid and plate some form of resistance. It is fairly obvious that on very low frequencies the energy getting back will be small because the condenser is too small, so that we shall not have to put much resistance in our circuits, but as the frequency steadily rises, more and more energy gets passed back, so that one will have to increase the resistance until one arrives at a frequency where the valve will hardly magnify at all, due to the wastage in the resistances.

How Neutrodyning is Obtained.

A more useful way of preventing this back-flow of energy is that known as neutrodyning. The trick involved in this neutrodyning can be considered in this way. The plate circuit of the valve has alternating current in it. Suppose at any moment the plate is swinging positively, this will induce a charge on the grid. If we can now find another place on the plate circuit which at the same moment is swinging negatively and we can apply this negative induction to the grid at the same time as the first positive induction, the two effects will balance out.

The basic circuit for doing this is that shown in Fig. 1, where the plate coil is fed with its high tension at the centre, the valve current flowing through only one half of the coil, and we now have one end of the coil swinging positively while the other is swinging negatively. This negative end can now be used to apply to the grid an opposite potential to the other end of the coil by means of a condenser, C, of the same capacity as that between the grid and the plate. Various alternative methods of doing this balancing can be devised, such as that shown in Fig. 2; but they are, at least superficially, the same thing.

It has recently been found out that such arrangements, although they do not pass back into the grid circuit energy of the frequency we are immediately dealing with —i.e. the frequency to which the circuits are tuned—energy of other frequencies can be passed back, and in consequence such an arrangement may oscillate, although it will not oscillate on the frequency we are tuned to. Fig. 3 shows Fig. 1 redrawn, and Fig. 4a is the same figure with the valve replaced by a small capacity and the batteries removed. It will now be seen that if the two halves of the plate coil oscillate so that both ends are positive at the same moment, then it is possible for energy to flow back to the grid circuit and in consequence oscillation may take place, particularly if the grid circuit is made up in the same split way as the plate circuit, as is liable to happen when one is cascading two or three valves, as in Fig. 5. The period of these oscillations will be very high and care has to be taken, in neutrodyne circuits, particularly with three or more high-frequency stages, to prevent the energy flowing back in this way.

Astatic Coils.

Two methods have been adopted to prevent this trouble occurring; one method is to make the grid circuit and the plate circuit in such a way that although their natural periods are the same for the wave-length we are dealing with, for these short waves their natural periods are very different indeed, and Fig. 3 is nearer this than Fig. 5. The original Hazeltine neutrodyne adopts this method, whether accidentally or not, and I have used this idea in various receivers, particularly in the Straight Eight, where the coils between the valves

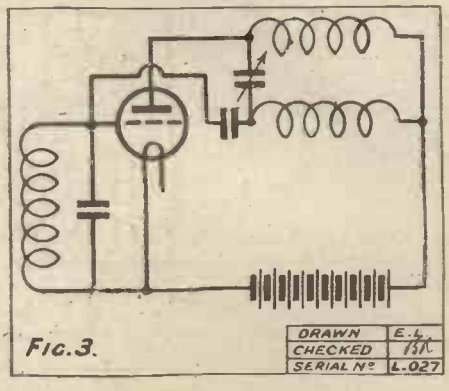


FIG. 3.

are as shown in Fig. 6. The circuit in Fig. 5 would be very liable to produce short-wave oscillation, and actually this does happen if the correct precautions are not taken. Adopting this idea of making the wave-

(*Continued on next page.*)

SOME NEUTRODYNE TROUBLES.

(Continued from previous page.)

lengths of the circuits very different from one other, I arrange that the split coils are wound alternately in different ways, and the way I most generally use is to wind a coil, say, quite normally, and tapped in the centre, and the second coil I wind the two

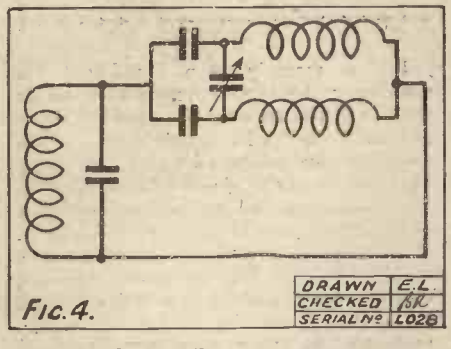


FIG. 4.

halves on the spindle in the opposite sense. The inductances of the coils for the normal wave are arranged to be equal, but it will easily be seen that for short wave production the astatic and non-astatic coils will be of different inductance.

Stabilising Resistances.

Another method, due to Mr. G. W. Wright, is as shown in Fig. 6, where damping resistances are inserted in the grid circuits in such a way as to damp very seriously the short-wave oscillating circuit. These resistances are quite possible to arrange so that there is practically no loss on the normal wave-length being used. Various other ways, no doubt, can be found of preventing these parasitic oscillations, but they will, I think, depend upon one of these two principles.

It is sometimes very hard to trace out these short-wave oscillations when one is building up a receiver, as the effect of them is very often merely to weaken one's general reception, and one tends to look for trouble in valves or batteries rather than the correct place; but I have found that by placing a finger on various terminals when tuned in to a station, a terminal can be found which prevents the oscillation when touched, and the normal signals being received will strengthen up very greatly. This test can be used to find out if the trouble is occurring.

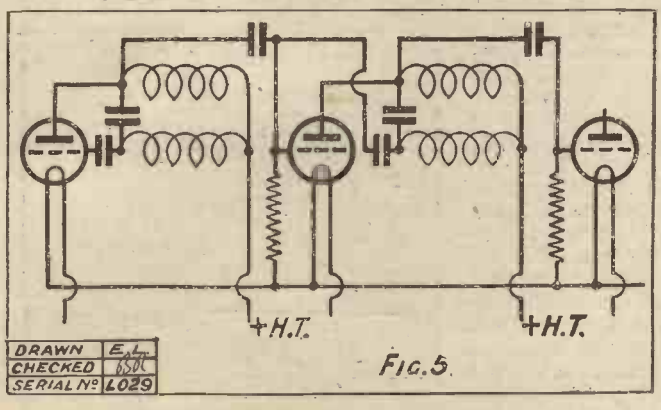


FIG. 5.

Sometimes, however, the short-wave oscillations occur in a modulated way, modulated as a sort of squeak, and they can then be very easily recognised. Tendencies to oscillate on other wave-lengths occur in transmitting circuits as well as in receivers. I can well remember the trouble I had a few years ago at Carnarvon when paralleling fifty power valves. Although all my circuits were tuned to 14,000 metres the system refused to oscillate at any other wave-length than 95 metres, usually with serious damage to a valve every time it happened. In this case the reason for the oscillation was that with such a large number of valves in parallel the whole system could oscillate, some of the plates of the valves going negative and others going positive, the wave-length being decided by the busbar system. I have actually heard of a wave-length as low as five metres being produced in this way. The method used to overcome this trouble was to insert damping resistances in the correct places, thus lessening the tendency to oscillate.

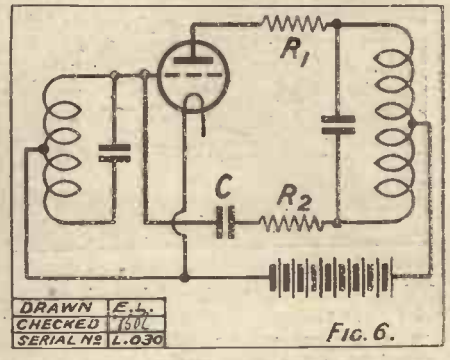
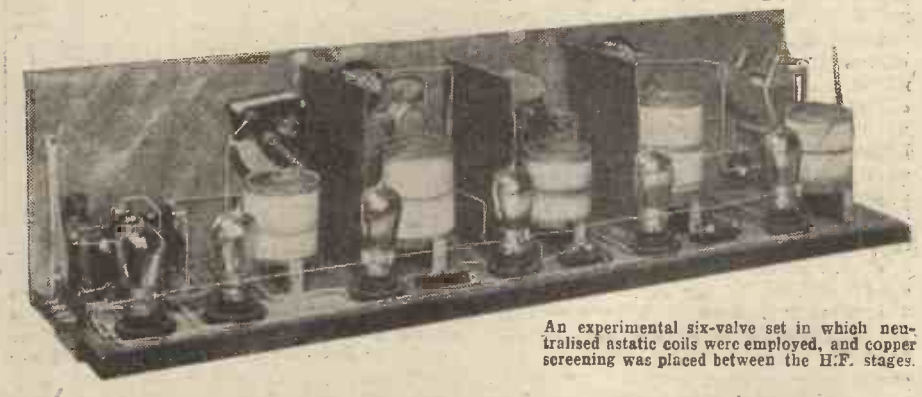


FIG. 6.



An experimental six-valve set in which neutralised astatic coils were employed, and copper screening was placed between the H.F. stages.

IMPROVED 'PHONE TAGS

By P. C. T.

ALTHOUGH the positive lead on most good makes of 'phones is marked distinctively, it is surprising how often the leads are connected the wrong way round on a receiving set. This is either done by accident or through ignorance, and the result is that the 'phones become less sensitive, due to the magnets being demagnetised.

Making Sure.

On a crystal set it is of little importance how the 'phones are connected, but with a valve receiver it is essential that the positive lead of 'phone or loud speaker should be connected to H.T. positive when there is no output filter circuit.

To make sure of always connecting the 'phones the right way to a receiver the positive lead should be fixed to a valve leg and the negative to a valve socket. The 'phone terminals on the set should then be replaced by a valve socket and valve leg for positive and negative terminals respectively.

If two or more 'phones are used it is simplicity itself to connect them in series. A neat way of fixing valve leg and socket to 'phone tags is to obtain pieces of brass tubing ¾ in. long and tap one end of each for a distance of ¼ in. to take the thread, generally 4 B.A., of the valve leg and socket, which are cut off to ¼ in. A small hole is then drilled and tapped in the side of the tubing to take a grub screw, which when screwed home holds the 'phone tag.

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TECHNICAL NOTES.

A Weekly Feature Conducted by

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

THE old argument about the so-called Heaviside layer seems to be as far from being concluded as ever. Some new experiments have lately been carried out by the United States Department of Scientific Research in connection with polarisation in long-wave transmission. It will be recalled that a considerable amount of work was recently done on the polarisation of the shorter waves by Dr. Alexanderson, and these experiments have now been extended to the longer waves up to 15,000 metres. It has been found that the reflection from the Heaviside layer is by no means so simple a matter as has usually been thought.

A plane-polarised wave striking the Heaviside layer may, in certain circumstances, be transformed from a plane-polarised wave to an elliptically-polarised wave, this being, of course, due to the presence of two components out of phase. If the usual direction-finding apparatus be used for the reception of the wave polarised in this way, indeterminate readings will be obtained, and it is now believed that this gives the effect known as "night variation" in bearings. The effect is more particularly pronounced at sunset, but it is also troublesome throughout the night, and during the winter months it persists even during the daytime.

Sensitivity and Selectivity.

It is not commonly realised that the selectivity of a receiving set is affected not only by the dimensions and other qualities of the aerial, but also by those of the earth lead.

The length of the earth lead has an influence, as well as the type and thickness of wire used.

It is preferable to use thick, stranded wire, and it has sometimes been found, in practice, that it is better to insulate this wire up to the point at which it enters the ground. This, at any rate, is the belief of many experimenters, although it is rather difficult to see what object can be served by insulating an earthed wire. It is conceivable that slight potential variations may find their way to the wire; but, personally, I am inclined to think that, provided the wire is sufficiently thick for the purpose, it is immaterial whether it is insulated or not.

Talking about selectivity, it is often believed that the longer the aerial the greater the receptive efficiency of the set. This, however, may be—and is frequently—quite a misapprehension. If the wave-length received is above 1,000 metres, it is reasonably correct to assume that greater signal strength will be obtained with a longer aerial. Having regard, however, to the fact that the wave-lengths used in broadcasting are usually between 300 and 500 metres, it may be that a long aerial may bring with it important disadvantages.

In general, it will be found that for the reception of broadcast an aerial of about 40 to 60 ft. in length gives the best results. Somewhat greater lengths may give greater signal strength, but this advantage will be obtained at the expense of selectivity; whilst if the aerial be reduced to 20 or 30 ft., an increase in selectivity will be obtained but at the expense of signal strength. An all-round length of about 50 to 60 ft. will usually be found to give good signal strength with a fair measure of selectivity.

Short-Wave Valves.

With the increasing attention which is being devoted to short-wave work—I mean, between, say, 10 and 50 metres—it seems likely that there will be forthcoming a supply of valves specially designed to operate at these low wave-lengths. So far, the average short-wave experimenter has had to rely upon the smaller transmitting valves which are already on the market, but here he has to contend with the fact that the valves were never designed for use at very high frequencies.

It would seem, however, that quite a useful market is now arising for small-power valves specially designed for short-wave work, and therefore the short-wave experimenter may look forward to being adequately catered for in this respect.

Microphone Amplifiers.

Experimenters who use microphone amplifiers are sometimes in doubt as to the type of transformer which should be used. Of course, a great deal depends upon the circumstances in any particular case; but, in general, it is not sufficient to use an ordinary low-frequency inter-valve transformer. It will be found that the impedance of the primary is too high, and the step-up ratio of the transformer is too low. What is usually required with a microphone is a transformer having a fairly low primary impedance and a fairly high step-up ratio.

* * *

An interesting experiment is reported from Guatemala, where a farmer who happens, also, to be a wireless enthusiast connected an aerial to a lime-fruit tree which was old and regarded as practically useless, with the result that the tree was rejuvenated and bore fruit exactly as it had done in its palmy days. This result was attributed to the fact that the aerial served as a path for atmospheric electrical discharges. It has long been known that frequent slight electrical discharges will sometimes have the effect of stimulating the growth of living plants, and systems of so-called "electro-culture" have many times been tried. It has often been thought that the electro-culture has been attended with success, but, owing to the many other conditions which influence the growth of a tree or a plant, it has been difficult to ascribe any result obtained to any particular factor.

Definite Results?

In the experiments with the lime-fruit tree (and other experiments were tried, using several "aerials" attached to different parts of the tree) the conditions were so governed that it was possible to ascertain that the results were due to the electrical stimulation of the tree.

* * *

A curious application of a wireless receiver has been made by one of the United States power companies, who have used a receiving set for the purpose of locating a break in a power cable. For this purpose a super-sensitive receiver is employed, using a loop as the collector of energy, and this is carried in a motor-car along the track of the cable which is under examination. It is found to be a very simple matter to locate the fracture in the cable (even though the cable may be underground) owing to the stray noises picked up by the receiver.

* * *

A well-known member of the Institute of Radio Engineers has carried out an elaborate series of tests, by means of a cathode

(*Continued on page* 1399.)

A recent photograph of Dr. J. H. T. Roberts, our chief consultant.

PARALLEL OR SERIES?

A simple and interesting explanation of two important terms.

By G. V. DOWDING, Grad.I.E.E.
(Technical Editor.)

THE easiest way of explaining the meanings of the terms series and parallel to anyone not too well acquainted with the principles of electricity is as follows: Two components connected up in series are so joined together that the current flows through each one in turn; when two components are connected in parallel two paths are offered to the current and this divides and flows through each component simultaneously. There are objections to these explanations, but we will ruthlessly over-ride these by ignoring them in this article!

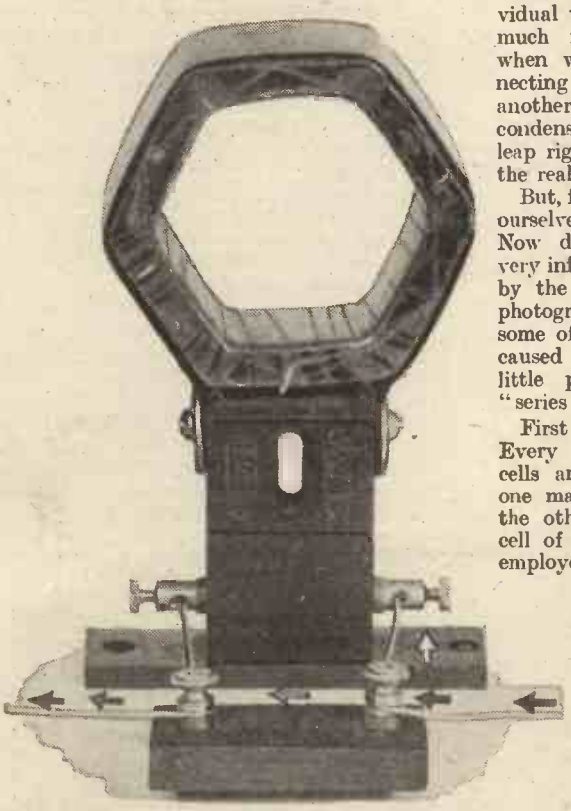


Fig. 1.—A fixed condenser connected in parallel with a plug-in coil.

In Fig. 2 we show a fixed condenser connected in series with an H.F. choke, while Fig. 1 depicts a fixed condenser joined up in parallel with a coil.

Now, unfortunately, it so happens that the effects of series and parallel connections are not always the same. In some cases the effect of placing things in parallel results in a simple addition of individual values, but in others something much more complex happens. And when we confuse the issue by connecting different components to one another such as when we join a fixed condenser across an H.F. choke, we leap right from the elementary class to the real technical institute!

But, for the time being, we will confine ourselves to components of a kind. Now diagrams and drawings can be very informative, but we feel sure that by the means of the accompanying photographs we will be able to clear up some of those points which may have caused at least some of our readers a little perplexity in connection with "series" and "parallel."

First of all, let us take batteries. Every battery contains a number of cells and each cell has two terminals, one marked positive (plus or +), and the other negative (minus or −). A cell of the Leclanché type, such as is employed in dry batteries used for H.T. or grid bias purposes, will have a voltage of approximately 1½ volts, while an accumulator cell will have a voltage of approximately 2 volts. The capacity of either type will vary in accordance with the size of its elements. When the cells of a battery are connected in series the resultant capacity will be but the capacity of one cell, but the voltage will be that of one cell multiplied by the number of cells connected in series. Thus, 10 1½-volt cells, connected in series, will provide a voltage of 15 volts.

The same number of cells connected in parallel will provide but the voltage of one cell with the capacity of 10. See Fig. 3, which shows a number of accumulator cells connected up both in series and parallel. In this case, remember that the voltage of each individual cell is 2 volts. All very simple, is it not? But we wonder how many listeners employ 4-volt accumulators to run 2-volt valves, wasting in the process many valuable ampere hours of capacity in overcoming the wasteful resistances of high value filament rheostats. Obviously, if the two 2-volt cells of similar sizes, which go to form a 4-volt accumulator, were connected in parallel instead of series, double the capacity would be available, although only the 2 volts of pressure could be obtained.

"The Weakest Link."

But what happens when accumulator cells of different sizes are used together? Supposing we have one cell marked "20 ampere hours" and another "40 ampere hours." These two joined in parallel give 2 volts with a capacity of 60 ampere hours; but when they are connected in series 4 volts pressure is available, although the effective capacity will be only the capacity of the smaller cell, 20 ampere hours. This should be very carefully noted. And when a number of cells of different sizes are connected in series the resultant capacity is always the capacity of the smallest cell. Without enlarging on the point unnecessarily, we can just add that a number of cells in series can be liked to a chain, the strength of which will be the strength of

(Continued on next page.)

Fig. 2.—A fixed condenser and an H.F. choke joined up in series. The arrows indicate a direction of current flow.

AN ECONOMICAL PANEL.

BY A CORRESPONDENT.

THE increase in popularity of the three, four and five-valve sets has required, up to the present, the use of large ebonite panels. This, in itself, has added to the cost of the set both from the professional and amateur points of view. Any method, therefore, which would tend to cheapen, without loss of efficiency, the initial outlay, would be greatly welcomed by everyone.

For the purposes, then, of this latest experiment an ordinary piece of mahogany was purchased and finished to the required size—i.e. 28 in. by 7 in. by ¼ in. Mahogany was chosen on account of its hardness, appearance, and ease in working. The requisite holes for the component parts were drilled; then, prior to the treatment of the panel to prevent leakage, and primarily with a view to the ultimate appearance of the wood, it received a coating of the brown stain generally applied to mahogany. This did not take long to dry, and in two hours a wax preparation was well rubbed in into the front and sides, thus forming the nucleus of the insulation.

Next came an application of oil and finally the front and exposed parts were French polished, so giving it a handsome appearance and completing the insulation. (It should be noted that the French polishing was done by one of the contributors, who is not a professional French polisher, and consequently no extra cost was entailed.) The holes also were given a liberal dose of this polish, particularly those taking the variable condensers.

A Substantial Saving.

As the set was a four-valve Neutrodyne (1 H.F., 1 detector, and 2 L.F.), it was essential to fix to the panel two variable condensers, four rheostats, one three-pole two-way switch, and seven terminals. The results obtained showed that the efficiency of the set was quite up to the standard of a set of the same design, using an ebonite panel. But the cost of the mahogany was only one-fifth that of the other panel, the amount expended on the wood being 2s. 6d., and on the preparation 6d., a total of 3s. Not only was there a saving of 80 per cent., but the appearance of the set was greatly enhanced.

PARALLEL OR SERIES?

(*Continued from previous page.*)

the weakest link—in this case the links being individual cells.

When we deal with coils we have only one factor of primary importance to consider, and this is inductance. Inductance and capacity are necessary for tuning circuits to certain wave-lengths. In a straightforward aerial tuner most of the capacity is supplied by a variable condenser. Increasing either inductance or capacity increases the wave-length tuning and decreasing either decreases the wave-length tuning. The inductance of two coils in series is merely the sum of the individual inductances. The effective inductance of a coil of 100 microhenries connected in series with one of 150 microhenries is 250 microhenries. But when coils are connected in parallel the resulting inductance is always something less than the inductance of the smaller coil. For two coils the simple rule is $L = \frac{L^1 \times L^2}{L^1 + L^2}$

That is, the two inductances multiplied together are divided by the same two inductances added together. In the case of our two previously mentioned coils it is 15,000 divided by 250, which is 60, and this 60 can be expressed in microhenries.

When more than two coils are connected in parallel the above rule cannot be applied, and we have to bring in the reciprocal rule. But this is not so fearsome after all. Here it is:

$$\frac{I}{L} = \frac{I}{L_1} + \frac{I}{L_2} + \frac{I}{L_3}, \text{ etc.,}$$

or the reciprocal of the total inductance equals the sum of the reciprocals of the individual inductances. In a previous article entitled "Repressing the Rheostat" we fully explained this little excursion into mathematics.

And it is worth noting that inductances are calculated in exactly the same way as resistances. Those who carefully read the above-mentioned article should know exactly how to deal with inductances in series and parallel, for the methods of calculation are identical.

Now, condensers in series can be dealt with similarly to inductances or resistances in parallel and condensers in parallel follow the simple rule of addition applicable to resistances or inductances in series. In fact, the calculations involved in the separate treatment of inductance, resistance, and capacity are identical, although unfortunately, in the case of the last-named, the above indicated reversal of rules is necessary. But don't confuse the ampere-hour capacity of accumulators with the capacity of condensers, these are very different.

Note These Points.

Let us pause awhile and tabulate our facts.

The simple rule of the addition of individual values applies to:

1. The capacity of condensers in parallel.
2. The ampere hour capacity of accumulators or dry battery cells in parallel.
3. The voltage of accumulator or dry battery cells in series.
4. The inductance of coils in series.
5. Resistances in series.

The more complex reciprocal rule applies to:

1. The capacity of condensers in series.
2. Resistances in parallel.
3. Inductance of coils in parallel.

The calculations involved in series-parallel arrangements are quite as simple as any of the foregoing. Supposing two condensers are connected in series and then another condenser is connected across both. First of all, the effective capacity of the two condensers in series is worked out, and as there are only two, we can dodge the "reciprocals" and can use the easy rule. Therefore, the two values can be multiplied together and then this result divided by the sum of the two capacities. To this figure should be added the capacity of the condenser connected in parallel.

Were these condensers resistances, we should first of all *add* the resistances of the two in series together, and then apply either the reciprocal or the easier rule (which applies only to pairs) to this figure, and that of the paralleled resistance.

A little elementary arithmetic and a little common-sense are all that is necessary to advance the amateur a long way on the road of L's and C's, Mics and Mu's!

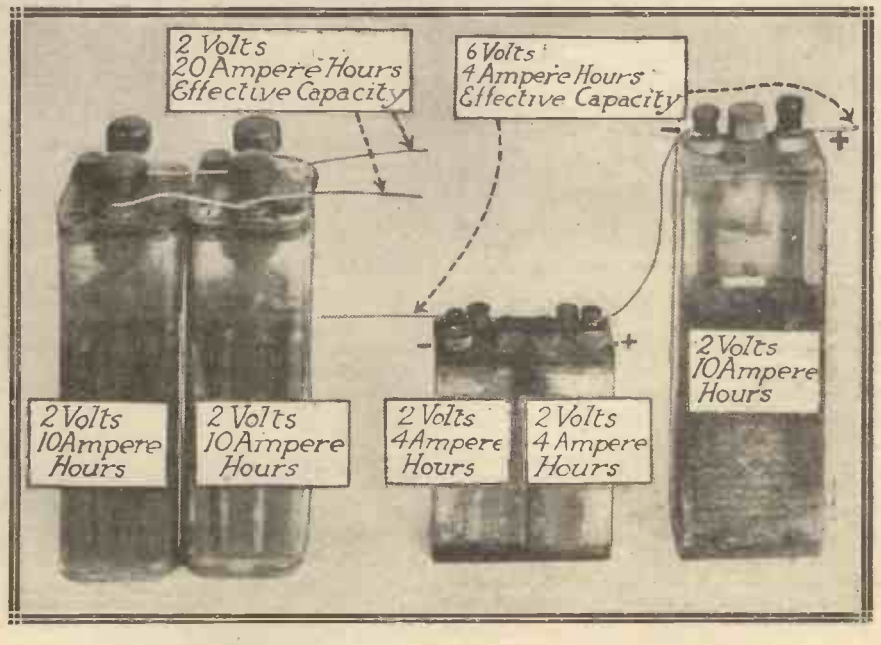


Fig. 1.—A home-made valve.

MAKESHIFT VALVES.

An interesting and informative article describing some experiments carried out by the writer with home-made "valves."

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

IT must not be presumed that the experimental valves described in this article are in any way intended to supplant any of the many excellent types of commercially made valves which are at present on the market. But it is a psychological fact that no matter how perfect a scientific device may be, the true constructional amateur always finds a source of pleasure and interest in constructing such a device with his own hands, no matter whether it be inferior or not to the manufactured article.

It is for reasons such as the above that I wish to place before the reader of these columns some fairly detailed instructions on the making of simple types of thermionic valves. These valves, if constructed with reasonable care, can be made to function very effectively in a simple circuit. Naturally they are not anything like as sensitive as any of the beautifully made commercial valves, nor can they be said to be economical in their current consumption. However, the fact that they *will* give results, and that their construction is not a matter of any great difficulty will, no doubt, cause many readers to become interested in their properties, and to try their hands at making them.

Simple Two-Electrode Type.

Let us first of all deal with the construction of a very simple type of two-electrode valve. All we require for this purpose is a 4- or 6-volt electric bulb, such as those which are employed for the headlights of motor-cars or motor-cycles, and for similar lighting purposes. If possible, the filament of the bulb should be a carbon one. However, this requirement is not essential. Care should be taken to see, however, that the glass of the bulb is not unduly thick, for, within certain limits, the thinner the glass of the bulb, the more readily are results obtained when such a bulb is utilised as a valve.

Having acquired a bulb of the above nature, take two narrow strips of tinfoil or silver paper and fasten these around the sides of the bulb in the manner shown in Fig. 1. Owing to the curvature of the bulb, it will usually be found an extremely difficult matter to make a really neat job of this exterior silver paper lining. Fortunately, however, the exact contour of the metal lining around the exterior of the bulb does not matter so long as the metal linings are continuous.

The metal bands may be fixed to the glass by means of a little good gum, although I have found the use of celluloid photographic negative varnish to be more satisfactory. In attaching the metal-foil bands to the glass of the bulb, great care must be taken to see that none of the gum, celluloid varnish, or whatever adhesive is used, gets on to the outer surface of the bands, otherwise, owing to the insulating nature of these adhesives, effective electrical contact with the metal-foil bands would be rendered impossible.

After attaching the exterior metal-foil bands to the glass of the bulb, the whole article should be placed in a warm oven for an hour or two in order to allow of thorough drying of the adhesive. After this period, the valve will be ready for experimental use.

The valve will, of course, require some form of mounting before it can be used. However, it is not a difficult matter to devise such a mounting. Any small piece of wood will do for the purpose and, as will be seen from a glance at the illustration,

Fig. 2.—Mounting the home-made valve.

Fig. 2, even the lid of a cardboard box can be brought into service for this purpose, provided that it has been well impregnated with paraffin wax beforehand in order to render it insulative to an H.T. current.

The illustration, Fig. 2, indicates the method of making contact with the external bands of the bulb, such contact strips being composed of copper foil.

The circuit in which such a valve can be used may comprise any simple valve rectifying circuit, the exact manner of wiring up the improvised valve being depicted in the diagram, Fig. 3. The L.T. battery for the purpose of heating the filament should be of the usual 4- to 6-volt accumulator variety and, in passing, it may be said that in order to operate the valve effectively, the filament must be heated to the greatest possible brilliance. On the average, an H.T. current of about 40 volts will be sufficient to apply to the plate of the valve.

How It Works.

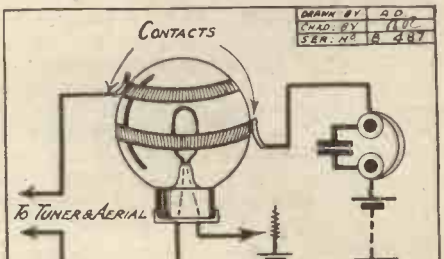
The mode of operation of such an improvised valve is not difficult to follow. The ordinary filament of the electric bulb acts as the electron emitter, the plate or anode of the valve comprising the external metal-foil bands around the glass of the bulb. When the filament is heated to a reasonable degree of brilliance, it gives rise to an electron emission, a portion of which finds its way through the glass of the bulb, thus coming in contact with the external anode.

Now, the amount of electron leakage taking place through the glass depends upon several factors, each of which may vary in bulbs of different construction. For instance, the electron leakage through the glass is governed by the exact disposition of the filament, the thickness of the glass, and also the temperature of the glass. This is an important point to observe, for when the glass becomes warm from the heat of the filament the electron leakage through the glass is improved, and consequently the effectiveness of the valve increases. On account of this fact, a carbon filament bulb is rather more effective to use as an improvised valve because it gives rise to a greater degree of heat, despite the fact that the actual electron emission from the filament may be less abundant than that obtained from a thin metallic filament.

A More Efficient Type.

A rather more efficient type of valve may be constructed from one of the familiar "dual-filament" electric bulbs, such as those which are employed for motor headlights. In these bulbs one of the filaments can be made to glow brilliantly, whilst the light given out by the other is much feebler, the whole bulb forming a "high-low" arrangement for dimming purposes.

In order to make use of an electrical bulb of this type as a radio valve, it is first of all necessary to remove the base of the bulb in order to effect a necessary alteration of connections to the filaments. In removing the base from the bulb, a small, sharp-pointed instrument, such as a stout hatpin or knitting needle, may be used, and, with a little care, the base will come away from the glass without any great trouble. The operation is, of course, tedious, and it may be hastened by soaking the bulb in a strong solution of caustic soda for a few hours beforehand in order to soften the cement. Another method of removing the base of the bulb is to apply a few drops of some strong mineral acid, such as nitric or hydrochloric acid, very carefully around the joint. The acid will not attack the glass, but it will,



METHOD OF ARRANGING VALVE IN CIRCUIT. FIG. 3

of course, eat into the metal base, and therefore its action should be carefully controlled.

However, having removed the base of the bulb, separate very carefully the connecting wires of the filaments, and bring out the two wires leading to the "bright" filament of the bulb. These should be carefully marked and, if possible, insulated. They form the leads to what is going to the

(Continued on next page.)

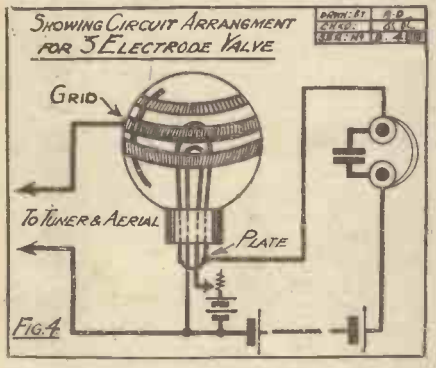
MAKESHIFT VALVES.

(Continued from previous page.)

filament of the valve. The other two leads to the "dull" filament of the electric bulb should be joined together, and a lead taken from them. This lead must also be carefully insulated. This second filament of the bulb forms the plate or anode of the valve.

A Third Electrode.

Having made the above re-arrangement of the connections, the next thing to do is to supply the valve with a grid, thus converting it into a 3-electrode valve. In such a device, the only type of grid which can be employed is what we may call an "external grid." This latter is made by cementing a strip of metal foil around the exterior of the bulb in the manner illustrated in the diagram Fig. 4. Connection to this external band of metal-foil may be made either by means of a contact strip in a manner similar to that shown in the photograph, Fig. 2, or



else a thin wire lead may be soldered to the metal-foil band by means of some plastic metallic cement.

The valve will be now ready for use and, as before, some form of mounting should be provided for it. However, in order to test out the capabilities of the valve only a very crude form of mounting is necessary. In fact, the valve may be merely laid on its side on an insulating surface.

The mode of wiring up the connections to this three-electrode valve is indicated in the diagram, Fig. 4. As before, the filament of the valve should be heated to its greatest degree of brilliance consistent with the safety of the filament. In operating the valve, begin with a plate voltage of 20, then gradually increase this to 75 or 80. The exact plate voltage required will be found to be a matter for trial, and no general rule can be laid down respecting it.

"Good Crystal Strength."

As in the case of the simple two-electrode valve described previously, the efficiency with which this home-made valve will function is dependent upon several factors. The exact arrangement of the filaments in the bulb, the thickness of the bulb glass, the exact temperature and mode of construction of the heated filament are factors which all come into play in determining the efficiency of the valve when used as a rectifier.

Speaking generally, however, a valve of the above type will give reception of a variety which we may call "good crystal strength" at a distance of up to 15 miles from a main station. That is, of course, provided the valve is employed in any ordinary simple one-valve rectifying circuits. The valve will not work in regenerative circuits, nor will it act as an amplifier under any of the usual conditions, the reason for this latter fact being that it would require the use of a specially wound transformer designed to meet the impedance of the bulb. I must, however, haste here to mention that the above observation is by no means put forward in any dogmatic manner. It has been merely based on experience, and if any experimenter does succeed in getting a valve constructed on the above principles to work as a simple L.F. amplifier, he would render a service in carefully noting the conditions and tabulating his results for the benefit of other experimenters.

In working with valves of the above nature, the amateur will very likely have to resist a great temptation to raise the filament heating current to more than safe limits, especially as he will find by actual trial that the brighter the filament glows the louder do the signals become. It should be borne in mind, however, that the majority of these small bulbs which are sold are designed for working on 4 volts, and therefore the use of any greater voltage will quickly destroy the life of the filament, if it does not burn it out altogether on one single occasion.

Obtaining Results.

After all, these makeshift valves, although their construction and operation will be a matter of interest to many keen radio experimenters, are, at the best, merely crude approximations to the conventional and professionally constructed valve and, being such, they cannot be expected to give results of the same efficiency as those which are forthcoming from the use of a commercial valve. Nevertheless, any interested experimenter who possesses one or two small electric bulbs in good condition may spend quite a profitable time in constructing and experimenting with improvised rectifying valves of one or other of the types described above. The most effective results are hardly likely to be obtained at the first "try out," but a few readjustments of the conditions under which the valves operate, together also with a little patience on the part of the operator, will be sufficient to show that even such a simple device as an ordinary electric bulb can, under certain conditions, be made to act as a radio rectifier.

OUT OF THE EARTH.

FROM A CORRESPONDENT.

THE frequent use of the term "Earth Potential" and the fact that the "earthed" portions of a wireless set are commonly regarded as uniformly "blank" may have led numerous amateurs to believe that an earth led is a route for H.F. and L.F. currents into an abyssmal calm. But placid Mother Earth can return a Roland for an Oliver and can hand out currents of her own.

This fact is well worth emphasising now that so many ultra-sensitive receivers are used with direct "earths." It is quite a common practice to employ "outdoor" aerials and earth with super-hets, while thousands of receivers incorporating two and more stages of H.F. amplification are operated under these conditions.

And earth currents can be of considerable dimensions at times. Pressures of as much as 500 volts and currents amounting to 50 milli-amps have been recorded, although it must be admitted that such cases are exceptional.

Cause of Earth Currents.

But with a sensitive radio outfit very small voltage and current fluctuations indeed will cause trouble and a few volts P.D. varying across an earth lead may result in the production of a noisy "background," or even in loud "statics."

Earth currents seldom appear to be of a constant nature and comparatively large fluctuations are sometimes noted. Some earth currents are due to leakage from power mains, but generally the larger ones are produced by some natural means. It is not thought that earthquakes or internal disturbances in the earth have anything to do with them, but it has been observed that when the Aurora Borealis in the Arctic regions is of a varying character earth currents are most active. These conditions generally synchronise with "magnetic" storms of fairly violent natures.

Now the longer the earth lead that is used between the surface of the earth and the buried metal plate or other object to which it is attached, the greater will be the potential difference set up across it by varying earth currents should such be in evidence in the immediate vicinity. But currents induced into such a portion of a wireless receiving system do not necessarily extend to the receiver itself or have any practical effect on it. But there is danger of this when the latter is not insulated properly throughout, including such items as the loud speaker or telephone receivers.

May Be Quite Large.

And for this reason. Two buried earths connected together form a complete circuit through which a current will always flow. This current may be very small indeed, so small as to be almost negligible, but on the other hand, it may be quite large—that is, speaking in micro- or even milli-amps. This current will be generated in a similar manner to that which is generated in a primary battery and may be reinforced by stray currents due to leakage from electric tramcar or other systems and by others due to natural causes—such as were referred to above.

When long loud-speaker extension leads are used many paths for earth currents between the earth used for the set and other earthed points can be opened if close attention is not paid to insulation. And to such in minor and major degree may be due many strange noises in many sets.

The most efficient earth from an ordinary reception point of view may be the one that collects the most interference from earth currents. Such are not often the cause of any trouble at all in the case of straightforward two-, three- and four-valve sets, but supers of various kinds are always safer on frame aerials or well insulated "capacity earths," or counterpoise aerials, as they are more correctly termed.

YES—

We get many Testimonials daily about this New Transformer!

YOU may wonder whether we receive many testimonials bearing out the claims we make in our advertisements for the new LISSEN Transformer. The answer is—yes we do. This is a typical specimen:—

Ref. 5150. From Norwich.
November 13th, 1926.

"Having recently purchased one of your new Lissen Transformers and met with such enormous success, I feel bound to express my admiration of such a unit. I find that either as a first or second stage transformer it gives results unequalled by transformer costing three times the price.

"I have since purchased a LISSEN H.T. Battery, Condensers, Variable Grid Leaks, Change-Over Switches and other of your components, and wonder how such high grade units can be sold for such modest prices. I have no difficulty in receiving America KDKA any night, using three valves, the transformer, battery and other components, giving a perfectly silent background. I have since induced other people to try LISSEN components who also express their utmost satisfaction with the LISSEN goods."

But LISSEN have paid the new LISSEN Transformer a more convincing compliment still by withdrawing all the previous expensive LISSEN Transformers in favour of the new LISSEN.

YOU WILL FIND IT FULLY AMPLIFIES EVERY TONE, EVERY NOTE, EVERY HARMONIC, EVERY OVERTONE, *AGAINST A BACKGROUND OF SILENCE.*

Not only can it be used as a fine transformer but it is also A GREAT CHOKE. By the simple act of connecting two of its four terminals as instructed on the box it becomes one of the finest Chokes that can be obtained.

7 DAYS' TEST.

Test this new LISSEN against the most expensive transformer and against the most expensive choke you can. If you do not prefer the LISSEN for tone and power to any other transformer and choke irrespective of price, return it within 7 days and your money will be willingly refunded.

8/6

GUARANTEED FOR 12 MONTHS

TURNS RATIO 3 to 1. RESISTANCE RATIO 4 to 1.

Use it for 1, 2 or 3 stages L.F. It is suitable for all circuits and all valves you will want to use.

There are many advertising manufacturers and all expect to share of the use of mention of their products. The best transformer is not necessarily used in the circuit of the periodical you may be building from. But you are free to choose your own transformer and your own parts. AND NO MATTER WHAT TRANSFORMER MAY BE SPECIFIED IN ANY CIRCUIT, IT CAN BE REPLACED BY THE NEW LISSEN WITH IMPROVEMENT IN VOLUME AND POWER.

REMEMBER THE 7 DAYS' TEST OFFER.

Your dealer uses a new LISSEN himself—he has one in stock ready for you to use too.

USE LISSEN FIXED CONDENSERS, TOO

(Mica and Mansbridge Types.)

Lissen Mica Type Condensers

Small energy-conserving condensers—note the new case which enables the condenser to be used upright or flat. At present the new case is available only in the most used capacities, but will quickly become a LISSEN standard.

Capacities—
·0001 to ·001 1/- each (much reduced).
·002 to ·006 1/6 each (much reduced).
Accurate to 5%—they never leak—they never vary.

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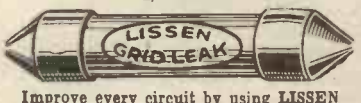
To a fine LISSEN quality condenser is added the specially moulded case—the condenser cannot short circuit on to its case. The new LISSEN case protects you if the condenser is used in any circuit connected straight on to the electric light mains. And due to our new policy of direct-to-dealer distribution this LISSEN Condenser costs no more than the ordinary type.

·01 to ·09	2/4
·1	2/6
·2	2/8
·25	3/-
·5	3/4
1·0	3/10
2·0	4/8

LISSEN FIXED GRID LEAKS

A case of these was left on our factory roof during the summer of 1925, soaked in rain, baked by sun, and the resistance value of these leaks never altered.
All capacities, previously 1/8. Now 1/- each.



Improve every circuit by using LISSEN parts wherever you can—save money, too—for now you get keen prices as well as fine quality.

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L. 228

Keeping It Secret

Now that transatlantic telephony communication is an accomplished fact, there remains the all-important task of making those communications secret—a task which, as our contributor shows, is not easy, but is, nevertheless, quite possible of accomplishment.

By J. C. JEVONS.

ACCORDING to a prominent Post Office official, the new wireless telephony service to New York, although not absolutely secret, is difficult to intercept. This authority claims, in fact, that it is impossible to overhear a London-New York conversation with an ordinary broadcast receiving set. In order to do so, he adds, special apparatus is necessary, together with considerable skill in using it.

At the same time, reports of the interception of transatlantic messages upon a wave-length of 5,760 metres have been received from a number of quarters, including places so widely separated as South Africa and Vienna.

The problem of devising a "secret" system of wireless telephony is one that has already occupied the attention of wireless experts. Long before the opening of the London - New York service, it was realised that the possibility of eavesdropping might seriously prejudice the success of radio telephony in commercial competition with cable or line communication, where absolute secrecy is preserved.

It must be admitted, however, that although it is possible—with a certain amount of possibly misplaced ingenuity—to "tap" the London-New York "radio" this fact does not appear to have deterred people from using the service. It is probable that if complete secrecy were to be offered at a high tariff and lack of complete secrecy at a lower rate, the latter service would in most instances be preferred.

Varying Frequency.

One of the most obvious methods of securing a certain degree of secrecy is to use a "wobbling" carrier-wave at the transmitting station instead of keeping to a constant frequency. This can be done, for example, by continually altering the setting of a variable condenser or variometer in the circuits of the master control, and so causing the radiated energy to fluctuate in wave-length.

The change of tune may be controlled by a clockwork or other motor geared to the variable condenser or variometer, and driven either at a constant or irregular speed.

In order to hear the whole of a message radiated in this manner, the tuning of the receiving set must obviously be varied at the same rate as the transmitter. This necessitates the fitting of special clockwork mechanism at the receiving end driven at the same speed as that used to control the transmission.

Side-Band System.

Unfortunately this system has not proved very successful in actual practice. By merely using a broadly-tuned or aperiodic receiving aerial it is usually possible to intercept most of the message, particularly at fairly close range. Under such conditions the incoming signals naturally vary considerably in strength, but not to a sufficient degree to ensure secrecy.

Another plan that has been proposed is to introduce at the sending station a mixture of confusing notes which, when received upon an ordinary set, overlap with the spoken message and so render it unintelligible.

The authorised receiving station is, however, provided with a number of filtering circuits designed to cut out the interfering tones, and to allow the "clear" message alone to get through to the telephones.

Whatever may be the virtue of this suggestion it is certainly not the one at present employed on the London-New York service. From the reference made to the fact that interception is "difficult" upon an ordinary receiving set, it would appear that the partial degree of secrecy is due to the suppression of the normal carrier-wave. In other words the message is sent out upon one side-band only of the carrier-wave. In this way it is differentiated from the ordinary type of transmission as used in broadcasting.

Although the actual processes involved in modulating a carrier wave with speech signals are perhaps too intricate to interest the average listener, he is probably aware that the net effect is to produce three different frequencies.

The first is a wave having a frequency equal to the sum of the frequencies of the speech currents and the carrier-wave. The second is a wave having a frequency equal to the difference of these two components. The third is the pure unmodulated carrier-wave.

As the latter does not carry in itself any of the speech currents it is, in a sense, wasted

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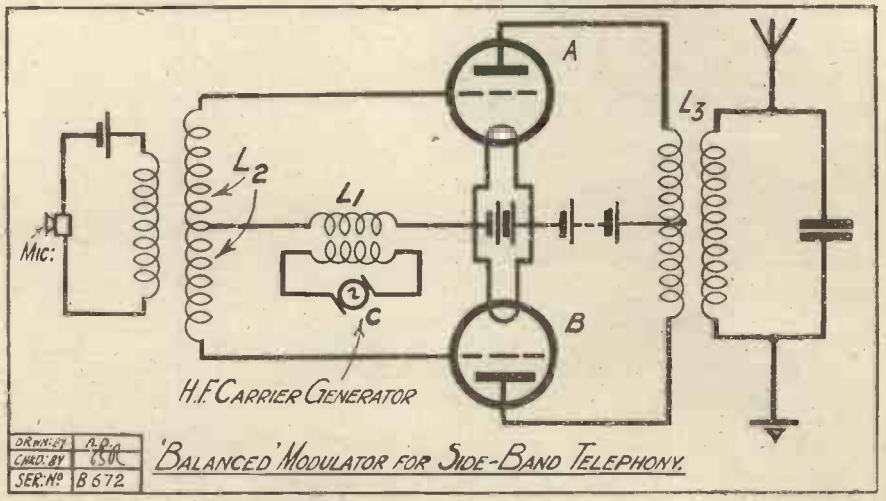


'BALANCED' MODULATOR FOR SIDE-BAND TELEPHONY.

By HUMPHREY PURCELL.

IT is a commonplace that every experimenter burns out a valve—or more than one—sooner or later. This is one reason the seasoned "fan" never throws away a tube, no matter how poor a specimen, so long as it will function. For when risks are to be taken, it is much less trying to chance your arm with a row of has-beens than with an array of the newest supers whose filaments (confound them!) give no sign of glow. If the poorer valves give results of a sort on a new hook-up, it is a simple matter to replace them by better valves (disconnecting the H.T. positives while making the change), and start afresh without any qualms as to a mistake in wiring.

A Common Cause.

The most common cause of burn-outs, in the bitter experience of the writer, is neglect to disconnect the H.T. battery during alterations. It is no argument, when pulling out a valve, or plugging in a different one, to say, "It doesn't matter if this does go west. I have never liked it." For if that valve is placed on the holder sideways, it may bring disaster to all the valves in the set. Even when the alteration is merely the moving of a grid-battery plug to a different tapping, the plug may slip from the fingers and touch the H.T. battery or a wire connected to H.T. positive, and thus bring disaster (in a set where H.T. negative and L.T. positive are connected). To fiddle with the innards of a set (to change a grid leak, for example) without disconnecting the H.T. battery is, of course, sheer folly.

Peculiar Burn-outs.

A burn-out which brought surprise as well as grief to a friend of the writer's was caused by disconnecting all battery leads and lifting the set off the table without putting the rheostats to the "off" position. The L.T. leads trailed across the H.T. battery, and a very tiny firework display cost two guineas. Another disaster was caused by disconnecting a detector unit from an amplifier without disconnecting batteries. The lead to O.P. touched a filament lead. Yet another was caused by using flex to make connections to a transformer on which the terminals were set close together. A stray strand of the O.P. flex touched a strand connecting with I.S. The owner deserved to lose those valves, even though the price at that time was 27/6 each!

It will be noticed, incidentally, that several of the calamities described might have been averted if H.T. negative had been connected to L.T. negative instead of L.T. positive. There are arguments in favour of both policies, but generally speaking "negative to negative" is the safety-first plan.

Rough Treatment.

Apart from actual burning out, there is one other practice that can be thoroughly recommended as a means of shortening the life of a valve. That is, to tug it out of its holder sharply, or to push it home with a click. As a matter of fact the writer has never yet known a valve to die peacefully in its holder. Death, in one shape or another, has always come violently.

"KEEPING IT SECRET."

(Continued from previous page.)

energy so far as the task of carrying the speech across the ether is concerned. It is, however, an essential factor in the process of detecting or restoring the original message at the receiving end.

If, therefore, the carrier-wave is not radiated from the transmitting aerial, the modulated side-bands, although they transfer the essential speech-sounds to the receiving station, cannot alone be reconverted into their original form by ordinary crystal or valve detection.

A way out of this difficulty is found by adopting the expedient of supplying, at the receiving end, local oscillations having the same frequency as the missing carrier-wave. The side-bands and the "local" oscillations will then combine to restore the original speech in intelligible form.

For instance, a back-coupled oscillating valve, if adjusted to the frequency of the original carrier-wave will restore the missing "carrier" and enable the original signal to be reconstructed.

In those cases where interception of the London-New York messages has been reported, it is probable that some such method has been adopted. It should, of course, be unnecessary to remind any listener who may succeed in "tapping" a private message that he is strictly bound by the terms of the Postmaster-General's licence not to divulge or communicate such matter to any other person.

Suppressing the Carrier.

The arrangement employed for transmitting messages, whilst at the same time suppressing the main carrier-wave, is illustrated in simplified form in the diagram, in which two modulating valves, A and B, are shown mounted symmetrically, back to back. The carrier-wave generator, C, is coupled to a coil, L1, arranged in the common grid circuit of the two valves.

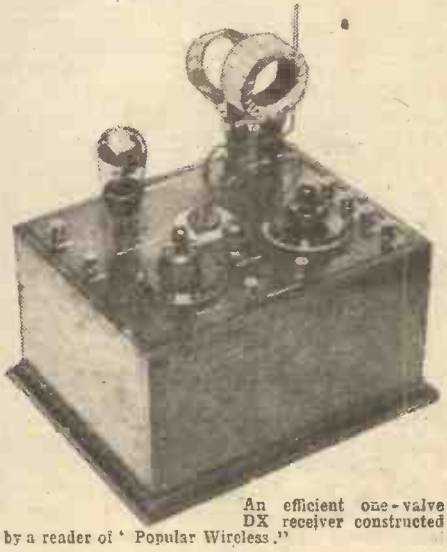
It will be seen that any voltages induced by the source C into the coil L1 will be applied to both grids simultaneously, and in phase, because both grids are connected to the same end of the coil.

Accordingly, the plate current of both the valves rises and falls simultaneously, and the net transfer of energy across the coil L3 will be zero, the two currents balancing each other out. Therefore, so far as the aerial is concerned, it will radiate no carrier-wave energy.

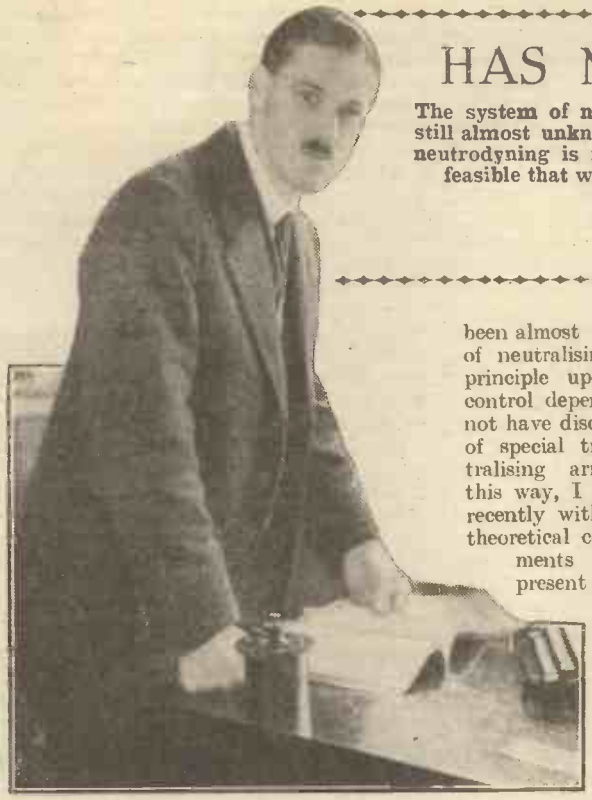
If, however, speech currents are applied by the microphone across the input coil L2, the normal condition of balance is upset. At any one moment, say, when the upper part of the coil L2 is positive, the lower end of that coil will be negative. These voltages are, of course, applied simultaneously to the grids of the modulator valves, but in this instance will give rise to a differential effect, as in the case of a push-pull amplifier.

As the plate current of one valve increases, under the influence of a positively-charged grid, that of the second valve decreases owing to its negative grid voltage, with the result that modulated side-bands of carrier energy are transferred from the coil L3 to the transmitting aerial.

As previously stated, these side-bands cannot be converted into intelligible speech by ordinary methods of crystal or valve detection, unless a local oscillator is used at the receiving end to supply the missing carrier-wave component.



An efficient one-valve DX receiver constructed by a reader of 'Popular Wireless.'



HAS NEUTRALISING MISLED US?

The system of neutrodyning was introduced at a time when special H.F. valves were still almost unknown. With modern valve and set design in many cases the need for neutrodyning is not so acute, and in this article Mr. Harris shows that it is quite feasible that we may be leaning on a broken reed where neutralising is concerned.

By PERCY W. HARRIS, M.I.R.E.

(*Editor of "The Wireless Constructor."*)

WHEN, a few years ago, a certain wireless company needed a special kind of receiving apparatus, the first instruments installed possessed unexpected defects. A device to remove these defects was soon fitted, but this in turn developed troubles of its own. By the time various attachments and compensating devices had been incorporated the complete receiver appeared a fearsome object.

Potentiometer Control.

Subsequently it was found that the work done by the complicated apparatus could be performed far more efficiently and simply by using only half the number of valves and controls, for the man who solved the problem had merely reverted to the original device and cured its troubles in a simpler way, the cure being unaccompanied by any diseases of its own.

I sometimes wonder whether we are not all liable to fall into similar errors in the design of our wireless receiving sets. The potentiometer method of stabilising has been almost entirely abandoned in favour of neutralising methods, and while the principle upon which the potentiometer control depends seems very bad, may we not have discovered for ourselves a number of special troubles inherent in the neutralising arrangements? Reasoning in this way, I began a series of experiments recently with the object of deducing not theoretical conclusions but practical arguments from any facts that should present themselves. The results have been so interesting that I think POPULAR WIRELESS readers would like to hear of them.

Let me say at once that I do not wish to decry the neutralising methods of obtaining stability. Their superiority over potentiometer control is, in many cases, so easily demonstrated as to put the matter beyond argument, but from this we should not deduce that it is a better method in all cases, for in some special circumstances, of which I am about to speak, the potentiometer method of control seems to have distinct virtues.

Considering matters carefully, it will be found that many neutralising schemes serve to balance out not only the feed-back due to the inter-electrode capacity in the valve, but also that due to stray capacities exterior to the valve, as well as some of the effects of stray fields. To what extent have our troubles in the past been due to feed-back due to inter-electrode capacity, and to what extent to factors other than this? I have come to the conclusion that in most cases the chief trouble has been due to causes outside the valve itself.

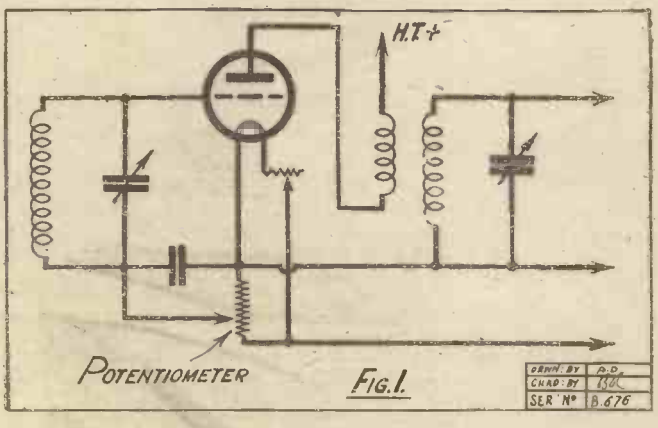


FIG. 1.

American receivers as sold in the large cities are practically all five-valve sets, with two stages of radio frequency, a detector, and two stages of audio frequency. Recently a number of "de luxe" sets have been placed on the American market with three stages of radio frequency and three of audio frequency, the latter often being resistance or choke coupled. In the main, however, the most popular sets are those with two stages of radio frequency, and anyone who has tried them knows that their sensitivity and selectivity are of a very high order. The H.F. transformers used are of the "low-loss" variety, tuned either by separate condensers or by some adaptation of "gang control."

Surprising Statistics.

Now, we all know that with two efficient stages of radio-frequency amplification the tendency to self-oscillation is pronounced. A number of manufacturers, licensed under the Hazeltine patents, utilise the Hazeltine neutrodyne method of obtaining stability. A larger number of manufacturers are not licensees under the Hazeltine or any other neutralising patents, and yet make receivers with two stages of tuned radio frequency—sets which are both sensitive and selective. Figures in my possession show that (*a*) the type of five-tube radio receiver having the largest sale is *not* neutralised, and (*b*) more five-valve sets of the un-neutralised variety are sold than of the neutralised. In giving these facts I am not expressing any opinion as to whether the neutralised sets are more or less efficient than those which are not neutralised—I am simply stating the fact that a very large number of sets containing two stages of radio-frequency amplification—sets which are both sensitive and selective—are sold in America and obviously give satisfaction to their owners.

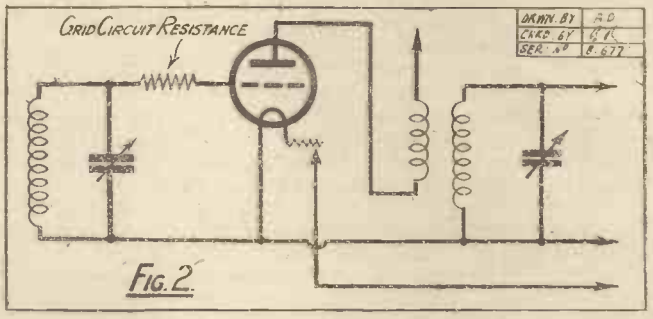


FIG. 2.

Stabilising Resistances.

An examination of those sets which are not neutralised shows that the spacing of coils has been carefully arranged to give the minimum interaction, and stability is obtained by (*a*) a resistance in the plate lead going to the H.T. battery, (*b*) a resistance in the grid circuit of the H.F. valve, (*c*) a combination of either or both of these methods with a special variable coupling between the primary of the transformer and the secondary.

The introduction of a resistance in the grid circuit interests me quite considerably, as it is obviously a "losser" method

(*Continued on next page.*)

HAS NEUTRALISING MISLED US?

(Continued from previous page.)

belonging to the same family as the potentiometer method. Remembering the amount of positive bias it was necessary to place on the grid of the relatively low efficiency valves in use two or three years ago, and bearing in mind that the modern valves of much greater efficiency have a far higher tendency to oscillate, it occurred to me to make a few experiments to see just how much loss it was necessary to introduce into a modern circuit to stabilise it if—and this is a very important point—proper precautions were taken to prevent interaction between parts of the circuit other than the valve itself.

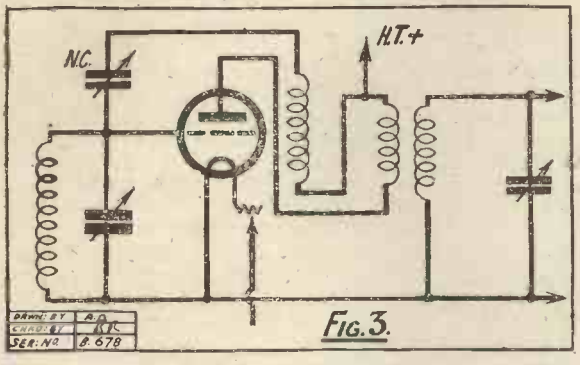


FIG. 3.

A good line of investigation appeared to be in connection with the screened coils now manufactured by a number of makers. Conclusions drawn from the use of one coil only, or from one stage of H.F.. may be very misleading. I therefore decided to build up a receiver with three stages of radio-frequency amplification, a detector, and one stage of transformer-coupled note-magnification. Such an arrangement of circuit should, if efficient, give admirable results with modern valves, provided stability could be obtained without too high a loss of efficiency.

Results Obtained.

If really adequate amplification could be given by the radio-frequency side, one efficient stage of audio-frequency amplification should be good enough for loud-speaker work on any station within range of the instrument. The usual trouble with a set possessing three stages of radio-frequency amplification is that of the multiplicity of tuning controls, and while this can be simplified by the use of "gang" condensers, such condensers are expensive, and, unless carefully balanced, both in the manufacture and afterwards by means of some separate control, are liable to give much trouble. On the other hand, two controls give very little more trouble than one, and a simple way out of the difficulty appeared to be to tune two of the coils at a time, using two "twin" condensers for the purpose. The receiver, then, has but two tuning controls, both of which read to approximately the same figure.

Considering such an arrangement in detail, it will be seen that it is possible to control three of the grids by potentiometer, the fourth (that of the detector) not needing such control. Some thought given to the matter led me to arrange for two potentiometers, one to control the first and second grids and the other to control the third grid. The receiver was thereupon made up—not in a straggling form along the experimental bench, for results obtained in this way are often most misleading—but in what may be termed a "practical form" in the space occupied by a standard panel, baseboard and cabinet.

The results obtained with this receiver far exceeded my expectations, for in the first place the amount of positive bias to "hold the circuit down" was very small—far less than we were accustomed to use with the old open coils and transformers. One particular point impressed me at once. We might reasonably assume that if the potentiometers were adjusted to give stability at the positions of minimum readings on the tuning condensers, the set would be very "dead" when a greater part or all of the ·0005 mfd. condensers were in circuit. In actual practice, once the set had been stabilised on the lower readings of the condensers, it was still sensitive enough to bring in a large number of foreign stations at full loud-speaker strength between 70° and 100° on the 100° condensers. True, the strength of these stations could be brought up still further by readjusting the potentiometers, thus lessening the positive bias, but the difference between the signal strength with potentiometers set for stability on the lower readings and that on the high was far less than one would expect.

The high-frequency transformers used in these screened coils were of the type known as "split primary," and after getting excellent results with one type of valve, I tried the experiments with a whole range of valves and soon found that with the potentiometers fully to the negative side many of the valves would not oscillate at any position of the condensers. This meant, among other things, that the coupling between primary and secondary of the transformers was too weak for these valves. In case anyone should assume that lack of balancing between the double condensers was the cause of this, I may say that balancing condensers were used in all these tests to make sure that all four radio-frequency circuits were properly in tune.

We now come to the point of selectivity. This, as might be expected, was a variable factor, depending upon the method of rectification used, the degree of positive bias, and the type of valve. By choosing valves of suitable impedance and amplification factors, a very high degree of selectivity was obtained—adequate for all ordinary needs. On an outdoor aerial the sensitivity of the set was comparable with that of a good super-heterodyne using seven valves and an efficient frame aerial of reasonable dimensions.

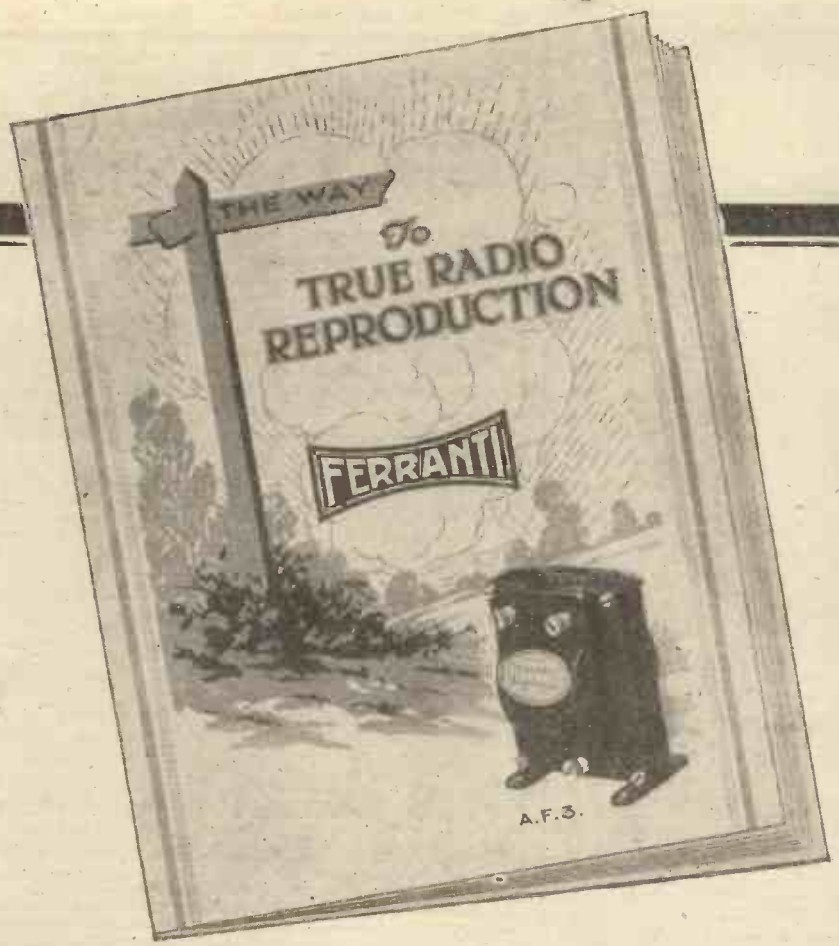
Effect of Neutralising.

While giving these facts, I must warn readers that too many conclusions must not be drawn from them. For example, it is quite evident that an appreciable part of the stability obtained in this receiver was due to the damping introduced by the metal screens, and, indeed, an examination of some of the commercial American receivers shows that eddy currents set up in the condenser plates by the fields of the radio-frequency transformers are deliberately made use of to obtain stability. At the same time, the reduction of interaction between fields, due to the screening of the coils, had a powerful influence on reducing the amount of positive bias necessary to obtain stability, while the comparatively weak coupling between primaries and secondaries was again an important factor in determining the results.

Trouble is sometimes found in using three stages of radio-frequency with screened coils and some neutralising methods. For this reason it occurred to me to combine the potentiometer control method with the neutralising method to see what happened. A special set was therefore made up along conventional lines with screened coils and a neutralised circuit. It was found that after all balancing adjustments had been made, there was still some instability on the lower readings of the condensers (not due to parasitics). Two of


A popular form of lay-out where neutralised circuits are employed. A certain amount of damping is introduced by the proximity of the condensers to the coils.

(Continued on page 1375.)



This **valuable Booklet** is obtainable from your **Dealer** for a Nominal Sum

THE contents include hints on the construction and operation of wireless sets, notes on valves, with a comprehensive list of valves recommended for each stage; and diagrams of connections for eleven different circuits.

FERRANTI

LTD.,

HOLLINWOOD, LANCASHIRE

FERRANTI ELECTRIC, LIMITED,
Toronto,
Canada.

FERRANTI, INCORPORATED,
140, W. 42nd Street,
New York.

HAS NEUTRALISING MISLED US?

(*Continued from page* 1372.)

the grid returns were then connected together and brought to a potentiometer, and, of course, when the potentiometer slider was on the negative side the effect was precisely the same as when the potentiometer was not inserted. Next the slider arm of the potentiometer was slightly advanced until the instability was removed, whereupon the set was found to be stable throughout its whole range, with little appreciable loss of selectivity or sensitivity.

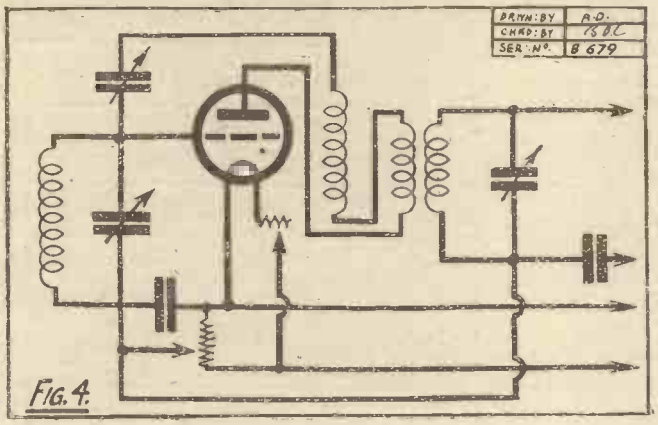


FIG. 4.

Looking back over our radio-frequency experiments for the last few years leads to the following conclusions.

1. Coupling between primary and secondary of the earlier radio-frequency transformers was far too tight, giving both magnetic and capacitative feed back requiring considerable positive bias to stabilise the circuit.

2. Capacitative and inductive couplings between circuits, other than the feed back in the valve itself, made further damping necessary.

3. The use of low-capacity valve sockets, careful wiring, and a much weaker coupling between primary and secondary of the transformers has reduced the feed-back between circuits to a greater degree than is generally realised.

4. Stability obtained in neutralised circuits using screened coils is due at least as much to damping introduced by the screen as to the balancing effect of the neutralising condenser.

Damping Caused by Screens.

Pursuing still further investigations in regard to damping introduced by screens close to the coils, an Ultraudion receiver was made up and by a suitable choice of anode voltage, grid leak value, the valve, and other factors, the set was made to oscillate over the whole range of a ·0005 mfd. condenser. The Ultraudion circuit, as readers will probably know, is rather a peculiar arrangement due to Dr. Lee de Forest, in which the set normally oscillates, and is kept off the oscillating point by adjustment of filament temperature and by grid leak value.

The coil used in these experiments was of the "six-pin" variety, designed for use inside a screen. Without the screen the set oscillated smoothly throughout its whole range, and by adjustment of filament resistance and grid leak, could be brought below the oscillation point so as to be in its most sensitive condition for distant reception. Placing the screen over the coil immediately stopped all oscillation, and the circuit could only be made to oscillate with the greatest difficulty on a few degrees at the lower end of the condenser scale. No amount of readjustment of filament voltage or grid leak value would induce oscillation over any appreciable portion of the condenser scale.

In using screened coils, then, we must consider them as compromises. There is no question that they do serve a very useful purpose by restricting fields, thus enabling us to make sets more compact than would otherwise be the case. Furthermore, they certainly reduce local "pick-up," one of the bugbears of wireless receiver design. At the same time they must not be considered as magical devices or cures for all radio troubles. Nor must we exaggerate the importance of balanced circuits in obtaining stability. The difference between the home constructor and the commercial set manufacturer must be borne in mind, and tends to widen as the radio art advances.

The factory-built receiver can be designed with dead accuracy reproduced with the same accuracy and sold specifically for particular makes and types of valves. Furthermore, such a receiver can be carefully neutralised at the factory, and this neutralisation will remain constant so long as the particular valves specified are used. The home constructor, on the other hand, is less likely to reproduce the receiver exactly, and for this reason is likely to have more trouble with his neutralising. Furthermore, the average home experimenter wants to try a large number of different kinds of valves, and quite likely those valves he has on hand at the moment are not quite suitable for the particular set he desires to build.

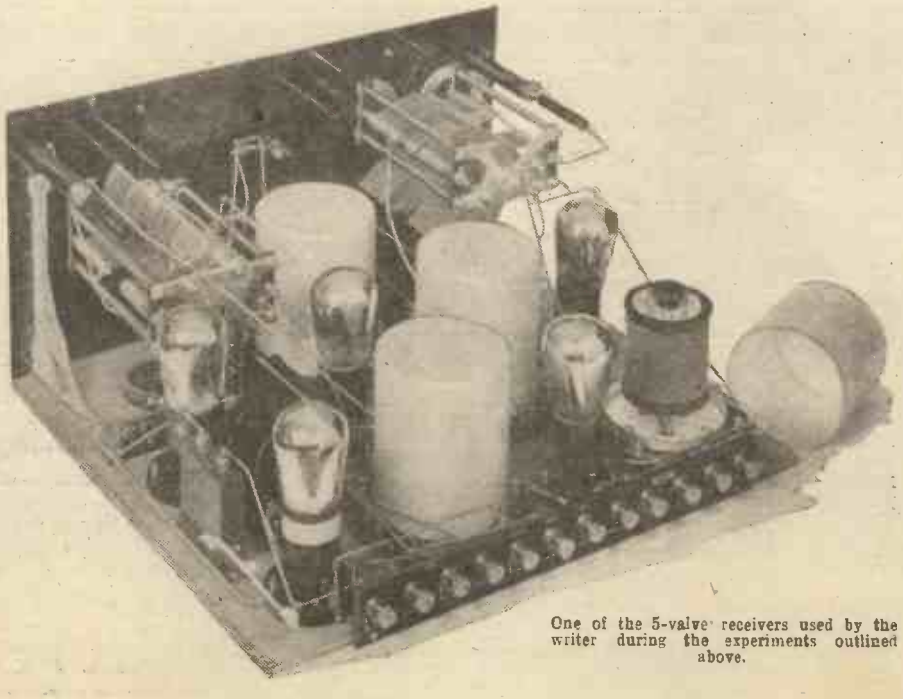
A wide experience of home constructors' troubles has led me to the conclusion that the process of neutralising a set offers considerable difficulties, whereas the use of the potentiometer to obtain stability is extremely simple. For the highest possible efficiency there is no question whatever that one of the modern balancing methods is the best, but receivers using them require careful design, and, if results equal to those obtained by the designer are to be obtained by the home constructor, the designer's set must be copied very closely. By combining potentiometer and balancing methods, we give the home constructor a latitude he will find very useful.

A Compromise Advisable.

By carefully avoiding interaction of fields, by suitable screening, multi-stage high-frequency receivers can be built and reproduced by the home constructor with the certainty of obtaining really highly sensitive results with great simplicity of control.

Once more, then, we are reaching the position of compromise. I urge all experimenters not to overlook the potentiometer in developing their high-frequency receivers. My own experimental five-valve set has shown me what remarkable results are obtainable without neutralising methods, and has also revealed the fact that too much credit has been given to neutralising in the good results we now obtain with our multi-valve sets.

I shall be glad to hear from readers who carry out experiments on the lines I have indicated as to the results they obtain and to have their opinions on the subject of neutralising as applied to modern circuits.



One of the 5-valve receivers used by the writer during the experiments outlined above.

THE "POPULAR WIRELESS" VALVE GUIDE—*continued.*

4-VOLT L.F. VALVES—*continued.*

Make of Valve	Type	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp. Fac.	Price	Remarks
								s. d.	
B.S.A.—									
B.S.A. Ltd., Small Heath, Birmingham.	P.425	3·5–4·4	0·28	130 max.	2–8	5,000 –7,000	6·8	18 6	Power valve (P.425A —bayonet fitting)
	P.485	4·0	0·9	130 max.	3–12	6,000	6·0	35 0	Super power valve (bayonet fitting)
B.T.H.—									
British Thomson-Houston Ltd., Crown Hse., Aldwych, W.C.2.	R.	4·0	0·7	40–100	0–3	27,000	7·5	8 0	General purpose
	B.5	2·8	0·06	20–80	0–4·5	17,000	7·0	14 0	General purpose
	B.5.H.	2·8	0·06	40–120	0–1·5	55,000	17·5	14 0	Res. coupling
	B.6	2·8	0·12	40–120	0–4·5	12,000	8·0	18 6	Power valve
BURNDEPT—									
Burndept Wireless Ltd., Bedford St., W.C.2.	H.L.310	3·0	0·1	45–90	1·5–3·0	20,000	6·5	14 0	General purpose
	H.310	3·0	0·1	90–120	1·5–3·0	55,000	17	14 0	Res. coupling
	H.L.425	4·0	0·25	90–120	1·5–3·0	10,000	9	18 6	General purpose
C.A.C.—									
C.A.C. Valve Distrib. Co., 10, Rangoon St., E.C.3.	B.E.L.F.	3·5	0·5	40–100	1·5–9·0	12,000	6	6 0	L.F. valve
	D.E.·06 L.F.	3·8	0·06	40–100	1·5–9·0	14,000	5	9 0	L.F. valve
CLEARTRON—									
Cleartron Radio Ltd., 1, Charing Cross, W.C.2	C.T.·08	3·0	0·08	30–100	0–6	18,000	7·5	14 0	General purpose
	C.T.·08+	3·0	0·15	60–120	5–15	5,000	3·5	18 6	Last stage L.F.
COSMOS—	—	—	—	—	—	—	—	—	—
COSSOR—									
A. C. Cossor, Ltd., Aberdeen Wks., Highbury, N.	P.1	4–4·5	0·7	30–120	0–3	25,000	6·6	8 0	Det. and L.F.
	P.2	4–4·5	0·7	30–120	0–3	40,000	10	8 0	Res. and choke coup.
	W.R.1	1·6–6	0·3	30–120	0–3	19,000	6·6	16 0	Det. and L.F. (spec. res. in base)
	W.R.2	1·6–6	0·3	30–120	0–3	30,000	10	16 0	Res. coupling (spec. base
	Point 1. (Black)	3·8	·1	90	3–4·5	10,000	10	14 0	L.F.
	Point 1. RC(Blue)	3·8	·1	120	6–9	—	—	14 0	Resistance Coupling
	Stentor four	3·8	·1	120	3–6	5,000	5·0	18 6	Power Valve
CUNNINGHAM—									
Rothermel Ltd., 24, Maddox St., W.1.	C.299	3	0·06	—	—	—	—	10 0	General purpose, C.X has spec. base
	C.X.299	3	0·06	—	—	—	—	10 0	
	C.X.200	3	0·125	—	—	—	—	10 0	Special L.F. valve
DEXTRAUDION—									
E.E.C. Ltd., Fitzroy Square, W.1.	306	2·8–3	0·06	40–75	0–6	20,000	—	12 6	General purpose
	312	2·8–3	0·12	60–100	0–6	18,000	—	16 6	Power valve
	406	3·8–4	0·06	40–75	0–6	21,000	—	12 6	General purpose
	412	3·8–4	0·12	60–100	0–6	18,000	—	16 6	Power valve
EDISWAN—									
Edison-Swan Electric Co., Queen Victoria St., E.C.1.	A.R.·06 (L.F.)	2·5–3·0	0·06	20–100	2–6	14,000	5	14 0	Det. and L.F.
	P.V.8	3·0	0·12	60–120	4–10	10,500	6	18 6	Power valve
	G.P.4	3·5–4·0	0·15	60–120	1–2	22,000	12	14 0	General purpose
	P.V.4	3·5–4·0	0·35	60–120	3–7	9,500	6	18 6	Power valve
	A.R.L.F.	4·0	0·75	30–80	—	15,000	6	8 0	Det. and L.F.
	R.	4·0	0·75	20–100	—	25,000	7·5	8 0	General purpose
ELKA—									
L. Kremner, 49a, Shudehill, Manchester.	D.	3·5–4·0	0·15	20–100	0–4·5	—	—	—	General purpose
FRELAT—									
L. Kremner, 49a, Shudehill, Manchester.	A.V.L.	3·8–4	0·5	20–100	—	—	—	4 11	Amplifier
	L.	3–4	0·25	30–100	—	—	—	4 11	L.F. valve
	P.	3·8–4	0·5	100–200	—	—	—	4 11	Power valve
LOEWE-AUDION—									
Audion Radio Co., 52, Dorset St., W.1.	L.A.101	4·0	0·3	60–200	—	16,000	—	12 6	Power valve
	L.A.74	3·0	0·06	50–100	—	35,000	—	9 6	General purpose
	Triple Valve	4·0	0·5	60–300	(not yet available)				New 3-stage L.F. amplifier
LOUDEN—									
Fellows Magneto Co., Cumberland Avenue, Park Royal, W.	F.E.R.1	4·0	0·1	40–100	0–6	13,000	6	8 0	Det. and L.F.
	F.E.R.2	4·0	0·1	40–100	0–6	24,000	12	8 0	Res. coupling
	P.E.R.1	4·0	0·2	60–200	3–12	8,000	5–6	11 0	Power valve
	P.E.R.2	4·0	0·2	60–200	3–12	20,000	18	11 0	Power for res. coup.
LUSTROLUX—									
Lustrolux Ltd., Bollington, Macclesfield.	306 L.F.	2·8–3	0·06	80 max.	0–6	25,000	7	9 0	Det. and L.F.
	312P.V.	2·8–3	0·12	120 max.	0–6	10,000	6	15 0	Power valve
	406 L.F.	3·8–4	0·06	80 max.	0–6	18,000	8	9 0	Det. and L.F.
	412 P.V.	3·8–4	0·12	120 max.	0–6	12,000	8	15 0	Power valve
	434P.V.	3·8–4	0·34	120 max.	0–6	12,000	8	15 0	Power valve
	470B.E.	3·8–4	0·7	80 max.	0–3	25,000	7	7 0	Gen. purpose (for res. coup. use, H.F. type; *see* H.F. tables)

Make of Valve	Type	Fil. Volts	Fil. Amp.	Anode Volts	Grid Bias	Impedance	Amp. Fac.	Price	Remarks
								s. d.	
MARCONI—									
Marconiphone Ltd., Marconi House, Strand, W.C.2.	R.	4·0	0·7	30–100	0–6	40,000	9	8 0	General purpose
	D.E.3	2·8	0·06	20–80	0–6	22,000	7	14 0	General purpose
	D.E.3B.	2·8	0·06	120 max.	0–4·5	50,000	17	14 0	Res. coupling
	D.E.4	3·8	0·30	20–120	0–9	10,000	7	18 6	Power valve
	F.E.3	4·0	0·7	6–15	+6–15 (inner grid)	20,000 –8,000	4·5	16 6	Four-electrode valve
	D.E.V.	3·0	0·2	20–60	0–4·5	24,000	6	25 0	Special type
MÉTAL—									
John Rae Ltd., 60, Blackfriars Rd., S.E.1	T.M.	4·0	0·7	40–160	0–6	19,000	8·5	—	General purpose
	6/1000	4·0	0·06	20–80	0–6	19,000	8·5	9 6	General purpose
	E.1	4·0	0·25	40–120	0–9	25,000	9	—	Power valve
	6/100F.	3·8–4	0·06	5–25	—	—	+	—	Four-electrode
	C.L.104	4·0	0·1	—	—	—	—	15 0	Super power valve
MULLARD—									
Mullard Wireless Service Co., Mullard House, Denmark St., W.C.2.	P.M.3	3–3·7	0·1	50–100	0–6	16,000	—	14 0	General purpose
	P.M.4	3·7	0·1	50–100	0–6	7,000	—	18 6	Super power valve
	P.M.245	3·8	0·25	50–150	0–22	3,500	3·15	22 6	Super power valve
	S.4	3·0	0·2	20–60	0–6	14,000	6	22 6	General purpose
	S.6	3·0	0·2	20–100	0–3	100 000	22	22 6	Anode bend det., res. coupled L.F. and H.F.
	R.L.F.	3·8	·0·65	50–100	0–6	22,000	6·7	8 0	Det. and L.F.
NELSON—									
Nelson Electric Co., 138, Kingston Rd., S.W.19.	G.306	3·0	0·06	—	—	25,000	7	11 0	General purpose
	G.410	3·8	0·1	—	—	20,000	7	11 0	General purpose
NEUTRON—									
Neutron Ltd., Sentinel Hse., Southampton Row, W.C.1.	L.406	3·5–4	0·06	20–100	0–6	12,000	6–7	12 6	L.F. valve
OCTRON—									
H. S. Electric Ltd., 32, Charlotte St., Birmingham.	H.R.408	3·7	0·08	80–120	0–3	50,000	18	10 6	Res. coupling
	L.408	3·7	0·08	60–100	0–6	16,000	7·5	10 6	General L.F. and det.
	L.P.430	3·7	0·30	60–120	4–9	9,000	5	10 6	Power valve
OSRAM—									
G. E. C. Ltd., Magnet House, Kingsway, W.C.2.	R.	4·0	0·7	30–100	0–6	40,000	9	8 0	General purpose
	D.E.3	2·8	0·06	20–80	0–6	22,000	7	14 0	General purpose
	D.E.3B.	2·8	0·06	120 max.	0–4·5	50,000	17	14 0	Res. coupling
	D.E.4	3·8	0·30	20–120	0–9	10,000	7	18 6	Power valve
	F.E.3	4·0	0·7	6–15	+6–15 (inner grid)	20,000 –8,000	4·5	16 6	Four-electrode
	D.E.V.	3·0	0·2	20–60	0–4·5	24,000	6	25 0	Special tubular type
QUIKKO—									
J. W. Pickavant, Quikko Works, Lombard St., St., Birmingham.	D.E. 2 L.F.	4·0	0·2	120 max.	0–7·5	14,000	5	8 0	General purpose
	D.E. 2 H.F.	4·0	0·2	120 max.	0–4·5	45,500	14	8 0	Res. coupling
	P.4	4·0	—	—	—	—	—	9 0	Power valve
	B.E.L.F.	3·5	0·5	100 max.	0–7·5	12,000	6	4 3	L.F. and gen. pur.
	B.E.H.F.	3·5	0·5	120 max.	0–4·5	52,000	18	4 3	Res. coupling
RADION—									
Radion Ltd., Bollington, nr. Macclesfield.	406 L.F.	3·7	0·06	60–120	0–6	18,000	7·2	10 6	General purpose
	406 H.F.	3·7	0·06	60–150	0–9	60,000	20	10 6	Res. coupling
	4.V.L.S.	3·8	0·4	60–120	0–9	10,000	8	15 0	Power valve
	Pyramid 2	3·8	0·34	40–120	0–9	8,000	5·6	17 6	L.F. and last stage
	Pyramid 3	3·8	0·18	40–120	0–9	8,000	5·6	17 6	L.F. and last stage
	D.E.·06 L.F.	2·7	0·06	40–100	0–6	19,000	5·7	10 6	L.F. and gen. pur.
	D.E.·06 H.F.	2·7	0·06	40–120	0–6	59,000	16·8	10 6	Res. coupling
RADIO-MICRO—									
H. D. Zealander & Co., 124, Minories, E.1.	Special Power	3·5	0·06	40–80	—	30,000	—	8 6	General purpose
	New Power	3·5	0·3	40–250	—	8,000	—	11 0	Power valve
		3·5	0·1	40–250	—	10,000	—	12 0	Super power valve
RADVACO—									
Blitz Bros., 3, Lynton Rd., Horn Lane, Acton, W.3.	S.B.1	3·0	0·06	30–100	—	25,000	10	7 6	General purpose
	S.B.4	4·0	0·7	50–200	—	25,000	10	3 6	General purpose
	S.B.3	3·5	0·5	25–75	—	40,000	10	3 6	General purpose
	S.B.5	4	0·7	4–12	—	—	—	9 0	Four-electrode (4-pin)

(To be continued.)

AN AMAZING SUCCESS

SPECIAL NOTICE.

Owing to the extraordinary success of S.T. valves, as evidenced by the tributes from all wireless journals, and the fact that the sales of my valves are going up by leaps and bounds, I find it physically impossible to continue to initial with my own hand and pen the test certificate on each valve box. After January 27th, a rubber stamp or other similar method will be employed.

The huge increase in sales has necessitated this step, but the policy of being personally responsible for the extremely accurate tests of every S.T. valve is in no way altered. On the other hand, I shall have more time to attend to such matters.

(*Signed*) JOHN SCOTT-TAGGART.

BROADCAST NOTES.

BY OUR BROADCASTING CORRESPONDENTS.

The Prime Minister Again—One Recital Dropped—Mr. Stenson Cooke's Talks—The Children's Hour—Short Story Readings—Progress at Belfast—Dance Music on Sunday—Seaside Nights Again—The First Alternative—Miss Crue Davidson at Glasgow—Mr. Lloyd George Takes a Hand—The "A.B.C."—Queen's Hall Future—Plymouth to Calcutta—Surprise in Salvation Army Service—Soccer from Swansea—B.B.C. Controller in Switzerland.

The Prime Minister Again.

THE Prime Minister is to be heard on the ether once again, the occasion being the Annual Dinner of the Chamber of Shipping on February 16th. Mr. Baldwin is very popular as a broadcaster, quite apart from his official position. Listeners still remember how he scored off his opponents at the General Election in which he delivered his broadcast address from a studio and not from a public hall.

One Recital Dropped.

As a result of the present move to lighten the programmes, the 8.45 recital is to be dropped at once. Popular music will be substituted.

Mr. Stenson Cooke's Talks.

The revived offensive against Mr. Stenson Cooke's A.A. talks appears to have gained some ground. It is understood that this feature will shortly disappear from the programmes, and will be replaced by talks sponsored by a rival motoring organisation. The change is not likely to be any more popular than a recent change in the Children's Hour.

The Children's Hour.

The B.B.C. yielded quite neatly and gracefully over the Children's Hour. No announcement has been made; but this programme feature is now restored in all its details, including avuncular relatives.

Short Story Readings.

Plans are in hand for a new series of short story and dialect readings by well-known authors. Names already mentioned in this connection are P. G. Wodehouse, Somerset Maugham, and A. E. W. Mason.

Progress at Belfast.

The Belfast B.B.C. Station appears to be much more popular among its listeners than has ever been the case before. There is more co-operation with civic and state bodies. An example of this will be provided on February 9th, when in co-operation with Queen's University, Belfast, a special concert given in the University Hall will be relayed by the B.B.C.

Dance Music on Sunday.

It is believed to be the intention of the Governors of the B.B.C. to introduce dance-music from Daventry on Sunday afternoons and evenings. The dancing habit has long since ceased to be confined to weekdays, and this step would do much to promote the popularity of the new authority.

Seaside Nights Again.

The Seaside Nights so popular in the programmes last year are to be revived and extended this year. These taken in conjunction with frequent appearances of the new permanent Concert Party and the Roosters, are all on the side of the "anti-talk pro-entertainment" faction at Savoy Hill.

The First Alternative.

There is already much discussion about what is to be done with the first alternative wave-length, which will be working from Daventry in the autumn. Power will be of about 15 kw. and on a low wave, so that it should be alternative in the service areas of 5 X X and 2 L O. Most listeners would like continuous jazz; but it is unlikely that this will be conceded. The more probable fate of the first of the new waves is as a dumping ground for the stuff that at present encumbers the 2 L O and 5 X X entertainments. There is quite a proportion of the duller educational material which is actually forced on the B.B.C. by interested bodies and by Government Departments. If all this can be cleared off the Daventry and London waves, then these programmes can be enormously brightened. The uplift merchants can do their worst on the new Daventry wave, which nobody will tap.

Miss Crue Davidson at Glasgow.

It is a sign of a considerable strengthening of the Glasgow programmes in the afternoons that Miss Crue Davidson, the eminent Scottish contralto, has been engaged to broadcast from Glasgow S.B. to Scotland on Friday, February 4th. Apparently the disciplinary action against Glasgow contemplated at Savoy Hill over the time-signal fuss is not to be taken as yet. Edinburgh has not abandoned hopes, however, of ousting her commercial rival in the ether.

Mr. Lloyd George Takes a Hand.

The movement for separate Welsh broadcasting has claimed the attention of Mr. Lloyd George, who is now considering whether this might not be turned into a useful political issue. Since the breakdown of the negotiations for the broadcasting of the 1927 Eisteddfod, the feeling against the B.B.C. has appreciably hardened in North and Mid-Wales. There is insistent clamour for an entirely separate service and organisation. Post Office returns show that the licence revenue from the whole of Wales is a good deal less than the cost of the Cardiff Station alone. Therefore, the Welsh are already receiving a subsidy from English listeners. If the B.B.C. were to withdraw entirely from Wales, the revenue available locally would just about maintain the Swansea relay station working less than half the number of programme hours it works at present. So nothing will come of this new movement whoever sponsors it politically. When the West Country Regional Station is established next year, the listeners in North Wales will have a better service, and will have as much Welsh as they can stomach.

The "A.B.C."

Mr. Archibald de Bear is reviving his "Anti-Broadcasting Company," the "A.B.C." which was launched with such a flourish at the time of the Sitwell fracas. It is understood that various moves by intermediaries to heal the breach between Mr. de Bear and the B.B.C. have only had the effect of intensifying the bitterness and the outbreak of large-scale hostilities cannot be long delayed.

Queen's Hall Future.

The Governors of the new B.B.C. are understood to be considering a number of proposals for absorbing or "trustifying" the Queen's Hall. It would seem probable that this great centre of music will belong to the B.B.C., or at least be under the control of the B.B.C. by the end of 1927.

Plymouth to Calcutta.

Mr. Eric Dunstan has been followed to India by Mr. S. Wallich, the popular and efficient director of the Plymouth Station. Mr. Wallich will be in charge at Calcutta.

Surprise in Salvation Army Service.

A special Salvation Army Service and Appeal will be broadcast from London on February 20th. The service will contain a surprise feature.

Soccer from Swansea.

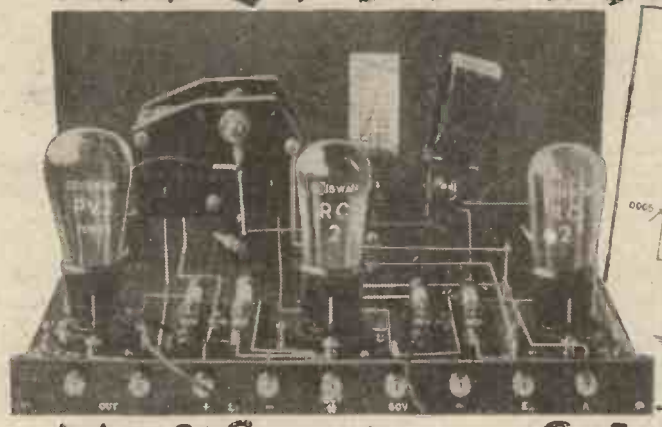
The Wales versus France Soccer Game will be broadcast S.B. from Swansea on Saturday, February 26th, from 2-30 to 4-0.

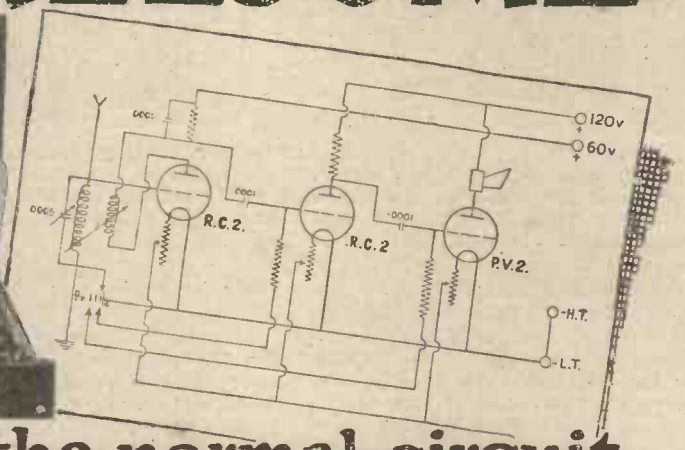
B.B.C. Controller in Switzerland.

Vice-Admiral Carpendale, the B.B.C. Controller, who has been on extended leave in Switzerland, is reported as having won several trophies in ski-ing and skating competitions.


THE CHILDREN'S HOUR
AUNTIE MIRIAM IS GOING TO SING TO YOU AND UNCLE REG WILL TELL YOU ALL ABOUT THE ENCHANTED EGG.
PROFESSOR BODDLE WILL NOW DELIVER A LECTURE ON "THE FUTILITY OF FAIRY TALES"
THE PASSING OF THE UNCLES AND AUNTIES.
FRANK SHAW

R.C. THREESOME





Modification of the normal circuit to *increase range and selectivity*

CONSTRUCTORS have acclaimed the R.C. THREESOME as the leader of receiving sets for pure reception of the local station. In some cases, however, *additional range and selectivity* are required, and not solely a receiver for pure reception of the local station.

To meet this need a method of introducing reaction into the circuit has been devised, and in addition to providing increased range and selectivity to the constructor with a really efficient aerial, it also enables the Threesome to be used on an inefficient aerial, with first-rate results.

There are certain districts in the country which are known as "blind spots," and others where reception conditions are not good. In all these cases the modification will satisfactorily overcome the difficulties.

EDISWAN WIRELESS SERVICE

Refer your wireless problems to EDISWAN. Experts will advise you. There is no charge made. Address your queries to Service Department.

FREE BLUE PRINT & INSTRUCTIONS

In order that the R.C. THREESOME will give satisfaction even in these cases, an additional blue print (which can be laid over the original blue print) has been prepared, together with a leaflet of instructions giving details of the necessary alterations. There is no trouble whatever in carrying out the instructions.

CUT OUT COUPON AND SEND NOW!

EDISWAN

V.20

To THE EDISON SWAN ELECTRIC CO. Ltd.
(Publicity) 123/5 QUEEN VICTORIA STREET LONDON, E.C.4

Please send, post free, presentation copies of (mark with a cross the literature required)

R.C. Threesome Instruction Book and Blue Print
R.C. Threesome Modification Blue Print and Instructions

Name .....

Address .....

PLEASE USE BLOCK LETTERS .....

P.W. 5/2/27.

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

A VERSATILE TUNING UNIT.

THE Wireless Apparatus and Battery Charging Co., of 256, Narborough Road, Leicester, recently sent us one of their Imperial All-Purpose Coils to test. It is a very versatile sort of component. It is about the size of an L.F. transformer of average dimensions, and is in shape a cylinder with convex ends. Two knobs and pointers of similar appearance project from one side, but one has a dial scaling through 180 degrees, from 1 to 7. The latter is an "aerial" control, the former a reaction coil adjustment. Six terminals are fitted to the unit, and with three of these three different sizes of reaction coil are obtainable. The other three include two aerial "tappings" and one earth terminal.

Additionally a plug and socket are fitted, which enables the unit to be plugged into a coil holder like an ordinary coil. Alternatively it can be mounted on the panel similarly to any other tuning unit.

Altogether, as will no doubt be agreed, the "All Purpose" fully deserves its name, the more so as it can be used as an anode unit, with or without reaction if desired. We carefully tested the sample sent us, and it gave good results. In an aerial tuning capacity it adequately covered a range of from 200 to 3,000 metres, although it was necessary to vary the reaction tapping towards each end of this band.

It is a very compact, well-made unit. The control operates smoothly and efficiently. Its retail price is 27s. 6d., and this, in our opinion, is more than reasonable.

* * *

A USEFUL BOOKLET.

An interesting and informative little booklet entitled "How to Build Your Own High-Tension Eliminator for A.C. or D.C. Mains," has just been produced by the Telegraph Condenser Co., Ltd., of Wales Farm Road, North Acton, London, W.3. Written by Percy W. Harris, it is illustrated with a number of clear photographs and easy-to-follow diagrams. It is available for any "P.W." reader who sends 3d. for postage and part cost of production.

* * *

TWO CHEAP VALVES.

The following two "Atwil" valves were recently sent in for test by M. Stanley & Co., of 174, London Road, Liverpool.

1·8—2 volts; ·25 amps.; 50—150 volts H.T.; impedance 10,000 ohms. Price 6s. 9d.

5·5—6 volts; ·25 amps.; 50—150 volts H.T.; impedance 8,000 ohms. Price 7s. 6d.

On test we found that the two-volter made quite a good detector, a fair H.F. amplifier, and a good L.F. amplifier when handling medium inputs. It is stated to be a power valve, but it would not occupy the last stage of a three-valver employing two stages of L.F. amplification without slight distortion occurring. Nevertheless, in receivers of medium sensitivity (two or three valves employing one stage of transformer-coupled L.F., for instance) it gives results out of proportion with its price.

The six-volter was found to be capable of handling much more power, and very creditably occupied the "last" valve holder of a multi-valve set. Amplification of a high order was accomplished without distortion. We agree with Messrs. Stanley when they modestly state that there are better valves on the market, and we also agree with them when they add that the "Atwils" represent excellent value for money on a "costs to results" ratio.

(*Continued on page* 1384.)

APPARATUS TESTED.

(*Continued from page* 1382.)

NEW M.H. H.F. CHOKE.

A very cleverly designed H.F. choke has just been placed on the market by L. McMichael, Ltd., Wexham Road, Slough. Bucks. It has been designed to have a value of 60,000 microhenries, together with a very low self-capacity. The windings are accommodated on a slotted barrel former with coned ends. The ohmic value of the device has been kept low, and altogether it is a choke of a very superior nature. We have found it to operate efficiently in both short and long wave receivers, and thus it passes the "acid test" for H.F. chokes.

From a constructor's point of view, too, this latest M.H. production has advantages over many others on the market in that it can be baseboard mounted in the usual way, or it can be separated from its base and mounted between clips similarly to anode resistances and other such items.

In conclusion, we can thoroughly recommend this choke to our readers for use in either standard or special sets. Its price is rather below the average for this class of component, being only 9s.

* * *

LAMPLUGH S.L.T. VARIABLE CONDENSERS

We recently received two Lamplugh S.L.T. Variable Condensers, from S. A. Lamplugh, Ltd., of King's Road, Tyseley, Birmingham. One is of ·0005 mfd. (13s.), and the other ·0003 mfd. (12s. 6d.) Both are fitted with slow-motion movements, which provide excellent controls. The drive is positive and yet "velvety" and free from "backlash." Nicely engraved dials are fitted. These variables conform to all the normal "low loss" requirements, and very little solid dielectric is incorporated in their designs. They are well made, nicely finished, and leave no room for criticism. Their prices (shown above) are quite reasonable.

This is one of Brandes' receivers. Note the almost severely symmetrical lay-out of the panel.

EELEX TERMINALS.

We have received a further supply of Eelex Treble Duty Terminals from Messrs. J. J. Eastick & Sons, of 118, Bunhill Row, London, E.C.1. These terminals, which are supplied with indicating lettering, are substantial, yet neat in appearance, and are of a very useful design. They will accommodate either spade or pin type wire terminals, or ordinary wire or plugs. Naturally, they cost a little more than the plain W/O type of terminal, but once fitted to a receiver they provide insurance against many of those annoying little delays in wiring up batteries, loud speakers, with varying types of terminals, etc.

* * *

A "VARIABLE FIXED" RESISTOR.

Messrs. Bulgin recently sent us one of their baseboard-mounting "Deckorem" "variable fixed" resistors. Having a maximum resistance of 50 ohms, this component takes up but a square inch or so of baseboard area, but it has a height of three inches. Adjustment is by means of a slider which provides an efficient and positive contact. But we notice a tendency for this slider to push turns of the resistance wire together and thus short little bunches out of circuit. But this trouble could be overcome quite easily by slightly rounding the edges of the slider.

* * *

AN INTERESTING SOLDERING MATERIAL.

The Rexo Engineering Co., 2, Ravenscroft Square, W.6, recently sent us a supply of Junit, a wire which needs no solder. It is square in section and carries grooves on two sides in which it holds solder. Thus it is tinned and absolutely ready for just a little flux and the application of a hot iron to complete connections. We have tested samples of Junit submitted to us, and find it easy to handle and consider it well able to make clean, neat soldering work a simple task even when used by even a tyro.

Junit, 17 gauge square section, sells at 1s. per coil, which is quite generous in size, or 3-yard coils 18 gauge at 6d. Two-foot straight lengths are obtainable at 2d. per length.

RADIOTORIAL

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

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

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

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

TECHNICAL QUERIES.

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

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

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

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

Details of the "P.W." BLUEPRINTS are published fortnightly in the advertisement pages of "P.W."

(Continued on page 1388.)

LOW H.T. OPERATING COST!

DO you realise what this means to your upkeep expenses?

The indiscriminate use of any nondescript type of H.T. Dry Battery may be costing you several hundred per cent more than is necessary. The new **SIEMENS SUPER-RADIO DRY BATTERY** has approximately **7½ times the capacity** of the usual "small unit" H.T. battery, **but only costs 2½ times as much** per volt.

If you possess a multi-valve wireless set you will appreciate the eventual saving which can be effected by installing this battery, long life being one of its special features.

It is the only H.T. Dry Battery recommended by Burndept Wireless Ltd. for use with their receiving sets, a very significant fact which should not be disregarded.

A copy of our Catalogue No. 650, containing full particulars of the correct type and size of battery to use for any radio purpose, and also hints on the care and maintenance of dry batteries will be sent, post free, on application.

SIEMENS BROTHERS & CO., LTD., WOOLWICH, S.E.18

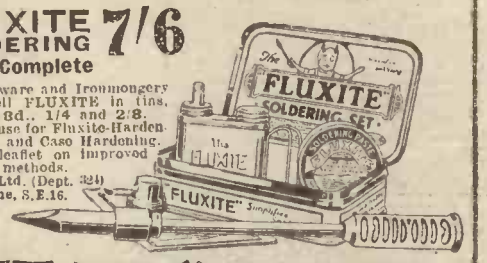
Weak Joints *need* Strong Treatment

An imperfect joint . . . a tiny leakage . . . gone are the chances of good, long-distance reception.

The Fluxite Soldering Set will fix all joints quickly, and for ever. No trouble . . . no mess . . . and so simple.

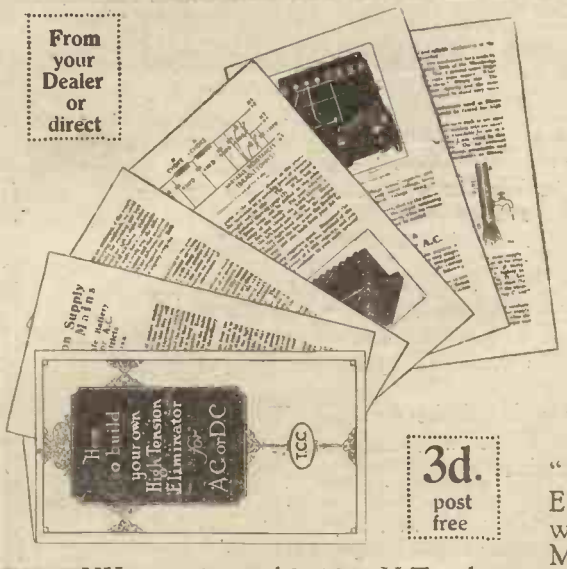
FLUXITE SOLDERING SET—Complete 7/6

All Hardware and Ironmongery Stores sell FLUXITE in tins, price 8d., 1/4 and 2/8. Another use for Fluxite-Hardening Tools and Case Hardening. Ask for leaflet on improved methods.
FLUXITE Ltd. (Dept. 324) Rotherhithe, S.E.16.



FLUXITE

From your Dealer or direct



3d. post free

Build your own H.T. Eliminator

Here's a book that will show you how to do it!

WHY continue buying H.T. dry batteries when right in your own home is current waiting to be used. Enthusiasts everywhere, now, are saving money by obtaining H.T. Supply from their electric light mains. At little cost and without skill they are building their own H.T. Eliminators which enable them to obtain constant H.T. supply at very little cost.

There is a little book available which gives clear concise instructions and easy-to-follow photographs and diagrams which enable them to build their own units. It is called "How to build your own High Tension Eliminator for A.C. or D.C.," and is written by Mr. Percy W. Harris, M.I.R.E., for appropriately enough, the makers of T.C.C. Condensers.

Write for this booklet—or get it from your Dealer's—and with very little study you'll be able to build an eliminator which, because it is designed and described by an authority, is absolutely efficient and which, because it employs the special T.C.C. 600 volt D.C. Test Condensers, is perfectly safe and reliable. Get your copy to-day. It only costs 3d.

T. C. C. Condensers for Battery Eliminators

Advt. Telegraph Condenser Co., Ltd., Wales Farm Road, N. Acton, W. 3. *Gilbert Ad. 7468*

RADIOTORIAL.

Continued from page 1386.)

BACK OF PANEL DIAGRAMS can be specially drawn up to suit the requirements of individual readers at the following rates: Crystal Sets, 6d.; One-Valve Sets, 6d.; One-Valve and Crystal (Reflex), 1s.; Two-Valve and Crystal (Reflex), 1s.; Two-Valve Sets, 1s.; Three-Valve Sets, 1s.; Three-Valve and Crystal (Reflex), 1s. 6d.; Four-Valve Sets, 1s. 6d.; Multi-Valve Sets (straight Circuits), 1s. 6d. Except **SUPER-HETERODYNE DIAGRAMS**, all of which, irrespective of number of Valves used, are 2s. 6d.

If a list of point-to-point connections is required an additional fee of 1s. must be enclosed. Wiring diagrams of commercial apparatus, such as sets of any particular manufacture, etc., cannot be supplied. (Such particulars can only be obtained from the makers.) Readers may submit their own diagrams, etc., for correction or for criticism. The fee is 1s. 6d. per diagram, and these should be large and as clear as possible.

No questions can be answered by 'phone.

Remittances should be in the form of Postal Orders.

INSERTING GRID BIAS.

"RATHER WORRIED" (Stockton-on-Tees).—Two or three months ago I bought a 2-valve set from a man who has gone abroad. It worked very well indeed, and he told me it would work a loud speaker easily if I liked to get a better transformer for it, as the one in it was only a very cheap foreign one.

Thinking I would get a real good one I waited and paid 25s. for the transformer, but now I find I can't connect it up properly. The terminals on it marked Grid, H.T.+ and Plate are easy enough to connect up, but what about the one marked Grid Bias? I haven't got any grid bias on the set.

There is no need for you to be worried, "Rather Worried." Although this terminal is marked "Grid Bias," it *can* be connected just like the other transformer was, i.e., to the lead that goes to L.T. negative.

A much better plan, however, would be to buy a 4½-volt tapped grid bias battery, and two plugs for it, with short leads of flex wire.

Then all you need do is to stand the battery inside the set, or conveniently near to it, and place the red plug in position at the + end of the battery. This red plug must be joined by one of the flexible leads to the L.T. negative wiring. The other plug (black) is joined by its flexible wire to the terminal on the transformer marked "Grid Bias," and then the black plug is inserted in the battery at the point which gives clearest and best results on the loud speaker. You will probably find this at the 3-volt position.

ARE BASKET COILS OBSOLETE?

T. S. W. (Southampton).—Are the old-fashioned "basket coils" considered to be efficient nowadays? I should like to know, because although I've always had splendid results from them on ordinary broadcasting wave-lengths, I don't want to include them in my new 4-valver if they have been proved to be inefficient in use.

(Continued on page 1390.)

TECHNICAL QUERIES.

Owing to very heavy pressure on the Technical Staff, there is a little delay in despatching answers to readers' queries.

At the moment every effort is being made to get replies posted within about 10 days of receipt, and it is hoped to reduce this period very shortly. Readers can help by making their questions as short and clear as possible.

RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 1388.)

The set is one I am going to take to sea with me—I am a ship's officer—and I prefer basket coils because they take less room than the wound-on-tube type.

Recent tests have again and again vindicated the old-fashioned basket coil as being one of the most efficient types it is possible to employ. As you are used to this type we should certainly carry on with basket coils in the new set—they can be tapped in the same way that the solenoids can, if you are keen on a "split-primary" or a split-secondary circuit, but the degree of coupling has to be carefully watched, both between the primary and secondary and between one pair of coils and another pair.

SUPPORTING SPIDER-WEB COILS.

"COIL-HOLDING" (Leighton Buzzard).—What is the easiest method of mounting spider-web coils to project below a panel?

Two good and easy methods are shown by the accompanying photograph. To the right is a spider-web coil mounted upon a terminal, by the simple expedient of bending over one of its projecting sections. (The others have been cut off to make the coil smaller.)

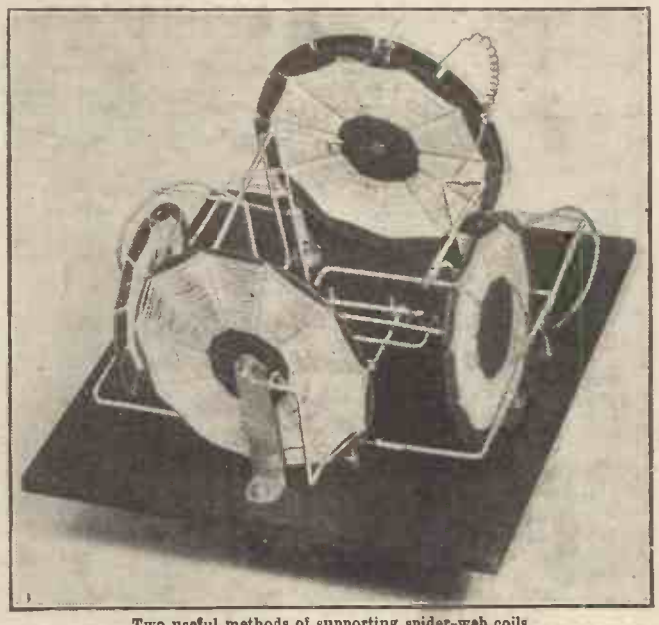
In the foreground is another (larger) coil, mounted upon a short brass strip, as in this instance the projection of the cardboard former was not long enough to utilise as before.

"TINNING" A SOLDERING IRON.

R. L. A. (Clacton-on-Sea).—How should a soldering iron be "tinned"?

Heat the iron over gas or a clear fire until it commences to "burn" a little with a bright green-tinted flame. Then file the tip of the iron till each surface is bright and clean. Have prepared a shallow tin lid—such as the lid of the flux, or preferably something a little larger—with some flux and a piece or two of solder inside it. Dip the cleaned, heated iron into this and rub it on the lid, and it will be found that the

(*Continued on page* 1392.)



Two useful methods of supporting spider-web coils.

RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 1390.)

solder will "run" smoothly over all the surfaces, making the tip of the iron clean and bright.

AMPLIFIERS' UNSATISFACTORY RESULTS.

F. E. B. (Shoreham, Kent).—The 2-valve amplifier that I got for my set is proving very unsatisfactory—in fact, the set was almost, if not quite, as good without it. What is likely to be wrong ?

You don't even say what kind of a circuit your set employs, and as much depends on this, it may be necessary for you to write again, giving us fuller particulars, such as the name or a sketch of the set, or some other means enabling us to visualise your difficulty.

The likeliest cause of the trouble, however, is failure to connect up correctly.

If your present set is a *crystal* set (not a crystal-reflex, but a crystal-without-a-valve set) try joining the amplifier's H.T. neg. terminal to its L.T. neg. terminal by a short length of wire. This may cure the trouble, showing that the amplifier you have was designed as an amplifier for a valve set, and this connection between L.T. and H.T. had been advisedly left off.

If it does *not* cure the trouble you had better send further particulars, and preferably a sketch showing how the two sets are at present connected together.

POSTAL QUERIES.

It is necessary to remind our readers that only in cases where they wish to make suggestions for future articles, to raise points which can be dealt with in print, or to report results, should they write direct to Mr. Harris or other authors.

No guarantee can be given of a reply to any letter addressed in this way, even when a stamped addressed envelope is enclosed, and it is pointed out that all questions of a technical nature *must* be sent to the Query Department, observing the usual rules. Under no circumstances whatever should remittances of any sort be sent direct to Mr. Harris or any other writer, since such remittances do not pass through our usual system of booking, and it is practically impossible to trace them in the event of any subsequent inquiry.

"IS BIRMINGHAM FALLING OFF?"

"DISSATISFIED" (Nuneaton).—Why is it that the voices at 5 I T seem to get farther and farther away each week ? When I first got my set, back in September, I had right good loud voices every night. But now I have to listen hard, and very often I miss words here and there. Is Birmingham falling off, or what ?

No. We are afraid you can't blame Birmingham ; but the fault lies somewhere at your end. Unfortunately, you have omitted to tell us anything at all about your set that would help us to help you, but below we have set out the likeliest causes of your trouble.

(*a*) Loose or dirty contact of the aerial wire, earth wire, lead-in, or (less probably) a loose or dirty connection inside the set would cause the trouble.

If the set is a crystal set, the cat's-whisker may have become dirty or blunt, or you may have accidentally soiled the crystal surface.

If you live near big factory chimneys, etc., a thick deposit of soot or dirt on your aerial insulators would account for the slow reduction in strength.

If the set is a valve set, the H.T. battery may be running down. Often it does not give out suddenly like the L.T., but gets slower, weaker and weaker, as you describe.

Perhaps you have been a little careless about the correct filament voltage and have tuned the rheostats too far. If so, the valve filaments may be "overrun." This would be indicated, too, by the fact that the filament resistance now has to be "all out" all the time to get best results.

There are several other causes which may be operating in your case, but we will give only two more likely ones.

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from previous page.)

These are, first, dust or dirt between the contact studs of a switch, valve legs, or similar places where insulation is important.

And, secondly, rust or some similar trouble in the telephones which may be failing to reproduce what is put into them. If, for instance, a loud speaker is used, demagnetisation of this would give a somewhat similar effect.

TURNS FOR FRAME AERIAL.

"FULHAM FLAT" (Fulham Palace Road, London, S.W.).—I cannot use an outdoor aerial, so I am going to make a frame. I want it to be as efficient as possible—what size should it be, and what number of turns?

We should use a frame having sides 4 ft. square, all the wires being the same length, and not wound one *within* the other, as is sometimes done.

You will need about eight turns of light flex wound round the frame, the turns to be spaced about half an inch apart.

BACK NUMBERS OF "P.W."

"BACK NUMBER" (Goring-on-Thames.)—Where is the best place to obtain back numbers of "P.W."?

Write direct to:

The Amalgamated Press (1922), Ltd.,
Back Number Dept.,
Bear Alley,
Farringdon St.,
E.C.4,

stating the number required, and enclosing 4d. in stamps.

VALVE CHARACTERISTICS.

"VALVO" (Soham, Cambridgeshire).—What gives different valves their different characteristics? To the casual observer a pair of them will often look alike and yet be quite unlike in operation. On the other hand, some valves which look very dissimilar appear to be blood-brothers as far as performance in the set goes.

The characteristics of a valve are determined chiefly by the shape and relative positions of its electrodes and partly by the degree of vacuum to which it is subjected.

For instance, by using a grid with a close mesh (many threads of wire spaced close together) a valve can be given a high magnification factor and a high impedance.

Now, if other conditions were unchanged, the substitution of an open grid for the close mesh would be found to have the effect of reducing the magnification factor of the valve, and also its impedance.

It is this fact, as well as the need for mechanical stability, etc., that accounts for the wide variations in the arrangement of the modern valve's electrodes.

VARIOMETER CONNECTIONS.

C. G. (Faringdon, Berks).—What is the surest and safest type of connection for the moving part of a home-made variometer?

The "pigtail," in which a spiral of thin metal is used, as shown in the illustration, is the most satisfactory method of making such a connection.

PUTTING THE 'PHONES RIGHT.

G. E. A. (Southbourne, Bournemouth).—I have a friend coming to stay with me next

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from previous page.)

month, and I particularly want my spare 'phones to behave properly. Now they sometimes go a little "wonky," and I'm never sure how long they will stay perfect. Can I do anything to them, or must I send them to be overhauled ?

Try the following: Disconnect the 'phones from the set and examine the cords. If the covering is frayed bind it with thread so that the wire inside is protected. Pay special attention to the ends, where the strain is most severe. If the cords are fastened to the earpieces by nuts externally, try with your fingers to loosen the nuts. If you can do so they are too loose and should be given a little extra pressure with a pair of pliers.

Then test if the 'phones are sensitive. Put them on in the ordinary way, but instead of joining the tags at the end of the cords to the set's terminals, put one of them in your mouth. Now rub the other tag gently with a key or similar piece of metal. If there are corresponding noises in the 'phones you can be fairly sure that they are O.K.

If, however, you have found no loose nut and the 'phones do not seem as good as new, we should have them overhauled properly by a firm specialising in this class of work. (See the advertisement pages of this journal.)

"4-VALVE FAMILY" UP TO DATE.

S. J. A. (Hexthorpe, Doncaster, Yorks).—I have only just noticed that Mr. Harris has been modernising the Family Four.

What issue of "P.W." was the article in, and were the alterations drastic ones, or the sort that I could do easily in spending just week-ends at home ?

The "4-Valve Family Set" was brought up to date in "P.W.," Nos. 235 and 236 (December 4th and December 11th issues).

It proved to be quite an easy task, and the new fitments were not at all too expensive, considering the very great gain in both selectivity and sensitivity.

The changes incorporated were (*a*) introduction of separate grid bias for the L.F. stages.

(*b*) Provision of separate supply for H.F. and detector, first note-magnifying valve and second note-magnifying valve.

(*c*) Substitution of a coupled aerial for the direct connection, for the purpose of improving selectivity.

(*d*) Neutralisation of the H.F. stage so as to simultaneously improve both the sensitivity and selectivity.

(*e*) The substitution of jack switching so that the voltages applied to the detector and note-magnifying valves would not be altered when changing over from one combination to another.

(*f*) Provision of certain shunting condensers where needed.

"LEAKAGE" IN A NEW SET ?

H. J. L. (Haywards Heath, Sussex).—My new four-valve set, though correct according to the instructions, is only giving poor results, and I suspect a leakage somewhere. What are the likeliest places in which to look for this ?

If no fault can be found with the wiring of the set, look for any places where leakage might affect signal strength. For instance, has any damp or dirt collected on the underside of the panel ? Has any soldering flux filled the space between two valve legs and subsequently collected a lot of dust ?

Have any lines, drawn with a blacklead when marking out the panel, been left in ? Are any two bare connections touching ?

Are any components mounted on wood which has not been thoroughly dried out before using ?

Failing the discovery of any wiring fault or serious leakage inside the set, make certain that all components are in good order and suitable for their work, and that batteries, etc., are correctly connected to their respective terminals.

THE LODGE "N" CIRCUIT.

The Blue Print diagrams of the Lodge "N" Circuit which we present to our readers in this issue are for the benefit of bona-fide experimenters, and it should be clearly understood that the Lodge "N" Circuit is subject to Letters Patent, and that sets embodying this principle must not be constructed without permission of the owners of the patent.

Readers desiring to build up Lodge "N" receivers must first of all obtain permission to do so, and they should address their applications to the firm which is acting on behalf of Sir Oliver Lodge—i.e. Messrs. Romer & Skan, of 4, Copthall Chambers, London, E.C.2.

CORRESPONDENCE.

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

DYNAMIC VALVE CURVES.

The Editor, POPULAR WIRELESS.

Dear Sir,—Mr. Taggart's article in POPULAR WIRELESS for Jan. 8th, on "What Dynamic Curves Mean" does not seem to have thrown a great deal of light on the working conditions of the average amateur's valve. If I read the article aright what the author is intending to impress upon us is that the ordinary characteristic curve supplied by the manufacturer does not mean anything. To use his own words he wants to show us "how utterly fallacious it is to judge of how a valve will operate by looking at its static characteristic curve." It is interesting to note that Mr. Taggart encloses a sheet showing not dynamic but static characteristic curve of his valves in each box.

The sheet says that they are given "to serve as some comparison with other valves. Dynamic curves are obtainable on application." If the facts are as stated, what is the use of the comparison, and why are the dynamic curves not reproduced if they are so important?

Perhaps the reason is that a dynamic curve, as shown by the writer in his article, can only be given for one particular set of circumstances which, in nine cases out of ten, will not be those under which the experimenter will work his valve. The author's explanation of "Impedance" on page 1150 immediately shows up a difficulty, for the voltage, as he explains, set up across an inductance coil, when a *direct* current is passed through it, is negligible if we consider that the coil has a negligible ohmic resistance. If, as he goes on to explain, we set up an *alternating* current through this coil, appreciable potentials will be set up across the inductance. Obviously, the voltage in such circumstances will be dependent upon the frequency and, as a loud speaker is dealing with frequencies from, say, 40 up to 3,000 or more, the voltage set up—and therefore the dynamic curve—must be different for every frequency.

Again, on page 1152 the author seems to have made a slip, because he says "the loud speaker only has a relatively small resistance compared to that of the valve." The average loud speaker, I believe, has a D.C. resistance of 2,000 ohms, and super power-valves now sold usually have a resistance of round-about 3,000 to 5,000 ohms, to judge by the makers' advertisements. Personally, I should not call 2,000 "relatively small" compared with 3,000 or 5,000 ohms.

Yours faithfully,
"PRACTICAL MAN."

Kingston.

[A copy of the above letter was sent to Mr. John Scott-Taggart in order to give him an opportunity of replying. His reply is appended.—ED.]

MR. SCOTT-TAGGART REPLIES.

The Editor, POPULAR WIRELESS,
Fleetway House,
Farringdon Street, E.C.

Dear Sir,—Your correspondent, "Practical Man," raises several points.

1. He says that my article was intended to impress on the public that ordinary characteristic curves "mean nothing." There is not a word in the article suggesting anything of the kind; on the other hand, I refer to them as "valuable" (page 1152).

2. His next point is that dynamic curves represent a certain set of conditions. He is merely repeating a very definite statement to the same effect in my own article.

3. In his last point he definitely quotes me as saying that the loud-speaker resistance is small compared to the valve resistance, and disagrees. In my article I said it "may be." In any case, he is completely wrong technically and has got confused between the resistance and A.C. resistance of a valve.

My article was, I believe, the first one in POPULAR WIRELESS dealing with this subject, and I assumed that the Editor would prefer me to deal with the matter in a first article in the simplest manner possible, rather than in a school-teacherish pedantic way. From past experience, however, I have learnt to keep an eye on several classes of reader:

1. Those who know more than I do.
2. Those who think they do and read the articles as a kind of indoor sport.
3. Those who have a good technical knowledge and read with a genuine desire to learn.
4. Those who have less technical knowledge and who do not desire to be confused by too much technical detail.

(Continued on next page.)

CORRESPONDENCE

(Continued from previous page.)

I have always endeavoured to make even the simplest and most unconventionally written article accurate, although every detail and every apparent exception cannot and should not be explained. Although I am not infallible, there is no evidence at all in your correspondent's letter of any mistake on my part. Let me tackle each point separately:

He says: "If I read the article aright, what the author is intending to impress upon us is that the ordinary characteristic curve supplied by the manufacturer does not mean anything." He has not read the article aright. The title of the article is perfectly clear: "What Dynamic Curves Mean." Static characteristics are very valuable, especially if you have a lot of them. If I regarded static curves as useless, why should they be given in every valve carton containing an S.T. valve?

"Practical Man" himself seems rather worried about this, whereas the simple explanation is that not only do I not regard static curves as useless, but never said in my article that they were. On the contrary, on page 1152, I say they are "valuable."

What I said was that a static characteristic curve does not represent working conditions, but only conditions which never exist in practice. This is entirely different from saying the curves "do not mean anything."

I certainly suggested that it was "utterly fallacious" to look at, say, the 100-volt static curve, and judge from it what will happen in practice. I could give any number of examples of articles in the wireless papers where it is obvious that the authors regard the static curve as representing the working conditions. I go so far as to say that to judge the anode current readings from given grid potentials from the static curve would be "useless," and that the curve is "meaningless" for that purpose. But I never said, and never shall say, that a static curve does not mean anything. It means several things, but does not represent what happens in practice.

A "family" of static characteristic curves conveys valuable information to the technical man who knows all about amplification factors, impedances, etc., especially if the family is a large one. Dynamic curves are, as was explained in my article, derivatives of the "family." The dynamic curve can be obtained by calculation or direct measurement, but, as I say, it is customary amongst many students to look up, say, the 100-volt curve and make deductions from that which are absolutely meaningless, useless and fallacious. That is why I thought a simple article on the subject might be interesting to your readers.

Having dealt with this point, I should like to mention that when I write I do so as a private individual and do not expect the introduction of trade matters, but, as he has mentioned the question of S.T. valves, he may be interested in the fact that dynamic curves of S.T. valves are given in No. 1 of the Elstree Radio News.

My anonymous critic next points out that a dynamic curve represents only a given set of working circumstances. This is quite true, but a static characteristic does not represent any working conditions at all and has been the cause of infinite misunderstandings. Although I felt it best not to elaborate my article too much, I specifically said that a dynamic curve only holds good for the particular conditions which were specified. Variations in frequency alter the dynamic curve, since the output impedance is varied, and we consequently can produce a family of dynamic curves. As a matter of fact, there are two separate articles in the Elstree Radio News which go farther than my own in POPULAR WIRELESS. The new one by myself explains how very clearly dynamic curves emphasise how easy it is to get different distortion on different frequencies, and a small family of dynamic curves is given. Not only will the person ignorant of dynamic effects grossly exaggerate amplitude (bottom end) distortion, but his examination of static curves will reveal no distortion due to varying frequencies, whereas dynamic curves immediately show that bottom bend distortion may be negligible on the high notes, but serious on the very low ones.

There are numerous other reasons which make dynamic curves a necessary and fascinating study for the proper understanding of valves and valve circuits. They explain all sorts of phenomena which are not apparent from the static curves. But no extolling of the merits of dynamic curves can be fairly twisted into the suggestion that I have said static curves are "meaningless." I think and have said nothing of the kind, although I repeat that a static characteristic curve does not represent *working conditions* and is a regular source of all kinds of fallacies. To use the rough analogy of the non-rigid or semi-rigid airship, it is delightful to know its size and shape when still, if only to know what size of shed to put it in! If I were the designer, I should be far more interested in its shape and the stresses and strains on it while actually in flight, and I should not be less interested because these varied at different speeds of travel. The shape of the airship at rest corresponds to the static curve, while the flying conditions represent the dynamic curve.

(Continued on next page.)

CORRESPONDENCE.

(Continued from previous page.)

The last paragraph of "Practical Man," while supposed to point out a false apprehension on my part, is a very gross technical error on his, and, curiously enough, arises out of a lack of appreciation of the difference between static and dynamic conditions. He quotes me as saying that "the loud-speaker resistance only has a small resistance compared to that of the valve." He says that "the average loud speaker has a D.C. resistance of 2,000 ohms and super-power valves have a resistance of about 3,000 to 5,000 ohms. Personally, I should not call 2,000 relatively small compared with 3,000 or 5,000 ohms."

This criticism is really unimportant, because the point I was making was simply that when no signals were being received we could practically regard the anode voltage as being equal to that of the H.T. battery, but that when signals were received the big fluctuations across the loud speaker would vary the anode voltage above and below that of the H.T. battery. The value of the loud speaker resistance was quite immaterial to the theory, but since it is suggested that I made a slip, I propose to deal with it. What is more, I am going to ignore his slipshod quotation of my remarks. I did not say that the loud speaker "only has" a small resistance. My words were "may have," but even if I had said what he declares I said, I would still have been right.

His criticism would have made a good crushing ending to his letter. Unfortunately he has got confused between the resistance of the valve and its impedance, two entirely different matters. This confusion has arisen probably because we often speak of the A.C. resistance of a valve, and "Practical Man" has got mixed up between the resistance of a valve and the A.C. resistance (or "mean differential A.C. resistance," which is a more technical form).

While a super-power valve may have an A.C. resistance correctly rated at 4,000 ohms, its *resistance* may be very much higher. In the case of a certain super-power valve I have in mind, the anode current at 24 volts on the grid is 8 milliamps, with the anode at 120 volts. This means that the resistance of the valve under quite normal operating conditions is 15,000 ohms. I would consequently be right if I said that the resistance of the loud speaker (even if taken at 2,000 ohms, although some have a resistance of only 500 ohms) was small in comparison with the resistance of the valve.

Except for this last point, I think your correspondent's remarks are helpful in having afforded me an opportunity of elaborating my article. From his letter he obviously appreciates the importance of dynamic curves while regarding static curves as valuable as a basis. I entirely agree with these sentiments, and always have done so, and this letter cannot but satisfy him.

Should "Practical Man" desire to continue the discussion—although there appears to me to be no more to say—I trust he will write above his real name. In spite of the rather peevish tone of his present anonymous letter, I have given it every consideration in the hope of helping any readers genuinely interested in the subject.

Yours faithfully,
JOHN SCOTT-TAGGART.

MR. SCOTT-TAGGART REPLIES TO MR. ROYDS.

January 27th, 1927.

The Editor, POPULAR WIRELESS.

Sir,—Your further correspondent, Mr. A. D. Royds (published in last week's "P.W."), is apparently anxious to show that my simple introduction to dynamic effects is not a complete treatise on the subject. It is rather like a superior person criticising an elementary series of articles on electricity and complaining that the section on Ohm's Law is "incorrect" because it does not take into consideration negative resistance effects or Langmuir's equation dealing with the space current in a vacuum tube.

Like all critics who have a taste for dramatic statements about inaccuracy, Mr. Royds is really declaring as inaccurate not what I wrote, but what impression he himself got from my article. Although the article was not written for (to use his own phrase) "anyone pretending to any knowledge of dynamic curves" (in which class he obviously places himself), yet there is nothing to prevent anyone with threepence in his pocket from reading an introductory article such as mine. The least to expect, however, is, first, that the object and scope of the article will be borne in mind. A popularly written article of this kind was not intended to give Mr. Royds or myself an opportunity of exhibiting our technical knowledge. It was intended to indicate that the ordinary static curve gave entirely wrong impressions, not to Mr. Royds, of course, but to the average amateur, of what took place under actual operating conditions. I explained how the anode current fluctuations were entirely altered by the impedance of the anode circuit. To the best of my knowledge, the word dynamic had never before appeared in POPULAR WIRELESS.

The second consideration an author expects is, if his critic reads an article not meant for him at all, that the article shall be carefully read. Mr. Royds, in his haste, overlooks the little phrases and occasional

(Continued on next page.)

CORRESPONDENCE.

(Continued from previous page.)

words which I put in especially for his sake. His comments, on the whole, in my opinion, show a lack of sense of proportion, in that my article was really unworthy of his interest and certainly unworthy of his criticism, which should be reserved for stronger meat. Yet if he fails to appreciate the scope of an introductory article, he has nevertheless every right to expect accuracy. He must, however, be scrupulously accurate himself in searching my innocent little article for flaws which appeal to him. I use such sentences as "the negative half cycle at the maximum may only decrease the anode current to 10 milliamperes." Why do I say "may" instead of "will," although I am taking readings from an actual curve? The reason is that many years' writing and editorial experience has shown me that there is bound to be some individual in the Outer Hebrides or in Reigate who, if I said that the "anode current *will* decrease to 10 milliamperes" is certain to say: "Oh, no, it won't always. What about the case where the relative magnitude of the reactive and resistive components of the anode impedance are such that the decrease would be appreciatively different?"

Again, I continually refer to statements holding good for certain conditions. My cautiousness is also illustrated by my statement that the "loud speaker may have a relatively small resistance compared to that of the valve." I try my best to keep an eye on some possible meticulous critics, but I have no intention of sacrificing simple explanations by dragging in all sorts of matter which would seriously complicate an article. I doubt if the Editor would like me to sacrifice the interests of POPULAR WIRELESS readers to provide a Roman (or rather Reigate) holiday for Mr. Royds.

My critic complains that the dynamic curve should be shown in the form of an ellipse and not as the axis of an ellipse. He offers no explanation of why an elliptical curve can be obtained. Presumably he expected me to explain it. Let me say at once that the discussion of dynamic curves could be extended to a whole book. Let me supply very, very briefly what Mr. Royds would have liked to have seen in my article. Although a very simple case can be considered, yet the amplification of wireless signals can become extraordinarily complex. Differences in phase between the applied voltages on the grid and the resultant anode current have to be considered, and may produce ellipses which vary in shape and size. The minor axis and major axis may depend upon a whole set of circumstances such as the applied voltage, the inductance, resistance and capacity in the anode circuit, the capacity of the valve, the degree of reaction which may in itself vary, stray capacities, etc., etc. High and low frequency stages have individual problems. The case of an accurately tuned grid and a tuned anode circuit in an H.F. valve is naturally different from that of an L.F. transformer stage. The simple case of the dynamic curve of a valve used for resistance coupling would, no doubt, be condemned by Mr. Royds as totally inadequate. How much, of all this, is a writer to describe in an elementary article before my critic is satisfied? The subject is immense.

The statement that a dynamic curve is an ellipse might itself be characterised as slipshod. I am sure if I had referred to ellipses in my article, some person would have asked how does it become an ellipse starting from the grid bias point, what about spiral effects, is there time in practice for an ellipse to be formed, how far do broadcast signals trace out a Chinese puzzle of a dynamic curve resembling nothing on earth, what about limiting cases, what about dynamic curves where the anode circuit contains only a resistance and no reactive component, do you seriously imply that the ellipse cannot under appropriate circumstances resolve itself into a straight line? etc., etc. What good really does it do to introduce matters of this kind? Readers will judge for themselves how entirely altered the article could have been if I had complicated it.

My critic says that I regard ordinary curves as "unreliable," and that they are not. Of course they are not. I said they were "valuable." I explained that if you took a curve and judged the anode current changes in practice from the curve, then the results would be unreliable and utterly fallacious.

This was really the whole point of this simple article. Anyone reading the two letters of criticism might imagine that there was some controversy about dynamic curves. There is none whatever. If I have failed to elaborate my article to sufficient extent, I must ask Mr. Royds' indulgence, but the article was not written for him, and I was anxious to avoid burdening it with matter which would have made it extremely complex.

Mr. Royds also says that "anyone pretending to any knowledge of dynamic curves is able to picture from the ordinary static curves what the dynamic curves would be like." I admire his visualising powers, but, after all, the last person my article was written for was "anyone pretending to any knowledge of dynamic curves."

Yours faithfully,

JOHN SCOTT-TAGGART.

London, W.C.2.

TECHNICAL NOTES.

(*Continued from page* 1358.)

ray oscillograph, upon the wave-form of the current delivered from the low-frequency side of a receiving set, when using a regular choke coil, and when using a substitute coil, for example, the primary of a bell ringing transformer. It is not possible, in these notes, to reproduce the actual figures obtained, but it is interesting to note that the superiority of the results with the audio-frequency choke was very marked.

Experiments were also made to compare the purity of crystal rectification with that of the valve rectification; in this case it was found that, under proper conditions, the valve rectification could be equal in quality, or at any rate practically equal in quality, to that given by the crystal with, of course, the added advantage that greater voltage swings could be accomodated.

Cathode Ray Oscillograph.

Readers may not, perhaps, all be aware of the mechanism of the cathode ray oscillograph. This is a very interesting piece of apparatus, and one which has already found many important applications in radio engineering, and in electrical engineering in general. There are many elaborated forms of the appliance, but in its simplest form it consists of a vacuum tube about 12 in. in length and 3 or 4 in. in diameter, with suitable electrodes introduced for the purpose of producing a stream of electrons. The electron stream emitted from the cathode is projected along the axis of the tube and strikes the rounded end of the tube, upon the interior surface of which is a thin layer of some fluorescent substance, such as barium platino-cyanide or Willemite. When the tube is observed in a darkened room, the point at which the electron stream strikes the fluorescent screen is easily observed owing to the luminosity. The electron stream, shortly after emission from the cathode, is caused to pass between small metal plates which are insulated and arranged so that an electric field may be set up between them.

Thus the electrons whilst shooting through the field are subject to its influence and are deflected from their original course, with a consequent shift in the position of the luminous spot on the fluorescent screen. If the metal plates referred to be connected to a source of rapidly alternating or varying potentials, the spot on the screen will execute rapid motions correspondingly. It is here that the great advantage of the cathode ray oscillograph lies, as compared with any form of mechanical oscillograph, for the mass of the moving member, which in this case is the electron stream, is so exceedingly small that the system has very little inertia and consequently is able to respond faithfully to extremely rapid variations. It is this property which has rendered it peculiarly applicable to the study of telephone speech-currents and to the operation of the wireless valve.

Concerning Screening.

One of the most important tendencies in "set" design of recent months has been in the direction of improved screening, in order to avoid hand capacity and other interference effects. Screened coils are now quite commonly employed both in

(*Continued on next page.*)

TECHNICAL NOTES.

(Continued from previous page.)

the construction of commercial and amateur sets, with considerable improvement not perhaps so much in efficiency as in operation. In the design of superheterodyne sets, attention was much earlier paid to the important question of shielding, and the same remark applies to neutrodynes. As a rule, the general principle of shielding in these cases is the use of sheets of tinfoil or copper foil between the various stages.

IS THE TRANSATLANTIC RADIOPHONE A SUCCESS?

(Continued from page 1349.)

calls than business ones, at present. When you are having a friendly chat with a relative it really doesn't matter if your conversation happens to be overheard or not, or if you have to spend some time getting through—"

"Or (it was my turn to interrupt) whether you hear distinctly that Aunt Aggie's got a bit of a cold!"

We laughed together.

"But, seriously," said Mr. Selfridge, before saying good-bye, "I think this radiophone is a great stunt, and that every praise ought to be given to the people who have got it going. These are early days to say too much about it one way or the other, but it marks a distinct advance on anything that has yet been done. Everything novel is bound to go slow at first, and this time next year may see all the difference."

"Provided," I said, "that the authorities concentrate on clarity, quickness, secrecy, and reduction in cost?"

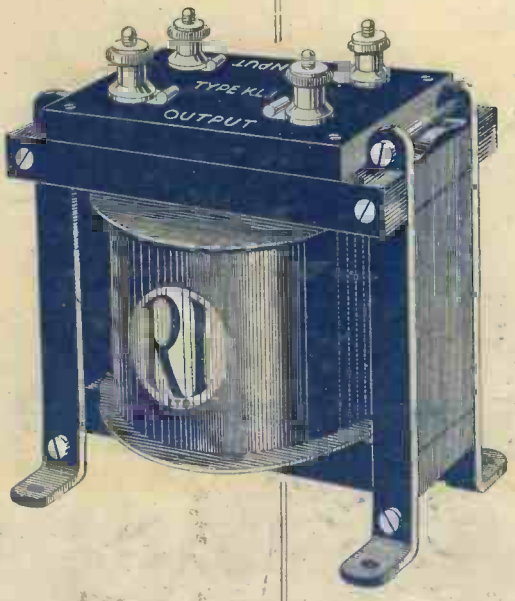
"Exactly," assented my companion. "Good-bye."

Straight from Oxford Street I went along to the Central Telegraph Office to see the chief engineer and ask him what was going to be done about removing the business man's radio difficulties as detailed by Mr. Selfridge.

When I got there, and when I telephoned later, I was told that I could not be seen, and that no information could be given on the matter.

This caused me no disappointment. Rather the reverse. I knew that if the chief engineer could not see anyone he must be very busy indeed. Busy, I suspect, upon the matters of clarity, quickness, secrecy, and reduction in cost! Let's hope he will have good news for us later!

R.I. K.L.1 Transformer for A.C. Mains



THIS transformer has been specially designed for the new G.E.C. K.L.1 Valve to operate direct from the electric light mains and is suitable for supplying the necessary power from 1 to 4 of the above valves.

This K.L.1 valve is designed to operate at a voltage of 3·5 and the fluctuation in voltage should not exceed 5 per cent.

The R.I. Power Transformer will maintain a ***constant*** voltage of 3·5 volts with a current of ***from 2 to 8 amperes*** for supplying up to 4 valves, and the watt consumption in the primary is negligible owing to the large iron core and special method of winding the coils, which are layer wound to avoid any possibility of short-circuit losses between the turns.

This transformer is absolutely safe; the insulation system between the primary and secondary is similar to that employed on large power transformers and there is no fear of injuring the K.L.1 valve through variations under load.

Ask your dealer to show you this new transformer. It is a sound engineering job throughout. It will save its cost in a few months by eliminating accumulators.

For Osram or Marconi K.L.1 valves.

Price 30/-

Write for the R.I. Green and Gold Catalogue

THE MARK OF BETTER RADIO

Advt. R.I. Ltd., 12, Hyde Street, New Oxford Street, W.C.1

All applications for Advertisement Space in POPULAR WIRELESS to be made to JOHN H. LILE, LTD. (Sole Agents), 4, Ludgate Circus, London, E.C.4. 'Phone: City 7261.

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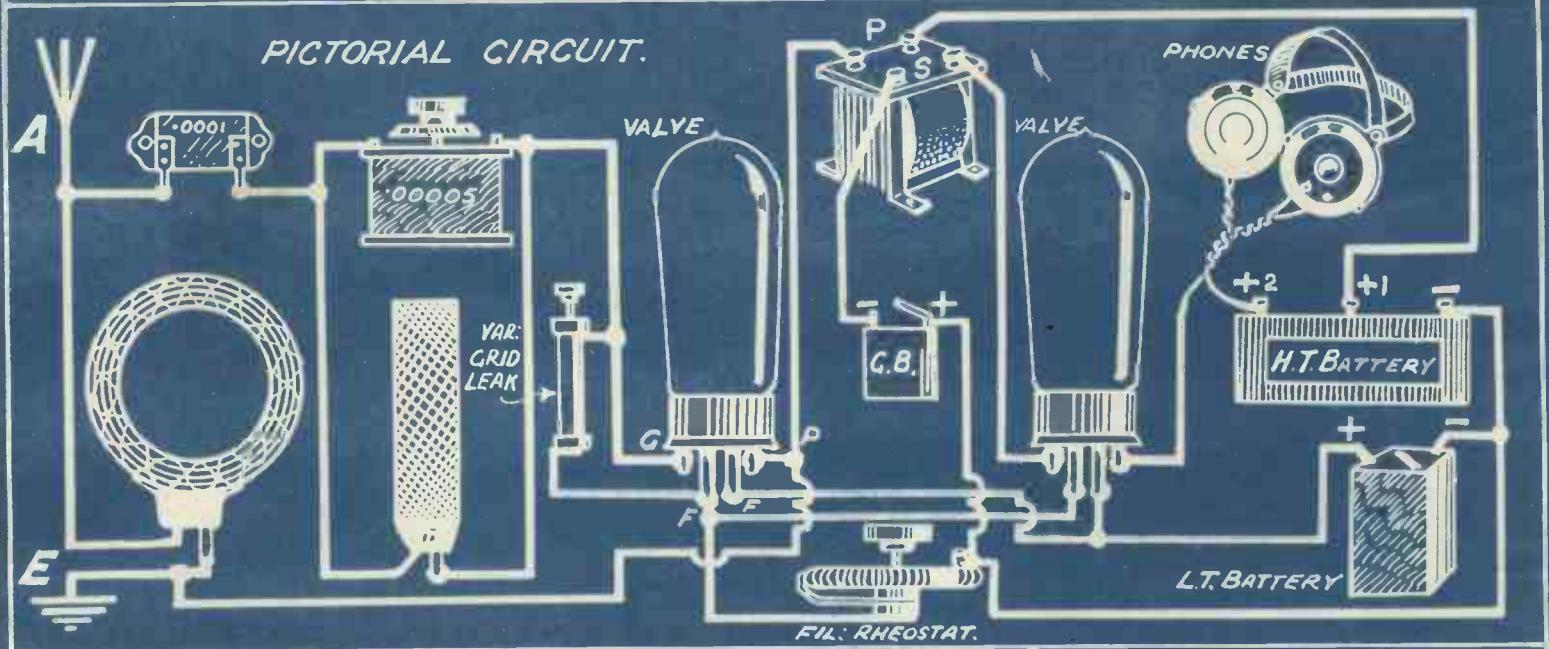
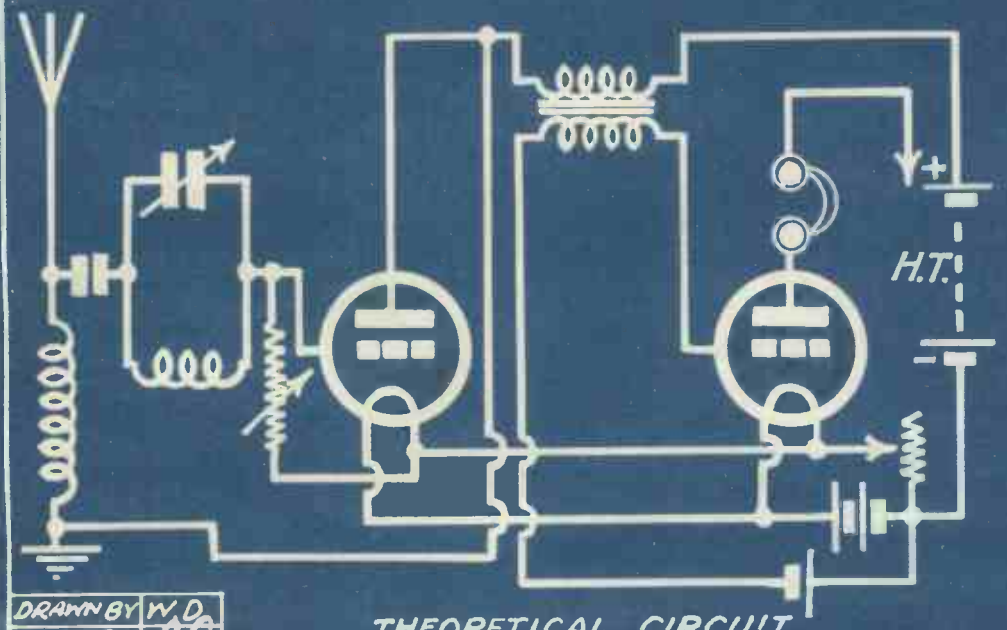
R/R

The "P.W." Blue Print Circuit, No. 21
The Two-Valve Lodge "N."

6d.





DRAWN BY	W. D.
CHKD BY	B.I.L.
SER. No	B.P.103.

The "P.W." Blue Print Circuit, No. 21
The Two-Valve Lodge "N."

List of Components.

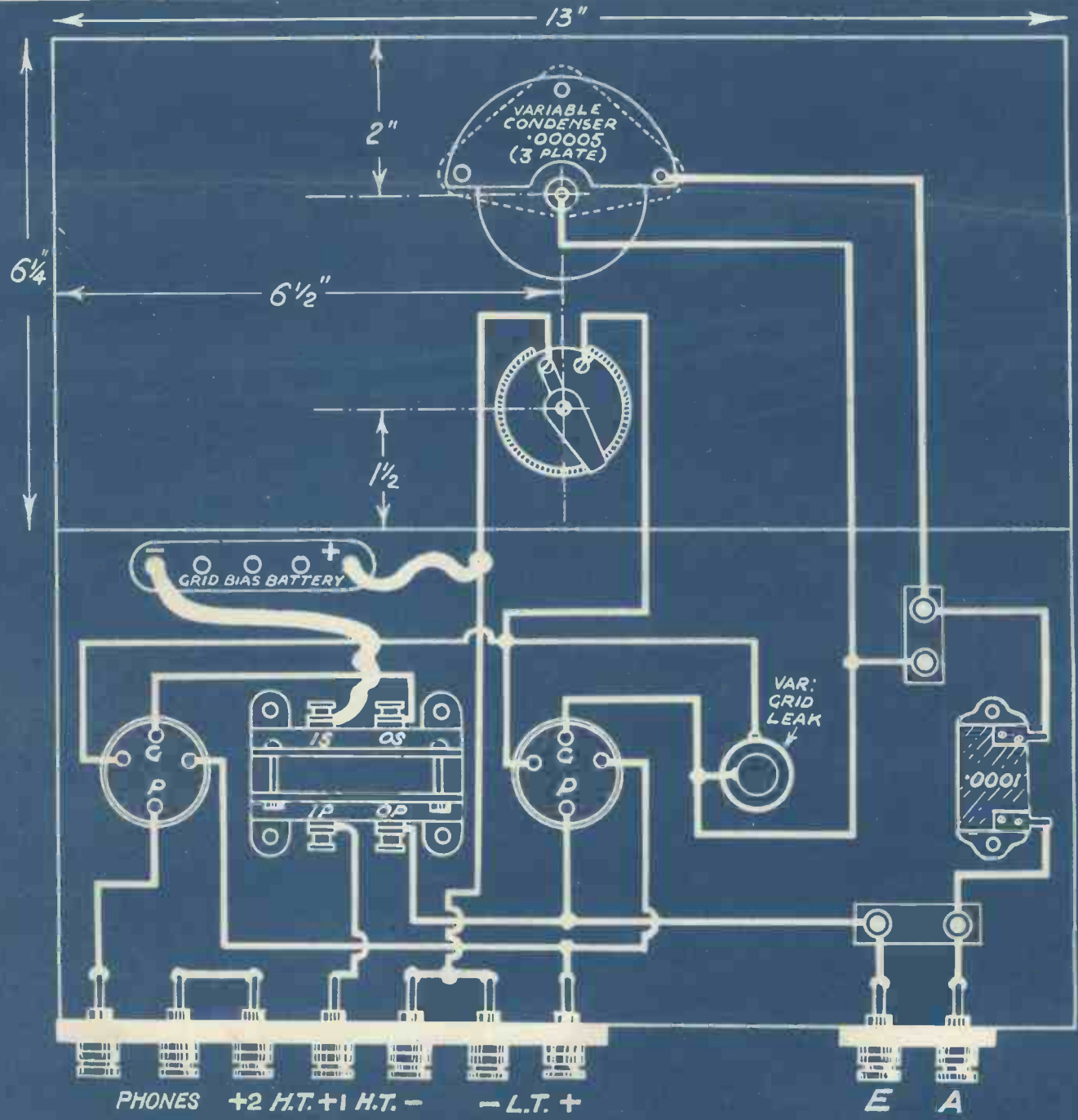
Panel, 13 in. by 6½ in. } with Cabinet to fit.
Baseboard, 13 in. by 6½ in. }

1 Variable condenser (3 plate, ·00005 mfd.).
1 Special L.F. transformer (as originally specified).
9 Terminals.
2 Single coil holders.
2 Valve holders.
1 Rheostat.
1 Fixed condenser, ·0001.
1 Variable grid leak.

Wire, screws, transfers, wander plugs, ebonite terminal strips, etc.

Accessories.

2 Valves (1 detector, 1 L.F. type).
2 Coils (150 and 45/60).
1 H.T. battery. } To suit valves.
1 L.T. battery. }
1 Tapped grid bias battery.
1 'Phones or loud speaker.



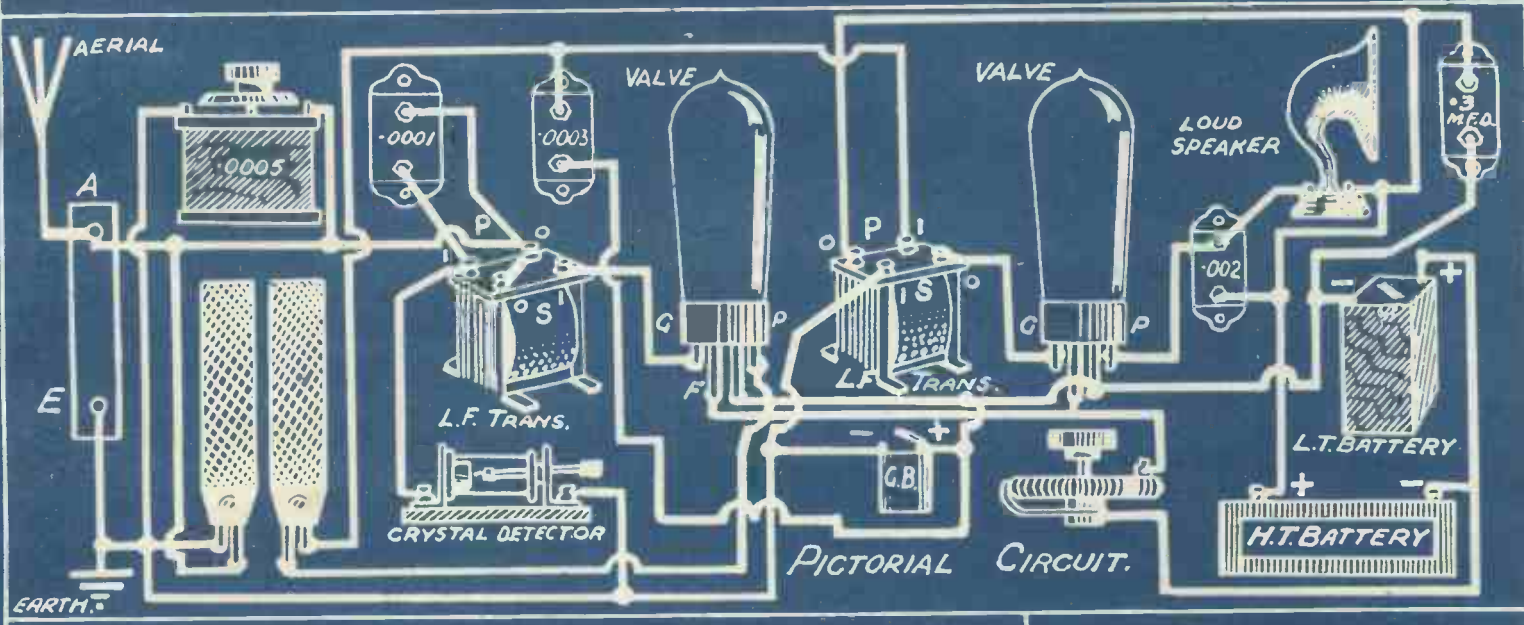
DRAWN BY	W.D.
CHKD BY	
SER: No	B.P. 104

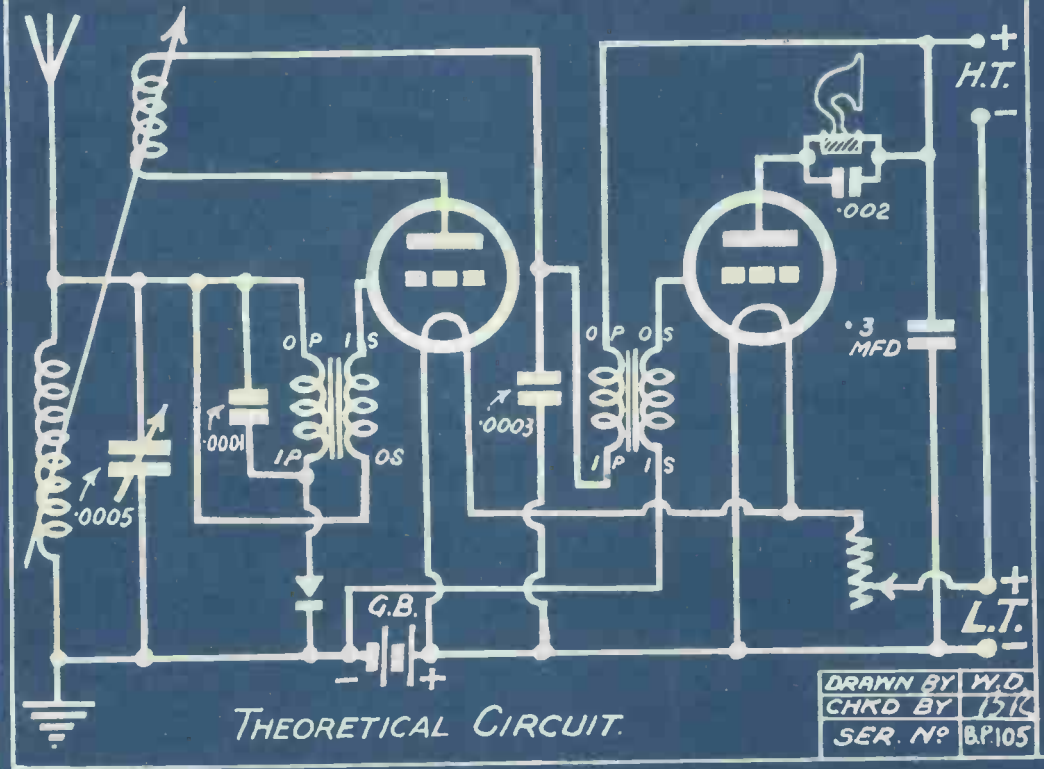
THE "P.W." BLUE PRINT CIRCUIT, No. 21. THE TWO-VALVE LODGE "N."

This, the famous non-radiating receiver evolved by Sir Oliver Lodge, F.R.S., will give clear and powerful results from the local station, and is extremely easy to operate. The grid leak employed must be one capable of smooth variation over a wide range of resistances, but once set for the particular valve in use it may be left adjusted. The grid bias battery must be tapped at every 1½ volts, the maximum voltage available being not less than 4½. Although 'phones are shown in the diagrams, the set will operate a loud speaker up to approximately 12 miles from the local station.

The "P.W." Blue Print Circuit, No. 22
"The Guaranteed Reflex."

6d.





DRAWN BY	W.O.
CHKD BY	
SER. Nº	B.P.105

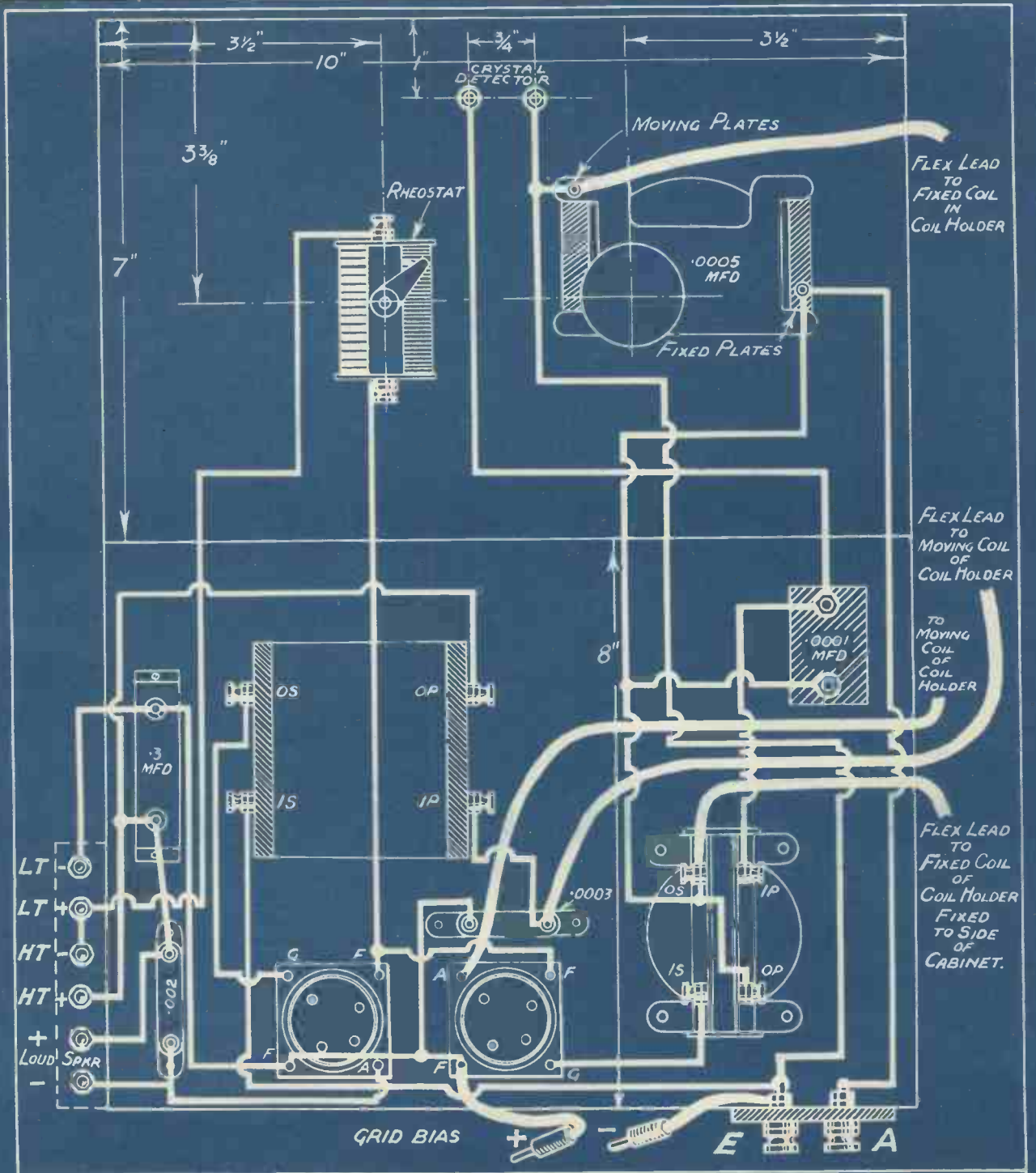
The "P.W." Blue Print Circuit. No. 22
"The Guaranteed Reflex."

List of Components.

Panel, 7 in. x 10 in. } and Cabinet
Baseboard, 9 in. x 10 in. } to fit.
1 Variable Condenser, ·0005 mfd.
1 Rheostat.
1 L.F. Transformer (First stage).
1 " " (Second stage).
1 2-Coil Holder.
2 Valve Holders (anti-microphonic).
1 Fixed Condenser, ·3 mfd.
1 " " ·0001 "
1 " " ·0003 "
1 " " ·002 "
1 Crystal detector, wander plugs, wire, screws, transfers, etc.
1 Six-terminal Strip.
1 Two-terminal Strip.

Accessories.

2 Valves (L.F. power type).
1 L.T. Battery } To suit valves.
1 H.T. "
1 G.B. "
2 Coils (A 35/50, Reaction 50/60) (for 5 XX : 150 and 200 turns).
1 Loud speaker.



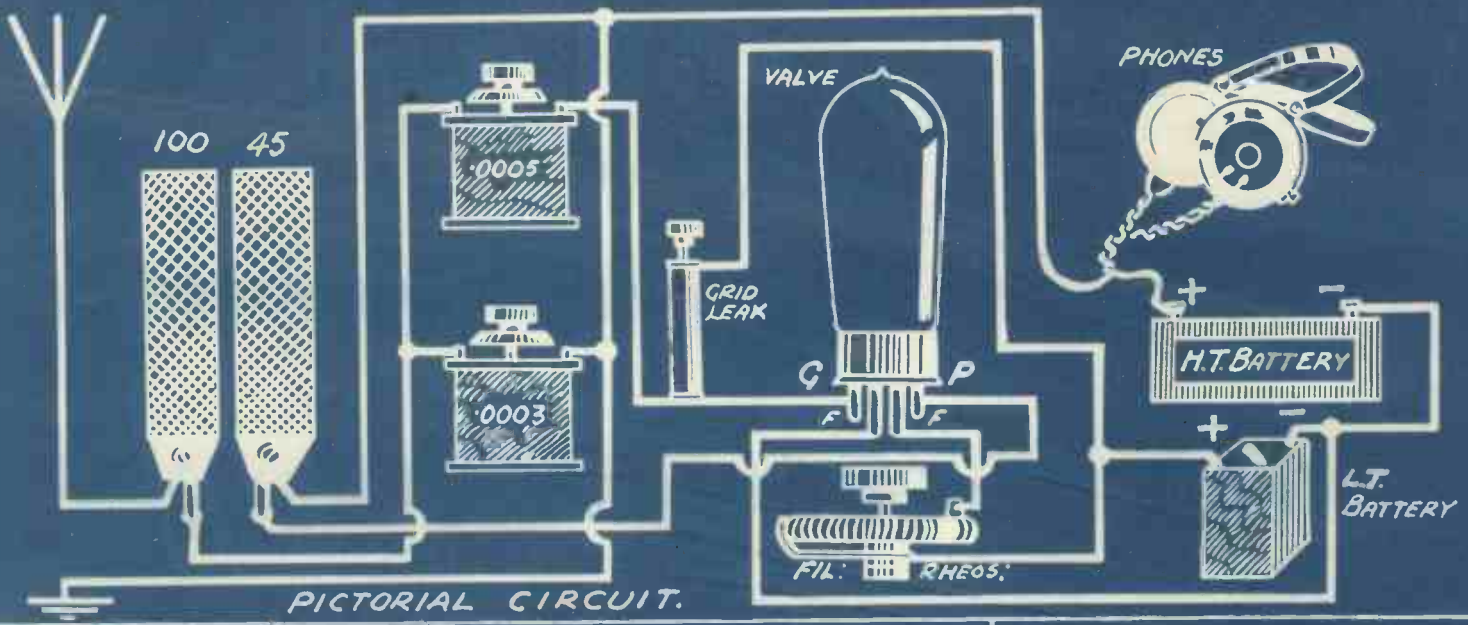
DRAWN BY	W.D.
CHKD BY	
SER. No	BP.106

The P.W." Blue Print Circuit, No. 22. "The Guaranteed Reflex."

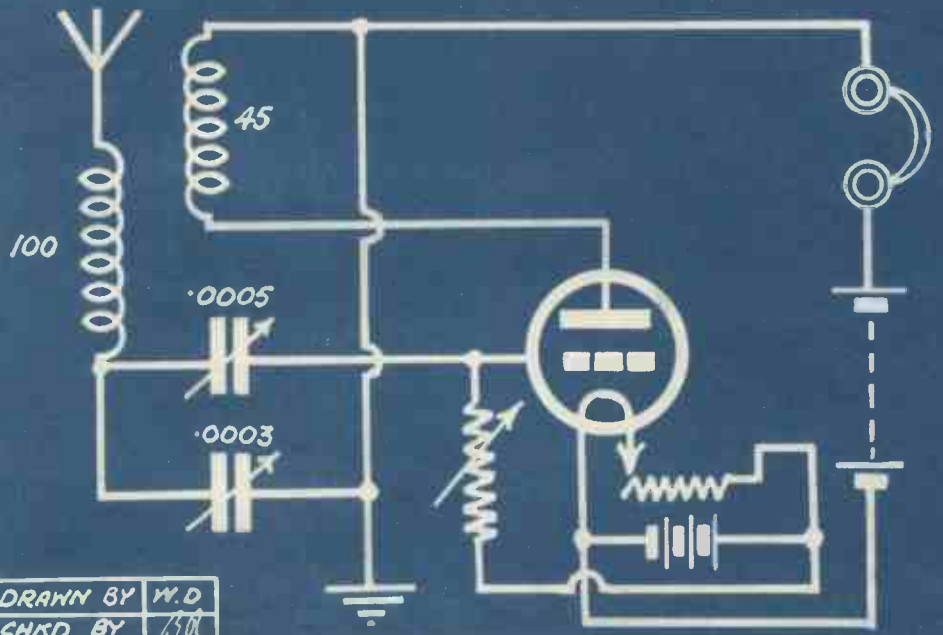
This popular receiver is very simply controlled, capable of giving tremendous volume, with quality far above the average. As L.F. transformer design is not standard, it may be necessary to reverse O.P. and I.P. (and/or O.S. and I.S.) on one or both L.F. transformers. If the set fails to oscillate, the effect of reversing the connections to the reaction coil should be tried. Correct adjustment of grid bias is essential to the successful operation of this set

The "P.W." Blue Print Circuit, No. 23
The One-Valve "Chitos."

6d.



PICTORIAL CIRCUIT.



DRAWN BY	W.D
CHKD BY	
SER: No.	B.P.101

THEORETICAL CIRCUIT.

The "P.W." Blue Print Circuit, No. 23

The One-Valve "Chitos."

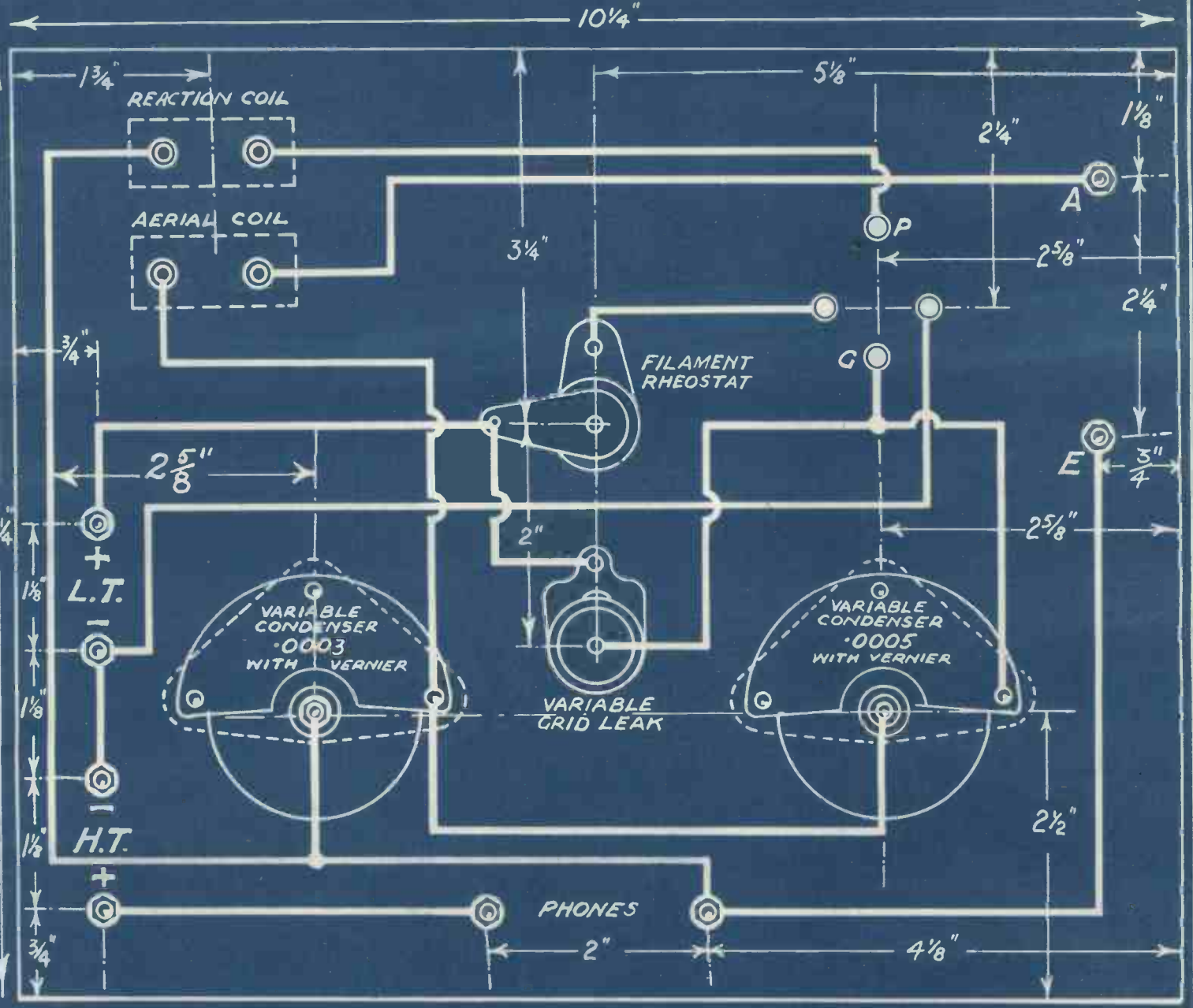
List of Components.

1 Panel, 10¼ x 8¼, with Box to fit.
1 ·0005 Variable Condenser. } Slow motion
1 ·0003 ,, ,, } or vernier
1 Rheostat.
1 2-way Coil Holder.
1 Variable Grid Leak.
1 Valve Holder (or 4 valve-sockets).
8 Terminals.
Wires, screws, transfers, etc.

* * *

Accessories.

2 Coils (A 100, Reaction 45 turns).
1 Valve.
1 L.T. Battery } To suit valves.
1 H.T. ,, }
1 pair 'Phones.



PANEL LAYOUT.

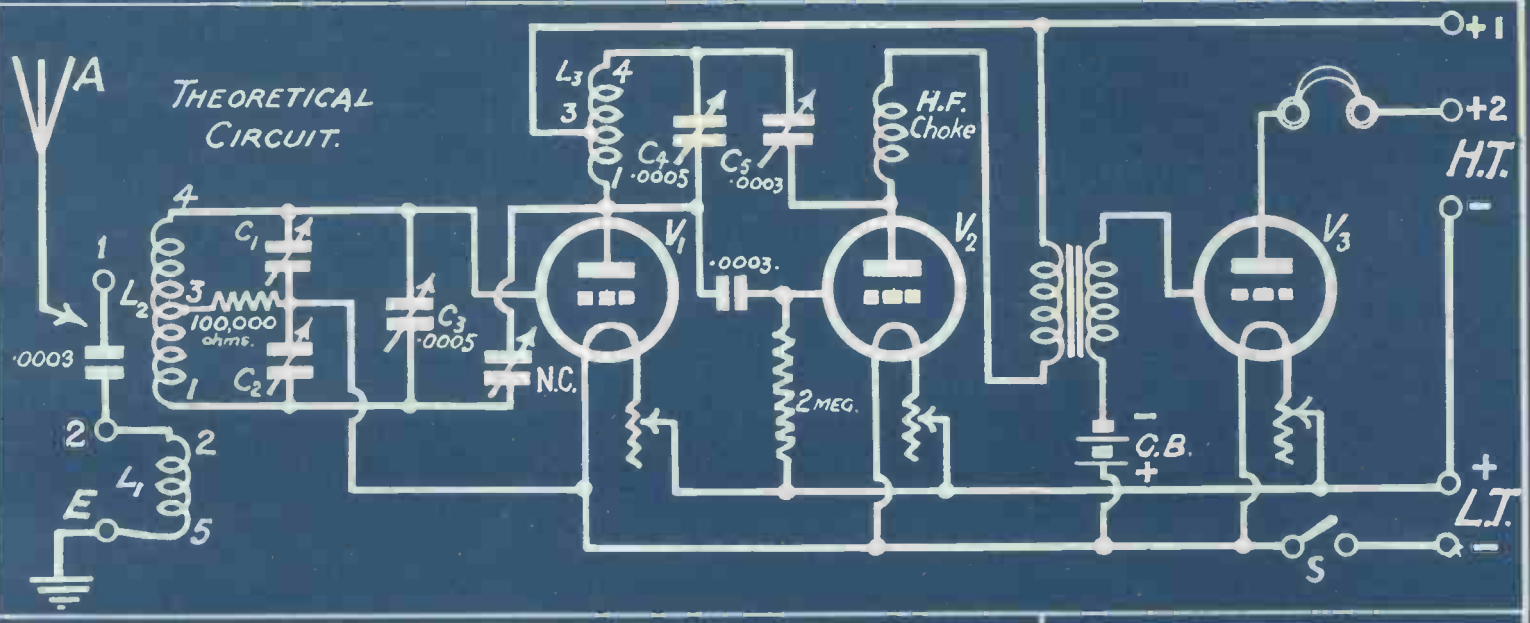
DRAWN BY	W.O
CHKD BY	
SER. Nº	BP 102

THE "P.W." BLUE PRINT CIRCUIT No. 23. THE ONE-VALVE "CHITOS."

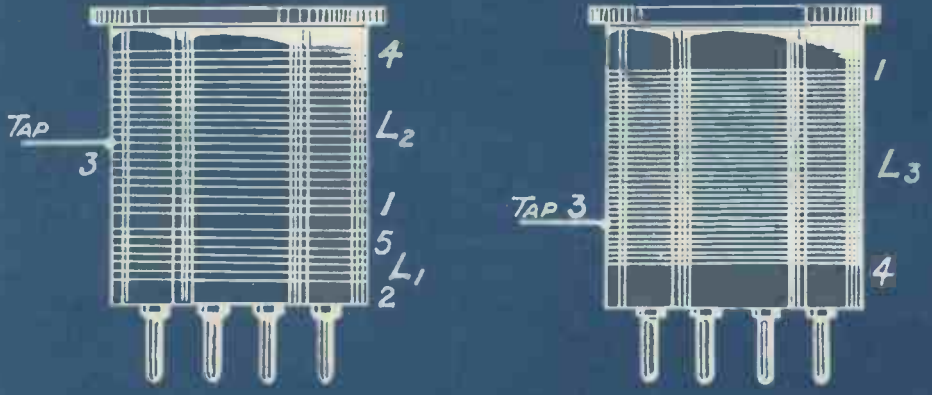
An excellent one-valve circuit for long-distance reception on 'phones. It is very selective, and capable of giving strong reproduction from the local station. (Like all circuits of this class it works best on wave-lengths below 600 metres.) If the set fails to oscillate, the effect of reversing the connections to the reaction coil should be tried.

The "P.W." Blue Print Circuit, No. 24
"The Spanspace Three."

6d.



DETAILS OF COIL WINDINGS.



THE COILS.

The special coils are wound on the standard "screened coil" formers, but no screens are used. Connections should be made as indicated by the numbers, which are standardised by the various makers. The windings are in single layers of No. 34 D.S.C. copper wire. The turn numbers and connections are given below. L1—20 turns. Top end to pin 5, bottom end to pin 2. L2—90 turns, on the same former and in the same direction as L1, tapped at 45 turns. Top end to pin 4, tapping to pin 3, bottom end to pin 1. L3—90 turns, in the same direction on the other former, tapped at 30 turns. Top end to pin 1, tapping to pin 3, bottom end to pin 4.

DRAWN BY	W.D.
CHKD BY	B.K.
SER. No.	B.P.107

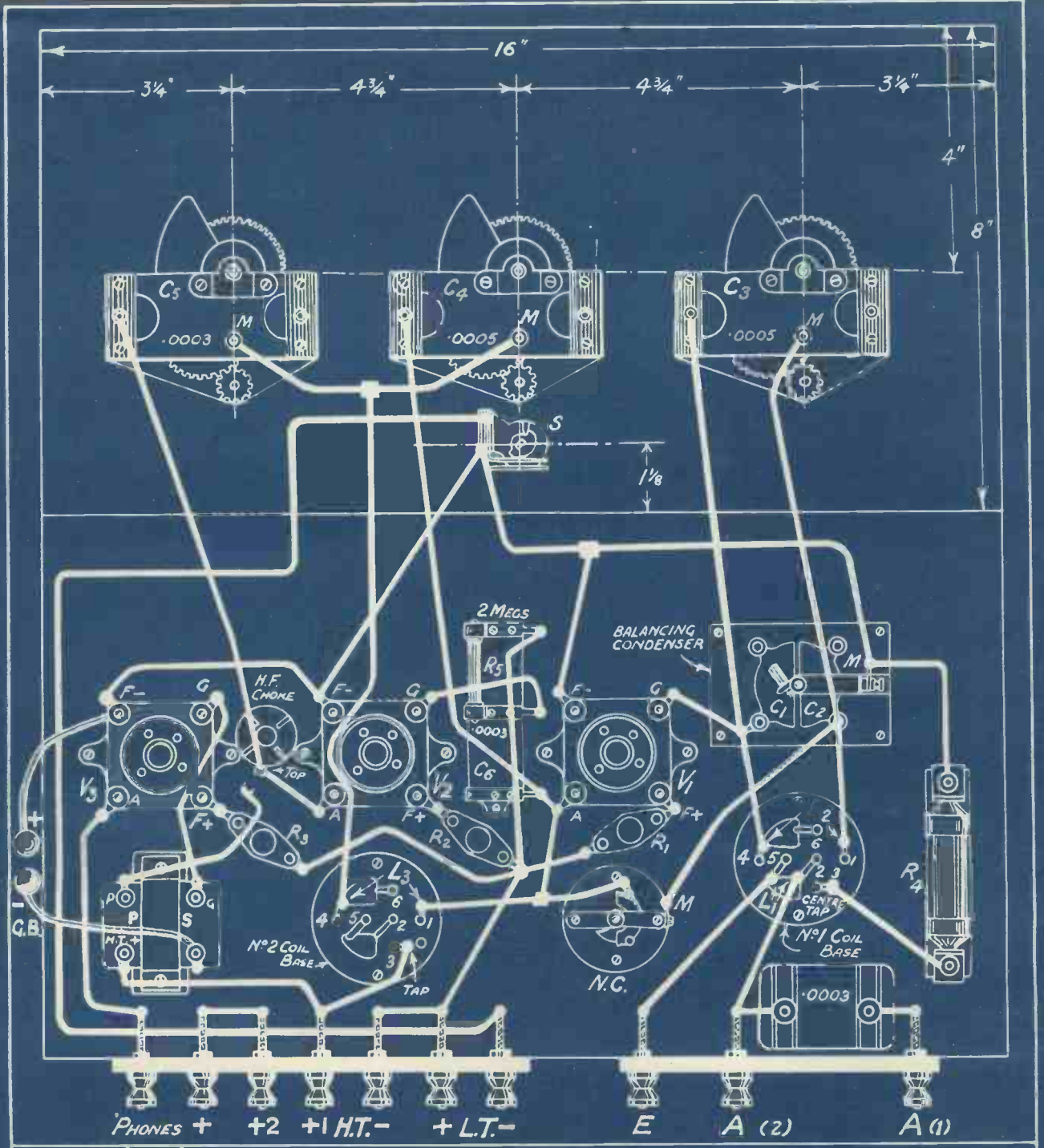
The "P.W." Blue Print, No. 24 "The Spanspace Three."

List of Components.

1 Ebonite panel, 16 in. by 8 in. by ¼ in.
1 Cabinet, with baseboard, 9 in. deep.
2 Panel brackets.
2 ·0005 and 1 ·0003 geared variable condensers.
1 Balancing condenser.
1 Baseboard mounting neutralising condenser.
1 Fixed condenser, ·0003, type 610.
1 Fixed condenser, ·0003, type 600, with grid leak extension, and leak 2 megohms.
1 100,000 ohm anode resistance, baseboard mounting.
1 H.F. choke.
3 valve holders.
3 Holders and 3 suitable fixed resistors.
1 On-and-off switch.
1 L.F. transformer.
2 Tapped coil formers, with standardised bases.
1 Ebonite strip, 5 in. by 2 in., with 3 terminals.
1 Ebonite strip, 7 in. by 2 in., with 7 terminals.
Glazite and a short length of flex.

Accessories.

2 H.F. valves.
1 L.F. or power valve.
H.T. & L.T. batteries according to valves used.
2 Special coils (if Daventry is required 2 more will be needed. Can be bought ready-made under the name of "Span-Space" coils).
1 Pair of 'phones or loud speaker.
1 Grid bias battery.



DRAWN BY	W.D.
CHEKD BY	B.R.
SERIES No	B.P.108

The "P.W." Blue Print No. 24. The "Spanspace Three."

Three-valve receiver employing one neutralised H.F. valve, detector with non-radiating reaction control, and one L.F. valve. Specially intended for long-distance reception on 'phones, and loud speaker at moderate ranges. Neutralise by setting reaction (C_5) at zero. C_1—C_2 at midway position, and adjusting N.C. until set does not oscillate at any position of C_3 and C_4; if local station available, turn out V_1 and adjust N.C. until station inaudible despite re-tuning. Tune on C_3 and C_4 bring up strength with C_5.

Presented with "Popular Wireless" week ending February 5th, 1927.