

COSSOR

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COMMODITY PRICES RISING

RUBBER up 3½d. per lb.—Copper up by £15 10s. 0d. per ton—Tin, Nickel, Aluminium—all showing big increases during the past twelve months. At home more blast furnaces starting up—more rolling mills working full time. Unemployment falling—wages going up. The world now climbing out of the Depression.

World rise in prices

But that's not all. Other commodity prices—almost equally sensitive to laws of supply and demand—are showing startling increases. Wheat is on the up grade—so is cotton, coffee, sugar and tea. What's happened? Well, to begin with, drought wiped out much of the American wheat harvest—thereby causing most of the surplus hitherto stored in giant silos to pass into the hands of the millers. Providence—in the form of the insidious boll weevil—came to the assistance of the cotton growers by spoiling their crop. A curious state of affairs, but it sent up prices by the simple process of curtailing production. Coffee prices are

higher—again through the gradual working off of surplus stocks and the compulsory curtailment of production. And the same applies to sugar, tea and most other commodities.

The effect on the Radio Industry

Now how does this state of affairs affect us in the Radio Industry? First of all, it shows that—whether we like it or not—we are directly in line with a period of Inflation. There are critics who say that this will mean a rise in prices everywhere. Higher wages—higher

prices—higher expenses—a merry-go-round which will bring us back exactly to where we started. But supposing it does, shan't we all be better off by the increased money in circulation? Is it not better for you as a retailer to sell many more Sets, even though your living expenses may rise to a certain extent? Surely the period of Deflation—which synchronised with the Depression—exploded the fallacy that with lower and still lower prices more goods would be sold.

The real lubricant to improved world conditions is

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Confidence in the Future coupled with a feeling of security. Inevitably this will tend to cause prices to rise rather than fall. Take yourself, for example. If you believed that motor car prices in the near future would be reduced by 20% would you buy now? You would not—you would defer your purchase. But on the other hand, if you thought that motor car prices would rise, would you wait? Assuredly not. You would appreciate that a rise in prices would be due to two things: (a) more people buying cars and/or (b) raw materials and wages moving upwards. Both of these are closely related to confidence in the future of a British industry, coupled with a feeling of security that we are now well past the depression.

Our point of view

Now we of A. C. Cossor Ltd., view with some misgivings any tendency to force down the price of radio Sets to an unnatural—and an unnecessary—low level. First of all it is doubtful whether such prices can be held in a world of rising commodity prices and wages. Secondly, instead of offering the public cheaper and still cheaper Sets, efforts ought to be made to raise quality and prices. With more money in circulation and more people at work, the public are in a mood to pay more—not less—for their radio. The sales of our higher-priced Cossor Sets have proved this during the past eight months.

And finally, a tendency to lower prices to any serious extent will inevitably introduce instability to an industry which has already suffered far more than its fair share of teething troubles.

The Retailer's point of view

Obviously no one manufacturer can ever hope to get away with a monopoly of exceptional values. This has never happened yet in any industry. He may obtain a temporary lead—but soon his competitors are pressing him hard—and back we go to a *status quo*. But if lower prices are a matter of concern to manufacturers, they are of even greater concern to retailers. It may be that a manufacturer can increase his turnover temporarily while he has a price advantage. And he can offset his lower prices by his increased volume—thereby maintaining his profits at a safe level. He does this, however, not by enlarging the market

but by taking sales from his competitors.

The retailer, however, is not in such a fortunate position. It is already fairly clear that the bulk of the market must be replacement sales. That the majority of those homes not yet equipped with radio are debarred from it because even the expenditure of £5 is entirely out of the question. Therefore lower retail prices will not assist the retailer to attract *new* buyers. The most that he can expect to do is to persuade existing customers to replace their old Sets. They will do this in any case as soon as money flows freely and risks of unemployment lessen. Therefore, the retailer will probably maintain his actual unit sales but with prices at a lower level. This will inevitably mean a scaling down of his gross profits.

NEW COSSOR BRANCH

—Nottingham this time

The Cossor Sales Organisation is still growing. By the time this issue of the "Courier" is printed our eleventh provincial branch will be opened, (twelfth including Dublin). It is situated at Nottingham: Mills Buildings, Plumtre Place, Nottingham. Its telephone number will be: Nottingham 40495, and its telegraphic address: "Amplifiers," Nottingham. This branch will be under the supervision of Mr. C. W. Rhodes who has been in the service of the company for a number of years. Following our usual procedure, it will be fully equipped for service work and will carry adequate stocks of all types of Cossor products. Traders will appreciate the fact that private parking accommodation will be available for their convenience.

A young Scots traveller had been doing remarkably well in Scotland for his Glasgow firm, who decided to send him on new ground over the border. There, too, he did very well, and on his return his chief congratulated him, and desiring to know the method he adopted when dealing with the English, asked:

"What did you say to the English?"

"I didn't see any English. I only saw the heads of the departments."

* * * * *

The new cabin boy was left to steer while the Captain and crew went below. The Captain gave him a star by which to steer, and was flabbergasted when, after ten minutes, the boy called down the stairs, "Hi, Captain, quick, give us another star—I've passed that one."

Continuing our series on Television technique, we return this month to the transmitting end

TELEVISION

—HOW IT WORKS

WE have now briefly considered the fundamental principles involved in Television transmission and reception, and it would be of interest to expand the subject in order that a more clear grasp of the situation can be obtained. This month's article will therefore, be devoted to a part of the transmitting end of the television system, and we shall try to make clear the way in which an Iconoscope operates.

The iconoscope consists of an evacuated glass vessel rather like a cathode ray tube in appearance. An iconoscope is, in fact, a cathode ray tube plus a photo-cell with a difference—it involves the principle of energy storage.

As was explained in the December issue of the *Courier*, when the subject to be transmitted is scanned and the light therefrom falls on to the photo-cell, electrical currents, which are dependent at every instant upon the light falling on the cell, are made to pass through it.

The principle of the Iconoscope

Dr. Zworykin, the inventor of the iconoscope, conceived the brilliant idea of the storage of energy, which makes the iconoscope so much

better than the photo-cell, in a manner somewhat as follows. He reasoned that the amount of energy released by the light from the subject to be televised, and which falls upon a photo-cell at any instant, is excessively small, and also that only the light from one portion of the subject is utilised at any one time. If, therefore, he thought, it were possible to make light from the whole area of the subject fall upon an extremely large number of minute photo-cells at once, a kind of light storage effect could be obtained and a vastly improved efficiency would result.

PART FOUR

THE ICONOSCOPE

—WHAT IT IS AND HOW IT FUNCTIONS

This ingenious idea, which is known as the electronic storage principle, is of great importance in television, and will almost certainly become of much more importance in the future.

Consider for a moment what this high efficiency means. It means, in the first place, that we can transmit subjects out of doors in very dull weather—do you remember the sheep dog trials which were transmitted from the Alexandra Palace grounds in a fairly thick fog? Although this was not of very great interest as programme material, it was extremely valuable from the technical viewpoint, in that it showed how the iconoscope can transmit subject matter which is hardly visible to the naked eye.

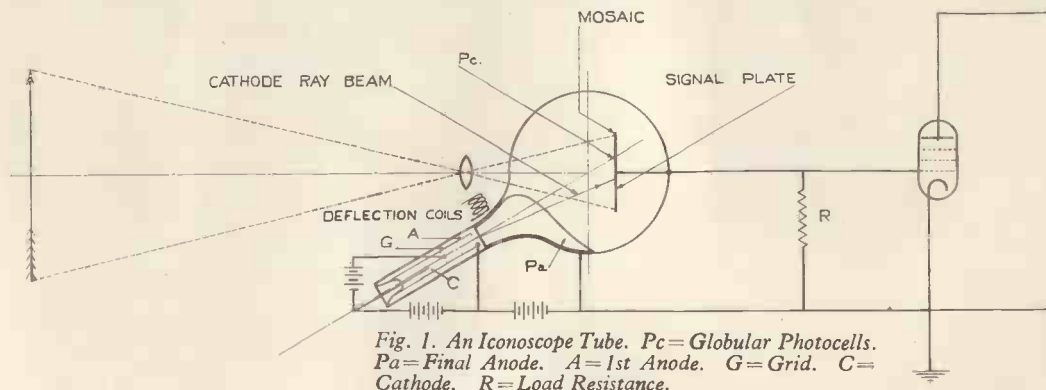


Fig. 1. An Iconoscope Tube. Pc = Globular Photocells. Pa = Final Anode. A = 1st Anode. G = Grid. C = Cathode. R = Load Resistance.

This attractive window bill—printed in black and blue is being widely used by Dealers demonstrating Cossor Television.



Secondly, this high efficiency means that performers in a studio need not be blinded by intense lighting and that the signal to noise ratio of the transmitted signal can be extremely good. This is by no means the usual case for transmitting apparatus employing non-storage principles. The iconoscope is, of course, at the moment the only instrument of its kind employing this principle. The electron-camera employs a multiplication effect, but not a storage effect.

Now, having discussed the advantages of the iconoscope, it would be interesting to know how it is made and how it operates.

How it works

The diagram shows an iconoscope tube, the lower portion of which is exactly the same as a cathode ray tube, but the cathode ray beam, instead of being made to impinge on a fluorescent screen, falls on a photo-electric mosaic. This mosaic is the heart and soul of the iconoscope and consists of a thin sheet of mica on which is arranged a photo-electric surface consisting of hundreds of thousands of minute globules of caesium-oxide on silver. These minute globules each form the cathode of a separate photo-cell.

On the reverse side of the mica sheet is a metallic coating which acts as a common anode for all the photo-cells. The mosaic is set at an angle to the cathode ray beam, and is so arranged that light from the subject to be transmitted is permitted to fall upon its surface through a lens. This lens is so adjusted that a sharply defined image of the subject appears on the mosaic. Thus, where a large amount of light falls upon the mosaic the photo-cells

concerned become highly charged, and where there is only a small amount of light they only become slightly charged. We have, therefore, a mosaic of photo-cells with varying degrees of charge in varying places. We have, in fact, a stored picture in the form of electric charges residing upon a sheet of mica.

The cathode ray beam

As has been explained in previous articles, before a picture can be transmitted over a single channel, whether it is a radio or land-line channel, it is necessary to transmit it part by part. We must, therefore, scan our electrically-stored picture, and this operation is carried out by means of the cathode ray beam in the iconoscope. This beam is deflected vertically and horizontally by means of time base circuits, as already explained in previous articles, so that it forms a raster upon the mosaic.

Now a cathode ray beam consists, as you know, of electrons and, remembering that the light which has fallen upon the photo-cell mosaic has charged the mosaic by removing electrons from it, you will appreciate that the cathode ray beam is capable of restoring the mosaic to a normal state of charge by supplying it with new electrons to make up for those which it has lost. When the beam restores the charge on the mosaic a like charge is repelled from the metallic plate behind the mosaic and passes through a resistance so that the potential across the latter is fed to the grid of an amplifying valve. In this way, a signal which is dependent upon the amount of charge, and hence upon the amount of light falling upon each part of the mosaic, is applied to the grid of the amplifier.

In the diagram will also be seen the principal circuit arrangements employed for the operation of the iconoscope. It is clear how the signal is obtained and passed to the amplifier when the mosaic is brought to a normal state of charge by the cathode ray beam.

It should be obvious that if, for instance, $1/25$ th of a second is taken as the period occupied in the transmission of one image, and assuming that there are, say, 200,000 picture elements, each of these elements will be charged for a period of a 25 th of a second, instead of for one $200,000$ th of one twenty-fifth of a second, as in the case of the photo-cell, which can only deal with one element at a time. Of course, in practice, the whole of this gain in efficiency cannot be obtained, but even without the whole gain it is obviously a highly efficient, and extremely valuable, piece of apparatus.

Photo-cell not an electric eye

The photo-cell is often spoken of as the electric-eye but this is really a mis-nomer. A photo-cell is like an eye which is capable of detecting the presence of light and, to a certain extent, of differentiating between colours, but it is quite incapable of seeing an image unless the parts of that image are presented to it separately. It is, for instance, as though the human eye were capable of detecting differences in colour, or in the brilliancy of light without in any way being able to determine its position. Thus, if our eyes were like a photo-cell, and we looked at a scene, we should just see a "lump" of light which would cover the whole visible area. A change in the scene would be merely indicated by a change in the brilliancy or colour of the light, and it would be utterly impossible to distinguish between any parts of that image.

On the other hand, the iconoscope is much more like the human eye. It is capable of responding to much the same colour range as the human eye although a little more sensitive to red and a little less so to green. It is also capable of detecting variations in brilliancy and in detecting the position of light. It is thus able to define the various parts of the subject forming the image. Indeed, the iconoscope goes one degree further than the human eye for, with the aid of transmitting apparatus it can project the image which it sees, to a distance, although it must be admitted that when it does this it translates the image into a black and white one.

COSSOR LABORATORY AND WORKSHOP EQUIPMENT

PAGE 18 of this issue contains a striking tribute to the efficiency and usefulness of Cossor Equipment for Service work. Below are shown the two of the most widely used instruments in the range.



THE COSSOR LINEAR PORTABLE OSCILLOGRAPH for detection of unwanted frequencies, examination of wave forms, examination of smoothing and hum in speakers, ganging of R.F. and I.F. Circuits (in conjunction with the Cossor Ganging Oscillator—see below).



THE COSSOR GANGING OSCILLATOR can be used as a signal generator for adjusting and measuring selectivity and sensitivity, for calibration, ganging, etc. etc.

SALES ARE MADE

—THEY DON'T "JUST HAPPEN"

IN the December *Courier*, our first Salesmanship article stressed the importance of knowing the goods. Last month we showed how important it was to study the customer. And now the time is ripe to analyse closely all the various stages that complete a successful sale.

Before we begin, however, let us say that we don't subscribe to any "super-salesmanship" theories. Experience shows that more sales are lost than are made by attempting to "rush" a customer before he is ready to buy. High-pressure, so-called American methods rarely succeed in this country.

There is little difference in technique in selling any commodities in the recognised luxury categories—radio, cars, furniture, etc. The sales procedure follows along the same well-defined lines. "Try the driving position,

—THE THIRD OF OUR SERIES, WRITTEN SPECIALLY FOR YOUR STAFF ON

HOW TO ACHIEVE SUCCESS IN SALESMANSHIP

to a successful conclusion.

"Guiding" the Sale

Yes—*guided*—that's a very good word. For to the successful salesman, sales don't just happen. He is master of the situation all the time—watching every phase—listening to every comment from the customer—ready to seize every opportunity—never at a loss for an appropriate sales argument. And at the end, the customer will believe that he has *bought*, whereas if the real truth be told it was the salesman who—by well-directed sales strategy—*sold*.

Now if you analyse a sale from the time a customer comes into the shop until his exit, it will follow through several distinct stages, as follows:—

- (1) Salutation, (2) Sales,
- (3) Payment, (4) Final Greeting.

Obviously there will be no actual division between these stages—they will merge smoothly into one another. But the fact remains, here



Demonstrating—by now, if the Salesman knows his job, the sale should be nearing a successful close.

Letting the customers operate the set for themselves — and, incidentally, concluding the sale,



is a complete sale—whether it be in a chemist's or a haberdasher's—broken down into its four component parts.

Make the Customer feel at home

First, the Salutation. Very important—at once the customer senses the atmosphere of the shop. Is it friendly—are they nice people to buy from—shall I get a square deal? These are some of the thoughts that may be crossing his mind as he steps through the doorway. And what better way of putting him at his ease than a cheery, "Good morning, Sir," coupled with a disarming smile. Also, step forward to meet him—if the lay-out of your shop permits it.

—and let him do the talking

And now comes stage two: the enquiry. Here it is most important to let the customer do the talking. Let him tell you the kind of Set he is thinking of buying. Don't over-prompt him. Don't jump to conclusions—you may be making a whole lot of trouble for yourself if you do. Remember it's far easier to row with the tide than against it—to sell the customer something he wants than something he doesn't. Therefore, exercise your patience and get clearly in your mind the kind of Set your customer wants—the price he anticipates paying—and the results he expects to get.

By this time you are already learning something about the customer—you are studying his characteristics—does he really know what he wants—are his ideas of price and values practicable? So now cautiously—feeling your way—you begin to interest him in one or two Sets. Take a lot of trouble over this—do not hurry—in ninety-nine times out of a hundred you'll be well repaid.

Don't forget the selling features

Now get down to technicalities—keep your explanations simple so that your customer can follow them. Compare the Sets side by side. Go over their individual selling features. Even if your customer knows little about Radio, don't be tempted to skip this part. Remember the less he knows the more he must rely on someone's judgment. And if you don't appear to know much about the Sets you are selling you may easily lose his confidence.

Finally come the actual demonstrations. We could, with advantage, devote a couple of pages to the right-and-wrong way to demonstrate Radio Sets. Perhaps in a later issue of the *Courier* we will cover the subject more extensively. But, have you noticed anything? You have shown the Sets—you have discussed their selling features—you have extolled their performance—but you have not yet demonstrated them. There is a most important reason for conducting the sales procedure in this order. It is vital that the customer should know exactly what he is getting for his money. Therefore, by keeping the demonstrations until last, he *must* listen to what you have to tell him. There are no extraneous influences at work—no distracting programmes to worry him. The moment you switch on, he will cease to listen to you. He wants to twiddle the knobs for himself. First one station—then another.

The only successful conclusion—the customer pays up.

Loud then soft. He varies the tone control. Moves the wave band switch. It's going to be very difficult for you to introduce any effective sales talk now. So you'll appreciate how important it is for you to do your selling *before* the practical demonstrations begin.



Importance of the satisfied customer

But, if you've done your job properly, the sale should be moving towards its close. Your customer should know why Set A—although costing perhaps a couple of pounds more than he originally intended to pay—is really a far better one for his particular requirements. That Set B—although externally more attractive and possibly cheaper—is not really so suitable. And here—according to the text-books—is where the customer makes his choice—the salesman rings up the sale on the cash register—and everyone lives happily ever after!

But in our competitive industry, things don't happen quite as simply as this.

Perhaps the customer wants to hear the Set at home—and this is surely a natural request. Or, he must get Mrs. Customer's approval. Or—he hates to mention it—there is the little matter of his old Set in part payment. Again, would Mr. Salesman mind if he brought a friend along to get his opinion? Oh yes—all these are hurdles to be jumped before the sale is finally completed.

But we have covered enough ground in this issue. If we have been able to show some of our young friends *how* sales are made—and that they don't just happen—our efforts won't have been wasted.

TREASURY NOTES for "Courier" Letters

As a wireless salesman or a service engineer, you have probably had some unusual experiences. We would like to hear about them—so would the readers of the *Cossor Courier*. Last month we told the story of the trader in Wales who took a litter of pigs in payment of a Cossor Set. Can you beat that? Servicemen may recall cases of an obstinate fault which turned out to be something extremely simple.

Anyway, whatever the experience—provided it is unusual—write it down and let us have it. Keep it brief, and for every letter published we will pay 10/- spot cash without any discount deductions! If you do not wish your name to appear, please say so at the time of writing. Address your letter to the Editor, *Cossor Courier*, A. C. Cossor Ltd., Highbury Grove, London, N.5.

More than 73-million copies of "national" newspapers are sold every week in this country. Most of them are published in London.

More than 4-million motor cars and commercial vehicles were sold during 1936 in the U.S.A.—a record exceeded only by the 4,400,000 sold in 1929.

A writer in the *Wireless World* records the fact that, using Det. and 1 L.F. he receives Alexandra Palace sound transmissions at Chichester (70 miles distant).

B.B.C. complain that letters from listeners dealing with programmes are falling off in numbers. During last twelve months they totalled only 160,000.

World's first regular Broadcasting Station W.W.J. has just celebrated its sixteenth birthday.



Dear Mr. Editor



COSSOR DEALERS COMMENT ON THE 'COURIER'

JUST about this time of the year, garden lovers will be preparing the ground, hunting through seed catalogues and making plans for "lifting" the Cups at the local Flower Show next August. Upon this all-important work will depend whether their hollyhocks are 8ft. giants—the envy of their neighbours—or mere puny little dwarfs. Running a Magazine like the *Courier* is something of a gardener's job, too. It's full of surprises. You've got to put in a lot of work before you can expect any results. Sometimes, of course, you strike lucky right away! And you'll get letters such as this:—

I think the new *Courier* is fine. I am glad that you haven't committed the error usually found in manufacturers' magazines by giving us too much Cossor! Your articles on Television are most interesting and my staff have read every word of them.

P.J.T. (Watford).

But before you've had time to pat yourself on the back and say you're not doing so badly after all, you'll get a real snorter from some irate Dealer who doesn't see eye-to-eye with you on the need for "better selling methods." This is what W.T.C., of Birkenhead, said after he had read his December *Courier*:—

You are making a great mistake in introducing articles on Salesmanship into the *Cossor Courier*. Stick to plain, straightforward information about Cossor Sets and such like. Don't go putting ideas into the heads of assistants about the right and wrong way to sell Sets. You can't learn selling from books anyway. I've built up a good business and I've never read an article on Salesmanship in my life.

W.T.C. (Birkenhead).

After absorbing these sentiments you feel like the gardener who has discovered that his choicest *Lychnis Chalcedonica* blooms have been devoured overnight by slugs.

Hello, what's this? Postmark Gloucester. Sounds a bit more appreciative. Window

displays . . . Let's see what W.B. says:—

Could you find room sometime in the *Courier* for Window Display suggestions? As you probably know, window dressing is a big problem for the small "one-man" business such as mine. It is a big job to get out really original ideas that attract people—particularly if the window isn't very large or deep. . . . Otherwise I think the *Courier* is first-class. Please see that my name is kept on your mailing list.

Certainly, W.B., we'll try to help. It's good to see that Dealers do appreciate the value of their shop windows. During the past season Cossor have issued many hundreds of pounds' worth of window material, pelmets, showcards, price tickets, etc. And, believe us, it's quite a problem to get Dealers to use it intelligently.

In our garden we try to grow something for everyone. Lots of folk hate the sight of Japanese lilies—although we are rather partial to them ourselves. "Chacun à son goût," as the French say—or do they? So it isn't to be expected that everything in the *Courier* will appeal to all its readers. Therefore some of our super-high-brow technical articles—written just to keep our Research lads in good form—are perhaps a little unappreciated in some quarters:—

I read the article on "Selectivity" in your last *Courier* but couldn't make head nor tail of it. I suppose it is all right to engineers, but not much good for fellows like me serving behind the counter all day long. Can't you keep the articles more simple so that we can understand them?

G.L.G. (Newcastle).

Sorry, Mr. G.L.G., we'll keep our pruning knife handy next time.

And now here's someone who wants a little light relief—and we don't blame him, either:—

We like the humorous touch in some of your recent issues of the *Courier*—specially the one in (we think) the November issue called "Do Radio Operatives Make Good Wives?" It

was good fun and a welcome change from the heavy stuff.

E.G.R. (Ilford).

On with the motley—we'll dig out the Court Jester, tell him to fill his fountain pen and get busy right away. Perhaps there will be something to your taste in this issue, E.G.R.

And now let us find a little consolation in our last letter from T.D.L., of Norwich:—

On the day that the *Courier* arrives I generally find some excuse to disappear into a quiet corner to read it. Its common-sense articles appeal to me. In particular, I would like to thank you for the information on renovating damaged cabinets which appeared recently. I

reckon that the hints and tips in this saved me several pounds.

T.D.L. (Norwich).

So now, you know something of our Editorial difficulties. Way back last August when we re-vamped the *Courier*—gave it a new overcoat (by the way, how do you like our covers?)—we knew it would take a little time before we could see the fruits of our labours. Radio Dealers are busy men; they haven't much time to write letters about the *Courier*. But to those who have, may we say how much we appreciate their criticisms—brick-bats are just as welcome as bouquets. And to those who haven't—well there's still plenty of time to give us your own candid opinion.

How Shop Sites are Chosen

IT is paradoxical to state that by doubling your rent you may easily halve your unit selling costs. Many retailers are inclined to look upon a high rent as a big sales handicap—one that should be avoided if at all possible.

Two shops in the same street—one rents at £200 per annum, the other at £400. Both are substantially the same width in frontage—yet the dearer may easily be the better proposition. Why?

There are many factors to be taken into account. As the song says, "Get on the sunny side of the street." In very few streets is the pedestrian traffic the same on both sides. People often get into the habit of walking on one side only. Perhaps the shops are more interesting—or there may be more of them. One side may be cut up too much with side turnings. One side may have a Woolworth's—always a Mecca for shoppers. Anyway, there may be a score of reasons why one side is more popular than the other.

Then compare the two shops themselves. What are their immediate neighbours—this is a very important factor. To have an empty shop next door is very depressing and bad for trade. Don't be afraid of Radio competition—at least if it is competition which is fair and above board. Remember that there are more draper's shops in Oxford Street to-day than in any other street in the world. Yet they all do a highly prosperous business. Two or three radio shops in one street establish a radio centre where people can come and compare values and service. Apropos of this, I

remember once sympathising with a grocer friend of mine who suddenly discovered that his next door neighbour was to be a Company shop. Said he, "I'm glad—my fellows will be keen to give even better service—within twelve months my turnover will be up." And he was right. His sales figures showed an increase of over 14%. Keener competition made him more efficient.

But we are wandering from our subject. How should the comparative values of two shops be assessed? There is one fairly safe method adopted by all the chain stores. It is on the basis of pedestrian traffic passing the doors. Count the passers-by. From Monday morning to Saturday evening get someone to stand on the footpath with a simple counting machine. Take an hourly record. Plot the figures on a graph. You'll be surprised and probably learn quite a lot. Now do the same thing in one or two other centres—including your present shop. Get the facts—don't rely on impressions. You may think you know—but the shopping habits of the people of your town may have changed unbeknown to you.

* * * * *
Customer: "I say, you remember that pair of patent shoes I bought from you the other week?"

Shoe Shop Assistant: "Yes, sir."

Customer: "Well, the patent has expired."

* * * * *
Dealer (at end of motor-car test): "A hundred miles, and never had to use a spanner! It's worth £250 as it stands. What'll you give for it?"

Prospective Buyer: "Prepare for a shock. I'll give you £25 and no more."

Dealer: "Prepare for another. I'll take it!"

HARNESSING THE ELECTRON

¶ Here is the second of our series on the fundamentals of Radio—the Science of Electronics.

IN a previous article (see *Cossor Courier*, December, 1936), we explained the nature of the electron and how it behaved as a minute particle of negative electricity having a small but nevertheless measurable weight. Now let us consider in more detail how these electrons work in a modern wireless valve.

The most essential feature of any valve is, of course, a plentiful supply of these electrons. Various sources have been tried and, in fact, are still in use, but at the present moment the most satisfactory is without any doubt a coating of certain oxides (principally barium oxide and strontium oxide, both of which are very similar both chemically and physically to quicklime) on a core of nickel. Such a combination, whether in the form of a filament heated directly by an electric current, or as a cathode tube heated by a separate heater, is capable of providing a copious flow of electrons for an almost indefinite period. Other sources, such as thoriated tungsten, while of extreme usefulness in special cases, are far less economical in filament current, since they require to be operated at very high temperatures, while the oxide-coated cathode or filament does its work at a dull red heat. It is, in fact, essential that the latter should not be allowed to get too hot, since at increased temperatures their supply of available electrons is not appreciably improved, while their "lives" may be impaired.

It is well known that in order to cause

anode current to flow in a valve it is necessary to apply a positive voltage to the anode; this is because electric charges of opposite sign attract one another, i.e., a positive anode attracts negative electrons. It is just as true that charges of similar polarity repel one another; this gives rise to a somewhat curious state of affairs in the region of the filament, for as electrons from the filament appear in this space they are mutually repelled by each other, since they are all of negative sign, those nearest the filament being pushed back towards it by those farther away. This causes a cloud of electrons or "space-charge" to be set up, from which electrons are drawn as required by the other electrodes in the valve, the number taken being made good by fresh supplies. This cloud, therefore, behaves as a reservoir, with electrons flowing in and out according to demand and ensuring a plentiful supply for any requirements of the circuit with which the valve is operating.

How the Diode Functions

We now know that electric current can only flow when the anode is made positive to the filament, in order that it may attract the negative electrons. If the anode becomes negatively charged it merely repels electrons back towards the source and currents cease to flow across the cathode-anode space. Thus in Fig. 1 we show the relation between current and voltage for a simple

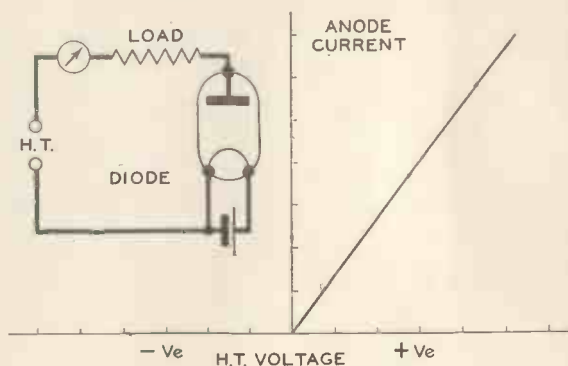
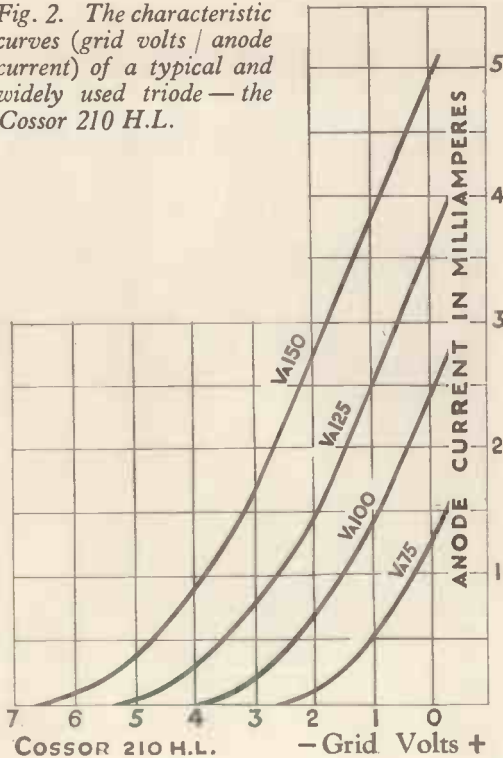


Fig. 1. On the left a simple diode circuit and right its anode volts/current curve.

Fig. 2. The characteristic curves (grid volts / anode current) of a typical and widely used triode — the Cossor 210 H.L.



diode which has a load in its anode circuit, with negative values of H.T. no current flows, while as the voltage is made increasingly positive the plate current rises steadily. This, of course, illustrates the rectification principle, since if the voltage on the anode is alternating between negative and positive values, it is only during the positive period that anode current can flow.

What Happens in a Triode

Let us now consider the state of affairs existing in a simple triode valve. Here again we have a cathode or filament surrounded by its cloud of electrons, an anode usually at a positive potential. Between these two electrodes we have, however, a grid which is normally maintained at a negative voltage. This grid, therefore, tends to repel electrons towards the cathode, while the anode voltage tends to drag them through the grid towards the anode. The result of these conflicting forces is a compromise, the anode receiving an amount of current which is determined by the values of the two voltages. The grid voltage

will always have a more marked effect on such current than the anode voltage, since the grid is much nearer the electron cloud. In fact, the amplification factor of the valve is a measure of the ratio of the effectiveness of the two voltages; if a valve has an amplification factor of 20, it means that the effect on the anode current of changing the voltage on the grid by 1 volt is equivalent to changing the voltage on the anode by 20 volts. Let us look at the characteristic curves of any triode valve, such as those of the Cossor 210 H.L. shown in Fig. 2. We see that a plate current of 1 milli-ampere can be obtained in any of the following ways:—

Anode Volts.	Grid Volts.
75	0.4 (approximately)
100	1.5 "
125	2.6 "
150	3.7 "

Thus we see that steps of 25 volts in anode voltage correspond to steps of 1.1 (approximately) in grid voltage, in other words, the amplification factor is $\frac{25}{1.1}$ i.e., 23 approximately.

In more complicated types such as screen grid valves, pentodes, etc., the underlying principles are practically identical, but in such types there are still other grids between the cathode and the anode. These further grids, by shielding the cathode from the anode, serve to prevent the anode voltage from having very much effect on the anode current at working conditions. This, of course, means a high anode impedance and a high amplification factor, it is, in fact, not difficult to make valves having amplification factors in excess of 1,000, as in the case of the Cossor M.S./PEN.

A young travelling salesman, deeply in love with his wife, but careless about money matters, started on a long business trip. Short of money, he promised to send a cheque, which he forgot to do. The rent came due, and she telegraphed: "Dead-broke. Landlord insistent. Wire me money."

The husband answered: "Short myself. Will send cheque in few days. A thousand kisses."

Exasperated, his wife replied: "Never mind money. Gave landlord one of the kisses. He was more than satisfied."

A Scotchman and a Jew were in the Police Court charged with being drunk and disorderly.

The Magistrate: "What proof have you that they were drunk?"

P. Constable: "Well, sir, the Jew was throwing pound notes away and the Scotchman was picking them up and giving them back again."

Our Special Correspondent TURNS INVENTOR!

“**SAY, Mr. Editor,**” said Our Special Correspondent, the other day.
“Prepare yourself for bad news. Get ready for the worst.
“I am leaving.”

When our roars of applause had died away, we asked O.S.C. for more information. He told us that he was throwing up his sinecure on the *Cossor Courier* for the thrills and insecurities of inventing, as a result of reading the article on “Patents” in our January issue.

“You will yet see my name splashed across the front pages of the dailies,” he announced proudly.

We agreed. “Half-Baked Inventor Starves to Death in Attic,” we suggested callously. O.S.C. treated this remark with scorn. Cocking a snook at us, he departed, slamming the door as he went.

He promises, therefore, that this is the last time he will inflict himself on our long-suffering readers. Personally, we fear that he will soon be back again on our staff!

YOU know, I’m rather a clever chap, although I says it wot didn’t ought. There’s not much I can’t do if I turn my mind to it. (Trouble is, there’s very little he ever turns his mind to.—Editor).

Money for—Soap

So when I was glancing through the Editor’s personal correspondence the other morning before he came in, and saw an article on patents, I thought: “That’s it. I ought to be an inventor. I’m wasting my undoubted abilities inventing new sequences to put words in. There’s no money in that. I’ll never make as much as the man who invented the Only Paint That Would Never Wear Off; and then invented the Only Soap That Would Remove The Only Paint That Would Never Wear Off, From People’s Hands. (Pardon chestnut).

“Therefore I can and I will become an Inventor.”

The first task in my new sphere of activity, was to decide what to invent. Now, that was pretty

difficult. Most of the things wanted have already been invented—beer bottles, safety razors, Belisha beacons, etc., etc.

The Inventor, Man or ?

So I decided to pop along to the library to get a line on what’s wanted.

Crikey! People tell me sometimes that I’m pretty daft. But some guys must be absolutely mongeese in the belfry, if I may say so. Just look at these things that *actually have been patented*—



“A device to enable people to walk upside down on ceilings, like flies.”

“A hat having a soft brim adapted to be turned down over the brows of the wearer, a monocle in a perforation in the front of the brim, and an irregular border of applied material adapted to hold the monocle in place.”

And here is a gem indeed (U.S. Patent 220538): “The object of my invention is two-fold, viz. to provide a detachable and easily applied protector for the moustache, thus keeping the ends or tips out of the mouth whilst eating; second, to so construct the said

protector as to render it useful when properly applied for the job of training the moustache in an upward direction towards the ears, thereby imparting to the face a gay and pleasant expression."

Too Bad for the Bugs

The inventor's motto must be—"Whatever you want, we have it—and we've got a lot you don't want, too." An electrical bed-bug exterminator, for example (unwanted as far as I'm concerned, at any rate); and a pocket case for fag ends, so constructed that "the ends retain their shape and do not soil the pocket, or get soiled themselves;" and an adjustable eye-protector for fowls, to stop them pecking each other's eyes out (recommended for the female sex and mothers-in-law generally!); and a metal gun for "the shooting down of wasps, etc." Some marksman!

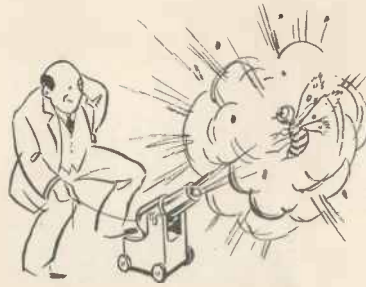
Another bright fellow has invented a "snake thrower" to "hurl venomous snakes at the enemy." Charming. But what appeals to me most is "a collar stud that cannot be lost." I must get one of those.

At last I decided that these things, although interesting, wouldn't help me any. So off I pushed to the Institute of Patentees.

Short Cuts to Millions

I know now *everything* that still has to be invented! Instead of wearing out my brains trying to decide what the public wants, I have a complete list of "895 Needed Inventions," published by the Institute. All that remains is to invent them one by one, and in a very short time I shall be a millionaire—or will I?

I think I'll start with Thing To Be Invented No. 22—"A machine for taking rind off bacon." Or perhaps No. 424—"A machine to put on the table to pick wrinkles." Mind you, there's a lot to be said for starting with "An



"... a metal gun for the shooting down of wasps, etc."

box of matches is placed and once placed cannot be taken away without smashing the box to pieces." That bears the stamp of a cry from the heart of a suffering soul! So does No. 615—"A 'silencer' which can be inserted in the muzzle of a barking dog, so that sick persons and others with 'nerves' may be spared the injury to their health occasioned by the aforesaid noisy animal." And Nos. 713 and 715—"Method of rendering feet 'corn-proof,'" and "Automatic indicator to register entry of club bores," respectively.

Sosses, Ancient and Modern

This has been passed to our research department—"A wireless loud speaker to translate any foreign language into English." This has not—"A substitute for sausage skins." Neither has No. 868—"Method to transplant or grow hair on a bald head." It is followed by No. 869—"Silent lawn mower." Is that funny—association of ideas and all that? Or is it?

After all this, you'd better have one on me—"A temperance drink that will keep and yet not pall on the palate." How would you invent "A device for preventing smash-and-grab raids at jewellers' shops"? Personally, I'd turn all jewellers into butchers, and that'd be the end of that.

"Something to keep one's fingers clean when changing a typewriter ribbon"? Easy. Make the office boy do it. And as a reward let him try your solution to the problem of "A device to enable people to walk upside down on ceilings,



"... to pull more bedclothes over a sleeper as the temperature falls."

like flies." Dracula would have been pleased with that.

Are any of the Bright Young Things readers of these pages? If so, they'll be glad to know that the inventive genius of the world is wrestling with the problem of producing "Linen which will be proof against lipstick. So far no linen has been produced which does not permanently stain." What's the odds they succeed? I'll stake my shirt on it!

No Need to Buy a Wow-wow!

Even if they don't, I surely ought to be able to find "a device to produce an artificial dog bark, when necessary, inside the house"; or "something useful into which gramophone needles could be turned." Or maybe "an umbrella which one does not leave behind." 716 is pretty good, too—"Method of making the other chap see your point of view." So is "An apparatus worked by thermostatic or other means to pull more bedclothes over a sleeper as the temperature of the bedroom falls, which at times is very considerable in this and other climates, and thereby ensure a good night's rest."

But what I'm going to start on—what I'm going to make my fortune with—is "a combined pen, pencil, penknife, eraser, paint-brush, ruler, compass, magnet, sparking-plug tester, toothbrush, nail-file, razor, adjustable watch key, cigarette holder, automatic lighter, corkscrew, monogram, toothpick, fitted with a clip for the waistcoat pocket."

Now then, you lads, let me have your orders. Just the thing for birthday, wedding or Christmas gifts for people you hate. Bedford lorry for carrying novelty included in price.

It is announced by *Time* (U.S.A. business paper) that Columbia Broadcasting Co. enjoyed a revenue for the first eleven months of 1936 of £4,157,600 from advertisers. This was an increase of 32% over 1935. National Broadcasting Company reported a gross income for the same period of £6,107,000. A third Broadcasting chain of stations, called the Mutual Broadcasting System, has now come in operation, attracted by the great money-making possibilities of radio broadcasting. Incidentally the N.B.C. networks (red and blue) now run to 111 stations from coast-to-coast. Columbia, on the other hand, muster 97 stations.

* * * *

Bakelite was first made by a Belgian chemist named Baeker in 1906 by heating together strong formalin and a substance obtained from coal tar, called phenol.

Do You Know—

- ... that aluminium was once £100 per lb.?
- ... that supplies of alumina are practically inexhaustible?
- ... that anodising colours the surface and makes it glass hard?

ALUMINIUM enters largely into Radio construction. Aluminium for coil cans—for variable condensers—for pot/meter and rheostat covers—often for chassis stampings—and used as foil for fixed condensers. Some facts about it may interest you.

Less than a century ago aluminium was a rare metal—as costly as gold. In 1850 it was quoted at over £100 per lb. The story goes that in 1879 the purchaser of a pair of opera glasses in Paris was offered platinum or aluminium mounting at the same price. The purchaser chose the latter—and lived to regret it!

We next hear of a process evolved in 1883 by a young man in the early twenties named Charles Hall. He discovered that Cryolite, when molten, would dissolve alumina (the oxide of aluminium) and hold a considerable amount of it in solution. Finally he discovered that by electrolysis he could separate the metal itself. Of course, since the early crude experiments, great advances have been made. To-day, two pounds of alumina will produce about one pound of aluminium.

Supplies are inexhaustible. No less than 8% of the earth's crust consists of alumina—although in a very impure form. When refined by various chemical processes alumina is a fine whitish material, not unlike table salt.

Aluminium is no longer available only with a silver-like sheen. It can be treated electrically by a process known as anodising and coated with a wide range of delicate pastel shades. Incidentally this has the effect of making the surface of the metal as hard as glass, and practically impervious to corrosion.

Instead of hammering out dents in motor car bodies and wings the latest idea is to fill them up by means of an electrically-heated spray gun using molten solder.

·0005^m/_m OFF ABSOLUTE

Another addition to our series on Valve Making

No. 5
EVACUATING

IS NOT GOOD ENOUGH So We Fire a "Flag"

IN the past three or four issues of the *Courier* we have explained as clearly and concisely as possible the many processes involved in the manufacture of valves. Incidentally, may we take this opportunity of thanking those of our readers who have expressed their appreciation to our representatives, or who have written us letters about this series of articles. It is gratifying to find that readers now have a much clearer idea of valve processes and some of the difficulties involved in manufacture.

We are now almost at the last stage. Our valve has been sealed into its glass envelope—the bulb—and stemmed ready for pumping.

Pumping—or evacuating—to the casual observer seems a very simple, straightforward operation. It would appear that all one has

to do is merely to withdraw all the air—or as much as is practicable—seal off, and the job is done.

Why hidden gases must be removed

But evacuating is not quite so simple as this. There is not only the air in the bulb to be removed, but it must be remembered that there are hidden gases within the metal parts. And, as you will appreciate, there is a considerable amount of metal in a valve structure.

The degree of vacuum to which a valve is pumped is very high—in the neighbourhood of one ten-millionth of the normal atmospheric pressure. Any gas, therefore, allowed to remain within the metal parts would ultimately be released by this enormous difference in pressure and the valve would rapidly become useless. In addition, certain chemical changes take place on the surface of the cathode or the filament while the valve is in use. Pumping, therefore, plays a very great part in prolonging the effective life of a valve.

Nowadays pumping is carried out with automatic machinery, which is far more elaborate than that previously used in the earlier days of valve manufacture. Everything possible has been done to eliminate the human element and to ensure uniformity. In addition, of course, these new methods have made it possible to speed up the operation of pumping, and reduce costs very considerably.

How the Pump Works

In the Cossor Valve Works, the type of machine normally used operates on rotary principles—not unlike a large wheel, which revolves horizontally. Around the circumference of the wheel are arranged a number of



Part of one of the large circular pumping machines in the Cossor Valve Works.

A corner of the Valve Works. In the rear can be seen two of the circular evacuating pumps.



separate pumping units. Each unit is completely self-contained, with its own motor. The procedure is somewhat as follows :

Two operators are required—one to load and the other to seal and take off. It should be remembered that the machine is continuously rotating, so that there is no break in the continuity of the process. After the valve has been inserted, a clamp is released which permits the pump to start immediately drawing off the air. The valve now passes through a tunnel oven electrically heated, where the temperature of the glass is gradually and carefully raised to a point just below its softening state. The valve travels through this oven for a period of several minutes. In the meantime, the pump is pulling away the gases given off from the interior surface of the glass bulb at this high temperature. This is an important part of the process.

In due course the valve emerges from the oven, and the next stage is to remove the gases from the metal parts. This is done by heating them by applying "Eddy Currents."

Eddy Current Heating

Eddy Current Heating or—as it is called in the factory—E.C.H. may be familiar to some, but here is a brief explanation of the principles involved.

Eddy currents are those local currents which circulate when a difference in potential is set up at various points in a conductor. These currents give rise to heat to a degree dependent upon the electrical resistivity of their path and the potentials applied. This in turn depends to a certain extent upon the strength of the magnetic field.

Reverting to our pumping process, we have

already explained that within the metal parts of the valve there will be a very appreciable amount of various impurities and gases. Pumping by itself will not remove these gases. Therefore it is necessary to heat up the metal parts to incandescence to drive them out, so that the pump can get to work and evacuate them. The only practicable way of heating them is to use the Eddy Current method. To do this, therefore, we arrange a coil of thick copper wire just large enough to encircle the valve and travel with it for a few seconds. An alternating current is passed through this copper wire—provided by a valve oscillator operating at a frequency of one million cycles per second. The magnetic field is built up to a maximum—then brought down to zero—built up to a maximum again in the other direction—brought back to zero—and this is repeated continuously a million times a second.

Metal parts made red hot

If you were standing by this big circular pump, you would see the copper coil automatically rise and then fall to encircle the valve. In a few seconds all the metal parts within that valve—anode, grids, supporting wires, etc.—will be brought to a bright red heat. And as a result of this intense temperature, practically all the gases within the pores of the metal are liberated and drawn off by the pump.

The third stage of pumping deals with the filament—or in the case of a Mains valve—with the cathode. Current is now applied to the

filament (or heater, as the case may be) in order to remove occluded gases here. In a Cossor battery valve, the filament is actually a wire core coated with barium carbonate. When the filament is first heated a chemical reaction takes place which causes the barium carbonate to give up its $C.O_2$. It is necessary, therefore, to remove this gas by pumping.

By now, pumping is almost complete, and the wheel has made nearly a complete rotation. But there remains one very important operation to be done.

“Why valves are “gettered”

The pressure in the valve at this stage is of the order of $\cdot 0005$ mm. off absolute. Forgive the technical term—it means “almost a perfect vacuum.” There is still, however, some gas

residue which pumping will not remove. Another method, therefore, is adopted. The valve must be “gettered.” You will probably have seen in a valve a little disc on the end of a wire. This disc (called a “flag”) contains a quantity of magnesium and barium. At the last stage in pumping it is fired by means of Eddy Current Heating. The vapour immediately condenses on the inside surface of the glass bulb. In so doing, it traps the remaining minute residue of impure gases and the vacuum will be safely retained at a high working value.

Pumping is complete, and all that is to be done is to seal off the valve from the pump manifold. This is done by the second operator by means of a small gas jet carefully applied to the valve stem. When this has been completed, the valve passes down a chute for its final operation—that of fitting a base.

“EVERY PICTURE TELLS A STORY”

User Comments on Cossor Test Equipment

MORE and more wireless dealers are now discovering that service work can be a very useful source of profit—provided the right kind of equipment is utilised. The old rule-of-thumb methods are no longer practicable. Circuits have become much more elaborate—fault-finding must be carried out in a systematic manner. This applies particularly to the lining up of Superhets.

The following letter from Mr. John Easte, the Service Manager of Klitz's Music Warehouse, 88 High Street, Lymington, Hants., speaks for itself:—

“We have long felt that the normal method of lining up a Superhet, particularly where some attempt at band-passing is included, is a very laborious process with an oscillator and output meter. We were therefore very happy to try the Cossor equipment. After three months' Service we must admit that we did not expect to find such a speeding up of all alignment jobs. Queer “hissey” superhets which had cost us many hours now show up at once. An alternative in alignment, decoupling or change of valve, and as the advertisement used to say, ‘Every picture tells its story,’ and there the picture is, right in

front of you. True, this equipment is expensive; but any tool which will make money for you is well worth having, and that is what we feel about the Cossor Oscillator and Cathode Ray Equipment.”

In every industry, labour-saving equipment is taking the place of older methods. No one will dispute, for example, that an electric drill will drill holes in a fraction of the time of the old hand drill. Certainly an electric drill is much more expensive but it saves its cost time and again by the elimination of wasted and unprofitable labour. Similarly, the Cossor Ganging Oscillator and the Linear Portable Oscillograph will soon justify their extra cost by saving time and insuring greater accuracy.

Full details of these two instruments are available in Leaflets L.180 and L.181, copies of which will be gladly supplied by the Instrument Sales Dept. of A. C. Cossor Ltd., Highbury Grove, London, N.5

“It isn't sanitary,” protested the visitor, “to have the pig-sty built so near the house as this.”

“Well, I dunno,” replied the owner, “I ain't lost a pig for fifteen years.”

WHAT DO THE PUBLIC



KNOW ABOUT TELEVISION?

“IF you want half-an-hour’s quiet amusement, start an argument among a few of your friends about television. You’ll be amazed how little the general public know about it. Or at least I was,” writes one of our Cossor Reps.

“‘Is it true that with television you can see into people’s homes?’ This question came—you’ll hardly credit it—from a cashier at a bank.”

“‘I suppose with a television Set you can see all that goes on in the studios at Broadcasting House—it must be great fun to see the Saturday evening variety programmes.’ This was quite one of the most popular fallacies. Proving that the public really hadn’t grasped the fact that the television programmes from Alexandra Palace were quite distinct from the normal broadcasting service.”

“Another curious thing was that hardly anyone present had any idea that the B.B.C. cameramen could film the Derby—the Boat Race—the Coronation—and then dash back to Alexandra Palace to televise the event within an hour or so of its occurrence. Or that outdoor scenes had actually been televised direct—such as Golf Matches, Sheep Dog Trials and similar subjects.”

“Among the more knowledgeable ones there was plenty of criticism regarding picture size. Although none present had actually seen a television demonstration, it was the general opinion that the present size was too small. It was quite clear that none of the critics had given the matter any serious thought. They

“—PRECIOUS LITTLE”
says this writer

didn’t appreciate, for example, that size of picture is closely related to such factors as viewing distance, room area, etc. That the

big screen at the cinema is necessary so that the greatest number of people can see simultaneously in comfort. But when it was explained to them that the present television picture is about the size of a large illustration in a paper like the *Sphere* or *Tatler*, they began to see that for home use—where only four or five would view at one time—the present size is quite ample.”

“Out of the dozen or so people who joined in the discussion, not one appreciated the fact that the television Set was also a first-class high fidelity Radio Receiver with an all-European programme range. Without exception they had all looked upon a television Set as something bought purely for television—a Set that would be in use only an hour or so during the day—and perhaps not every day at that.

“‘I came away,’ writes our Rep., ‘not with a feeling of despondency but rather in a chastened mood. I realised for the first time that a great deal of educational work was still to be done in giving the general public the real facts about television. It is perfectly obvious that misconceptions must be cleared away and radio retailers can assist tremendously. They—and they alone—are in daily contact with the buying public. Everyone is keenly interested in television—make no mistake about this. The public realise that it is the inevitable extension of the broadcasting service.’”

Meet Mr. Dowsett!

—and his Merry Men of “Brum.”

“Lord give me grace to catch
A fish so great that I
When telling of it afterwards
May never tell a lie!”

FATHER of our Birmingham Branch — genial Mr. R. H. Dowsett. With a smile and a handshake for one and all, he's terribly popular. On and off duty his favourite pastime is—fishing. Off duty, for the finny denizens of some murky pool or stream. On duty, for more and more and even still more Cossor orders.

A much more successful disciple of Isaac Walton during the week than the week-end. He often tells you about “the one that got away last Saturday.” But in business, nothing ever slips through his net.

His “order-trawler” has a crew of five :—



Mr. R. Skett

He spends his spare time cabinet making, interior decorating — and nursing his dispatch case! We're told he even takes it to bed with him! And to other people's beds, too. He visited a sick colleague recently, carrying “old faithful” in his arms, of course. Did he anticipate any orders? He got 'em—but we daren't say what they were here!



should have a complaint, the service department resign *en bloc* on the spot. They know life will be just too exciting for them until the trouble's put right. Boy, you should see him in action. He's positively dynamic.

Mr. B. J. Parkes

Every Saturday morning Mr. Parkes turns up regular as clockwork with—a brand new, original yarn! Where he gets them from has not yet been discovered. We must find out, one day, and let the B.B.C. in on the secret (perhaps)! He's also a very successful gardener—and proud of it. If your rose trees develop knobs or cucumbers begin to grow where you put carnations down—ask Mr. Parkes. He knows why.



Mr. W. L. Hartshorne

Whenever everything seems to go wrong, and you get in such a state that you howl for the office boy to get you “twopennorth of prussic acid, quick”—Mr. Hartshorne will see the funny side and make some apt remark that'll make you laugh and laugh and laugh just like little Audrey! His quiet sense of humour always comes to the fore when least expected.



Mr. H. L. Haywood

The embodiment of peacefulness, serenity and placidity—when seen in his beloved garden. But inside the office he's a holy terror! The despatch department is shaken to its foundations on the rare occasions one of his customers hasn't yet got wot he ought! And if a customer of his



Mr. L. T. Tongue

You should hear him give tongue to all Aston Villa's home matches! His shout is the terror of referees for miles around. Still, he hasn't actually killed any “refs” yet—although, of course, there's plenty of time.

Does a lot of horse riding. Also has a reputation for a quick-change artist as far as motor cars are concerned. But to the wonderment of customers and the staff, he's had his last car for *at least* six months. Shame, Mr. Tongue. We're surprised at you,



If you are building the "Cossor Courier"

COMBINED MULTI-RANGE MILLIAMMETER and VOLTMETER

—here are Details of the Resistances

IN the previous article we discussed various ways of extending the range of a milliammeter and of converting it for voltage readings. The construction of the various resistances is by no means a difficult matter. The lower values, under say 5,000 ohms, should be wire wound. This category includes all the shunt resistances and also the series resistances for the lower voltage ranges. Either copper wire can be used or any of the special resistance wires such as "Eureka" or "Nicrome." The latter have a much higher resistance for a given diameter and length of wire than has copper, and consequently the resistances will be less bulky if one of these wires is chosen. The resistance of Eureka wire is 28 times that of copper, while that of "Nicrome" is 66 times. It does not follow, however, that the highest resistance wire is always the best to use, since if the length of wire is too short the shunt becomes difficult to adjust. As an example, to shunt a 1 milliamperemeter to read 1 amp. a shunt of about 0.1 ohm is required. The wire tables show that No. 20 gauge wire will carry this current without overheating, and that the resistance of copper wire of this gauge is 23.6 ohms per 1,000 yards—12 feet 8 inches of copper wire would therefore be required. If "Eureka" wire is used, however, the length required is only 5.4 inches, and for "Nicrome" wire 2.31 inches. In this case, copper or "Eureka" would be most suitable.

When using "Eureka" or "Nicrome" it is important to remember to allow the shunt to cool after soldering before checking its value, since quite a large current may be generated at the joint by the thermo-electric effect between the two metals, and if allowed to pass through the meter may give rise to a considerable error.

It is not at all necessary to have a large number of different resistance wires available. Three gauges should be sufficient to wind resistances to cover all the ranges likely to be of use in radio work. For convenience in making up these resistances you should use

double silk covered wire.

If the gauge of wire available will not carry the current without overheating, two or more strands of wire twisted together can be used.

For the benefit of any who may not have wire tables, we give below the resistance and maximum safe current of three of the most useful gauges of copper, "Eureka," and "Nicrome" wire.

Gauge	Ohms/yard			Max. Current
	Copper	Eureka	Nicrome	
20	.0236	.661	1.56	1 amp.
32	.262	7.35	17.3	91 milliamps.
44	2.985	83.7	198.0	8.0 "

The best method of procedure is as follows: First calculate approximately the resistance required, then select a gauge of wire which will carry the required current without overheating—the current density should not be greater than 1,000 amps. per square inch of wire diameter—then find the length of wire required and allow 10% extra for the purpose of adjustment. The shunt should then be wound and adjusted, together with the same length of lead that will be used finally, to give the correct reading on the meter.

A convenient way of winding the wires thicker than say No. 32 gauge is to wind them in "bundle" form. The wire should be wound bunched up on a thin piece of card about one inch wide, and then slipped off the card and bound in the middle with cord or insulating tape. This makes a very compact resistance which can be wired directly into circuit.

For the finer wires it is better to wind on a slotted former, which can be built up with round wood washers and bakelite end cheeks bolted together; or turned out of wood dowelling. Alternatively, L.F. transformer bobbins may be used.

For the higher voltage ranges, wire wound resistances become rather bulky, and unless extreme accuracy is required, ordinary com-

position type resistances are quite satisfactory. It is unlikely, however, that they will be sufficiently close to their nominal values to allow their use without adjustment, and it is usually necessary to choose a value somewhat less than that required, and add additional resistance in series to bring it up to the correct value.

An alternative method is to use the solid type of resistance, such as the "Erie"—not those in which the resistance compound is deposited on an insulator—and increase its resistance to the correct value by filing off some of the body of the resistor. This method should be used with some caution, but it is quite satisfactory if the adjustment required is only a few per cent.

The adjustment of the resistances to their correct value is most easily done by checking the instrument against another of approximately the same range; but when this is not available one can calibrate the instrument over a limited extension of range against its original calibration.

For calibrating a milliammeter a partly discharged accumulator will give a steady source of voltage. The meter should be connected in series with a suitable variable resistance across the accumulator, and the resistance adjusted

to give exactly full scale deflection. The shunt is now adjusted until the meter reads $\frac{1}{2}$ or $\frac{1}{4}$ of its original deflection. This procedure can be repeated to calibrate a further range, but it is not desirable to do this more than twice, because the accuracy with which the meter can be set to a quarter of its full scale reading is not very high, and therefore the accuracy of the instrument will be reduced on each succeeding range.

Where another milliammeter is available for calibration purposes, the two should be connected in parallel, and the shunt adjusted until the two meters read the same. A voltmeter can, of course, be calibrated in the same way. The best source of voltage for checking a voltmeter is either on H.T. accumulator or dry battery in good condition. If a voltmeter is not available whose range is as high as the meter it is desired to calibrate, it is of course possible to measure accurately the voltage of the battery between its various tapping points and adjust the meter under construction to read the total voltage, but it is essential that a high resistance standard meter should be used in conjunction with an H.T. battery whose internal resistance is very low.

SYSTEMATIC FAULT DIAGNOSIS

—a Practical Example using Model 3733

SOMETIMES a fault in a Receiver can be quickly located. On other occasions, the problem may be more difficult. An expert radio engineer may be able to spot the defect at once—whereas one less experienced may spend an hour or so before the trouble is brought to light.

We are anxious, however, that the "Courier" should be useful to all service men—particularly to those who are learning their job. The secret of success in servicing is to be *systematic*. With

circuits becoming more and more complicated each year, guess-work must be eliminated. No Service Department can show a profit to a retailer unless the work can be carried out systematically and expeditiously.

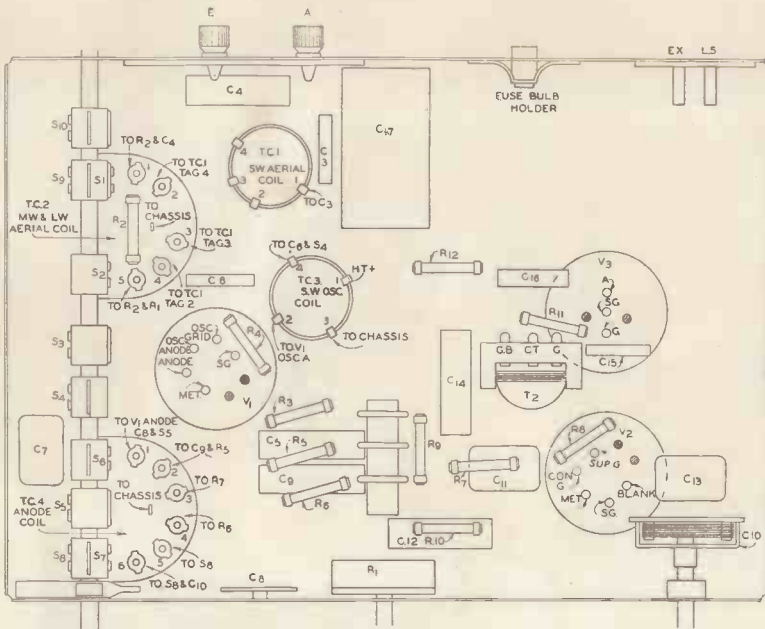
As an example of systematic fault finding, the following description of the methods employed in dealing with a typical Cossor Receiver—the Model 3733—should be of considerable interest to service engineers.

Among the preliminary tests to be made when dealing with any defective Battery receiver it is important to ensure that the fuse bulb is intact, and the H.T. and L.T. batteries above reproach. Do not overlook the possibility of intermittent contact in one or more of the various leads and plugs. Experience shows that corrosion, however slight, is one of the serious causes of trouble in battery receivers; make sure that the L.T. spades are free from any suspicion of this.

If the receiver is being tested at the customer's

house, do not overlook the possibility of a defect in the aerial-earth installation, and of course make sure that all valves are firmly seated in their holders.

To explain the correct procedure in systematically tracking down troubles, we will imagine that you have received from a customer a Cossor 3733. This is—as you will remember—a 3-valve battery Set covering three wave bands. On the medium and long wave bands it functions as an ordinary "straight-three" but on the short waves it operates as a Superhet. Assume also that—beyond the fact that



This diagram shows the underside of the chassis of Cosor All wave Battery Model 3733.

the batteries are O.K. and that the aerial and earth system is satisfactory—you know only that the Set will not function. The customer can give you no clue as to what has gone wrong—now it's up to you.

Adhering to the recommendation made in earlier issues of the *Courier*, we advise commencing your investigation at the grid of the output valve and carrying through stage by stage finally finishing with the aerial. Long experience has shown that this is by far the most satisfactory method of diagnosing faults.

Assuming the set to be dead, the valves should be tested in conjunction with the table printed below when, if they are found to be O.K., the finger should be placed upon the grid terminal of the output valve. If the familiar grid note is not heard in the loud speaker it is a safe bet that the defect lies in the loud speaker itself. The only tests to be applied here are for continuity of the transformer windings and the speech coil. The primary of the speaker transformer is 850 ohms, the secondary .2 of an ohm, and

the speech coil 2 ohms. It is obvious that the speech coil must be disconnected from the secondary for the purposes of this test.

Next, again apply the grid test to the 210 S.P.T. valve, when if there is no response in the speaker, one of the following components will be found wanting :—

- C14, .1 mfd. coupling condenser between the anode of 210 S.P.T. and T.2, the inter-valve auto transformer, which latter has a total D.C. resistance of 2,500 ohms, the primary side of the tap being 1,000 ohms and the secondary side 1,500 ohms.
- R11—100,000 ohms grid stopper to the output valve.
- C15—0001 mfd. by-pass condenser.
- C13—0001 mfd. anode by-pass condenser.

Continuity tests should be applied here between :

- (a) the grid of the output valve and the plug of the G.B.1 lead, when, if an open circuit is shown, the auto transformer or R11 will be found defective, or alternatively a break will exist in the wiring or lead between the points mentioned.
- (b) the grid of the output valve and chassis, and if anything but infinity is obtained, C15 should be suspect.
- (c) the anode of the 210 S.P.T. and the centre tap of the auto transformer. Here again the reading should be infinity, and anything in the nature of a leak would reveal a partial breakdown in C14.

So far as C13 is concerned, we should here mention that an open circuit would cause instability, and a short circuit would blow the fuse, as it is between H.T. + and chassis.

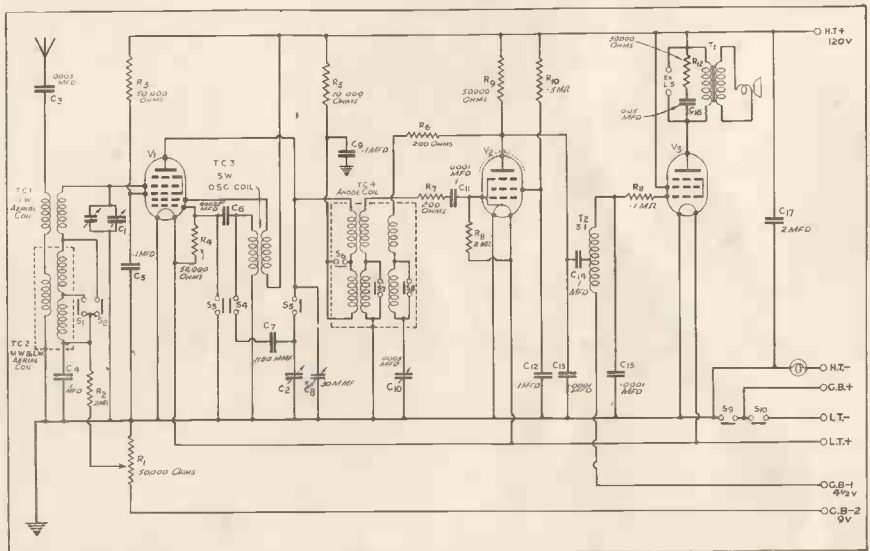
Proceeding to the grid of the 210 S.P.G. we come to a somewhat different proposition. This valve serves the dual purpose of S.G. amplifier on the medium and long waves, and frequency changer on short waves ; under the latter conditions the small coil TC3, situated under the chassis, is utilised, the thick wire winding being the Oscillator Grid Coil, and the inter-spaced winding the Anode Reaction Coil. The H.F. Transformer TC4 operates as an un-tuned intermediate frequency transformer with reaction.

COSSOR MODEL 3733 VALVE COMBINATION, VOLTAGES, ETC.			
Valve	Anode volts	Anode curr.	Screen volts
210 S.P.G. . .	108	1.2 m.a.	40
210 S.P.T. . .	70	.9 m.a.	25
220 H.P.T. . .	120	4.0 m.a.	120
Valve	Screen current	Osc. Anode volts	Osc. Anode current
210 S.P.G. . .	1.6 m.a.	120	1.4 m.a.
210 S.P.T. . .	.2 m.a.	—	—
220 H.P.T. . .	.9 m.a.	—	—

Theoretical circuit diagram of model 3733.

Having explained the unconventional method of operation used on the H.F. side, we can again proceed with the usual routine tests of this portion of the circuit.

If the grid test is again non-productive, tests for dealing with the short wave portion of the receiver can be applied as follows:—



- (1) Continuity between Oscillator Grid of 210 S.P.G. and L.T+ which measures the Oscillator Grid resistance, which should be 50,000 ohms.
- (2) Oscillator Grid coupling condenser C6. This is of .00025 mfd. capacity, and in view of the fact that it is in parallel with other components, any tests of this item must be made with one end disconnected.
- (3) From the coil side of C6 to chassis. The D.C. resistance here is sensibly zero, and a simple test for continuity will suffice.
- (4) Continuity between the Oscillator Anode and H.T.+ 120. D.C. resistance 8.5 ohms. This measurement includes the reaction section of TC3.
- (5) Between the coil side of C6 and the fixed vanes of C2. D.C. resistance infinity. This checks the 1,180 mmfd. short wave tracking condenser for breakdown.

For the above five tests the receiver should be switched to the short wave position.

The following information will enable tests to be made for checking continuity in the Modulator Anode circuit of the 210 S.P.G. on the medium and long wave bands:—

On the medium band the D.C. resistance of the primary of TC4 is 1.3 ohms, and on long waves 13 ohms. The anode resistance R5 is 10,000 ohms, and it necessarily follows, therefore, that for accuracy these should be measured separately.

It will be obvious that a short circuit in C2, the anode portion of the gang condenser or C8, its associated trimmer, will effectively short circuit the primary winding and will just as obviously short H.T. to earth.

C9 is also part of this tuned circuit and should be above reproach. Any leakage would result in low voltage to the anode of 210 S.P.G.

Now, coming to the secondary winding of TC4, measurements should be made between chassis and the coil side of R7, the 200 ohms stabilizer resistance; on medium waves the D.C. resistance is again 1.3 ohms and on long waves 13 ohms, as in the case of the primary winding.

Any high resistance or infinity readings during these coil tests will obviously denote badly soldered joints or winding breakage respectively.

The reaction windings of TC4 have a D.C. resistance of .8 of an ohm and 6 ohms respectively on medium and long waves. The reaction stabilizing resistance R6 has a resistance of 200 ohms.

Continuing from R7, the coupling condenser C11 is of .0001 mfd. capacity, and its associated grid leak R8 is 2 megohms.

We can now say that we have conducted all necessary tests for revealing defects between the 210 S.P.G. and 210 S.P.T., and can transfer our attention to TC1 and TC2.

These are best tested as follows:—

Between the coil side of the .0005 mfd. series aerial condenser and chassis. This test covers the short, medium and long wave coupling coils, and the approximate total D.C. resistance is 9 ohms.

Between the Modulator Grid of 210 S.P.G. and the coil side of R2 the 2 megohm decoupling resistance. This covers the short, medium and long wave tuning coils, and the D.C. resistance should be not more than 14.5 ohms. For this test the receiver should be switched to long waves.

Here again the aerial section of the gang condenser and its associated trimmer are across the coil arrangement, and it follows that any short circuit in the condenser will effectively short circuit the tuning coils.

The volume control may be measured between G.B.2 and chassis; its D.C. resistance is 50,000 ohms.

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