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PRACTICAL TELEVISION

6D

CONTENTS.

JANUARY, 1935.

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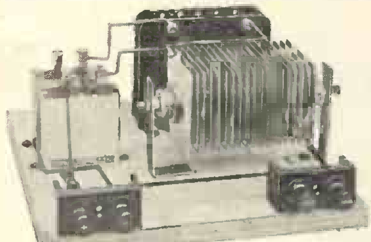

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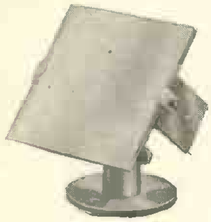

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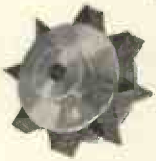

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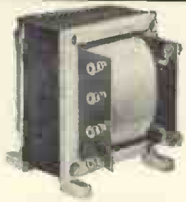

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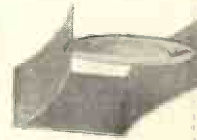

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PRACTICAL TELEVISION

Editor: F. J. CAMM

Vol. I JANUARY, 1935 No. 5

CONTENTS

	Page
Televiews	101
Telenews	102
In the Television Studio	103
Jekyll and Hyde of Broadcasting House	105
Choosing Your Television Motor ...	106
Synchronising with A.C. Mains	108
Long Distance or Local Television	109
Commercial Television Receivers	112
A New Design in Television Receivers ...	114
Sound by Synthesis ...	115
Scanning Discs ...	116
Periscopic Image Observations ...	120
The Mervyn 60/- Television Kit	121
A Cam Operated Friction Control ...	122
Television in Manchester	123
A B C of Television ...	124

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The Editor will be pleased to consider articles suitable for publication in PRACTICAL TELEVISION. *Such articles should be written on one side of the paper only, contain the name and address of the sender, and preferably be typewritten. Whilst the Editor does not hold himself responsible for manuscript, drawings or photographs, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL TELEVISION, *Geo. Newnes, Ltd., 8-11 Southampton Street, Strand, W.C.2.*

TELEVIEWS

Lord Selsdon on Television

THE British Television Commission, which at the moment of going to press is collecting information on the state of the science for presentation to the Postmaster-General (a similar commission is visiting Germany with the same object in view), will probably be back in this country before these notes appear in print. The Chairman, Lord Selsdon, in an interview whilst in America, expressed the opinion that Television was just about ready, but that it was awaiting a fairly extensive financial backing. He expressed also the view that it would be easier to finance television in England owing to the British licence system. He was, of course, particularly referring to the American Sponsored Programme system when making this comparison.

Many thousands of pounds of English money are already invested in television, and it is known that some of the largest Film Companies hold controlling interests in some of the English systems. It merely needs an assurance from the Postmaster-General that television programmes will be put out regularly for any necessary additional finance to be forthcoming.

Outdoor Television

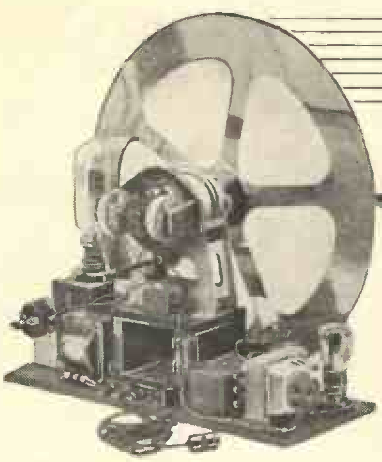
The great advantage of the Iconoscope system is that its higher sensitivity permits outdoor events to be transmitted, and daylight transmission may be rendered possible by means of this system. It brings measurably nearer the day of the televised news events. It would seem that the only difficulty with the system is in the accurate control (in manufacture and use) of the sensitive cells.

A Television Development

We learn that a well-known television firm is endeavouring to interest a well-known Film Company in its system, the object being to invite financial support up to £200,000. The efforts to bring about this unification have so far not fructified, but they indicate that television and film interests will not work in opposition to one another. Indeed, it is almost certain that the two interests will either amalgamate or co-operate. As we have remarked above adequate finance will be available once the fillip has been given to the industry by means of regular television transmissions.

The 30-Line Systems

Meantime the science of television merely relies upon the 30-line transmissions which are put out on Wednesday evenings and Saturday afternoons. It is true that the programmes continue for three-quarters of an hour instead of half-an-hour as formerly. Doubtless it is thought that these times are adequate to enable experimenters to test various circuit-arrangements and television apparatus. It may also be considered in official circles that it would be giving undue prominence to the low definition system if these times were further increased, since it seems reasonably certain that regular nightly television transmissions will make use of the high definition system. We think that this outlook is reasonable, and although there has been a vast increase in interest in this new science since the publication of No. 1 of "PRACTICAL TELEVISION" we think that present purposes are adequately served. After all, it whets the appetite to have to wait!



Telenews

Topical Reflections from The Radio Screen.
Pars about Persons and Programmes.

A Unanimous Opinion

IT is interesting to note that in a questionnaire circulated recently to members of the Television Society for the purpose of presenting a report to the Television Committee, was a question asking whether members favoured the continuance by the B.B.C. of the present 30 line transmissions on ordinary broadcast wavelengths pending the *complete* development of a practical system providing higher quality of vision. By an overwhelming majority, 92 per cent. of the replies to be exact, the reply was in the affirmative. Coming from a technical society, this unanimous expression of feeling concerning the present low-definition transmissions was most commendable.

Television at Windsor Castle

A SUNDAY newspaper revealed recently that a demonstration of television had been given a short time ago to the King at Windsor Castle. This was entirely of a private nature, for very obvious reasons, but it is stated that talking films were shown, the cathode-ray tube receiver being installed in the Castle lounge, and the signals sent by radio *via* the medium of ultra-short waves.

A Good Idea

WE see that a prominent institution of radio engineers has suggested that in their opinion it would be a good plan to run both the present B.B.C. low-definition transmissions (or a modified improvement) and any well advanced development of high-definition television transmissions as a dual service. In this way those who desire to experiment with television without a considerable expenditure of money would have their needs met, as well as those who preferred to graduate to apparatus suitable for the reception of images containing an increased number of scanning lines. The suggestion is one which merits the closest investigation.

Compromising

IN technical circles considerable emphasis has been laid in the past on what has come to be known as the "light-detail-sideband" compromise of television engineering, whenever discussions have taken place concerning the reasons for choosing the number of pictures per second, picture ratio and scanning lines for low-definition transmissions. Now that high-definition working is claiming so much attention, the compromise is seldom mentioned. Are we to assume from this that perfection has been attained in the laboratories and that no question of compromise now arises ?

C. R. Tubes

NOW that cathode-ray tubes are becoming quite fashionable for those experimenters engaged in investigations of high definition television, it is to be hoped that steps are being taken to reduce the length of the tube when large picture areas on the front fluorescent screens are required. At the moment it appears that a three-foot length tube is necessary for a picture size about one foot square when the tube is used direct. No doubt electrode and glass bulb configuration can be adapted to overcome this objection, and we are convinced that tube manufacturers are giving this side of the question very serious consideration for the purpose of commercialisation.

Everyday Analogy

EVEN television reception employing cathode-ray tubes is not exempted from commonplace analogies when descriptions of certain effects are given. When using time bases to control the electron spot movement on the front fluorescent screen, it is necessary to hold these "generators" in synchronism both horizontally and vertically. An uneven generation of the horizontal synchronising impulse is liable to cause a flapping or weaving of one picture edge, and this has come to be known in some quarters as the "handkerchief effect" due to a slight similarity between the handkerchief border movements when it is flapping in a gentle breeze.

Eye Stimulation

IN attempting to portray large-screen size images of the single zone thirty-line scan type, and also in the multiple zone systems, a better impression of the resultant image was gained by allowing visual persistence to be supplemented by persistence of fluorescence. This was demonstrated quite forcibly in the Baird lamp screen where the slight delay in extinguishing each lamp after it had been lit to a certain degree of brightness according to the incoming signal intensity, reduced the apparent flicker, although only 12½ pictures per second were employed. With cathode-ray tubes the same thing is happening, although television engineers are, as yet, not unanimous in their opinions as to whether fluorescent screens having a long (that is relatively speaking) afterglow are the most suitable for high-definition working.

Better Synchronising

THE B.B.C. are to be congratulated on their closer attention to the transmission of a better synchronising signal with their present programmes. In the earlier days of the Corporation's transmissions it was most annoying to find that this signal was of insufficient duration or strength to operate satisfactorily automatic synchronising equipment installed on receivers. Then, again, in changing from one scene to another, a break in the required continuity of the synchronising signal could be noticed very frequently. This complaint made by lookers-in has received the sympathetic attention it rightly deserved, and it is now a pleasure to be able to look-in and find that the image does not keep "running away." Apart from a slight hunt or an occasional re-framing adjustment, the image will remain steady for the whole three-quarter hour transmission.

Transatlantic Television

WHEN addressing the United States at the inauguration of a new Italian radio station, Marconi intimated that he hoped to conduct a television experiment between Italy and the United States in a few months' time. The first transatlantic television communication was established in 1928 by Baird, using short waves, this being followed by a mid-Atlantic reception on the liner "Berengaria," but since this date little attention appears to have been given to long distance television working. From the tone of the Senator's remarks, it would appear that he contemplated a two-way television experiment, for in addition to saying that he would show some of the apparatus he has used for recent experiments by television, he expressed the hope that he would, in turn, see some of his transatlantic audience.

Television in the Home

AT the recent exhibition of Contemporary Industrial Design in the Home was a most interesting all-electric ensemble. Apart from the very ingenious lighting effects and modern domestic appliances, it was noticed in the living room that a high-definition television receiver screen and a radiogram had been built in flush with the wall. Is this a foretaste of what the homes of the future may be expected to contain ?

IN THE TELEVISION STUDIO

Television has taken a step forward, inasmuch as the B.B.C. transmissions now take place from a more up-to-date studio. Read about the steps leading up to this change.

Fig. 1.—In the very early head and shoulder transmissions an outline guide was marked on the back screen for positioning purposes.

ANY new move which will assist in the development of television is always watched with the greatest of interest, and the change of headquarters for the B.B.C. transmissions from Studio B.B. to a large converted old-fashioned Regency drawing room at No. 16, Portland Place, some months ago, was one of special significance. Many readers are not aware of the arrangements and equipment in operation in this studio, and the following details may prove interesting.

Before dealing with the layout of these premises, it is interesting to look back and see how material is the progress which has been made in studio technique. The original transmissions sponsored by the Baird Company were of head and shoulder images only. The spot-light transmitter and associated photo-electric cells were fixed in position, and it was necessary to make the artist or subject being televised keep his head within very narrow limits, so much so that a head outline was marked on the back screen to act as a positional guide. This is shown very clearly in Fig. 1, the black silhouette being quite conspicuous and proving a great help in those early days.

Improvements both in photo-electric cells and the amplifiers associated with them soon enabled programmes of a slightly more ambitious character to be attempted. With an increase in cell sensitiveness, the light area scanned became larger, permitting a greater depth for back screen positioning, and consequently a little more latitude was given to artist movement. Occasionally, small sketches with one, or perhaps two, characters were experimented with.

A more ambitious attempt materialised in July, 1930, when the B.B.C. co-operated to produce the first play to be televised. It was called "The Man With a Flower in His Mouth," by Pirandello. Special scenery of bold outline was prepared, and one of these, together with the three artists, are shown in the studio in Fig. 3.

Note that in Fig. 3 the four photo-electric cells are housed in a metal screening box mounted above the wall aperture through which the spot-light beam was thrown. They were also tilted towards the artist to bring about the greatest reflected light pick up. Illuminated signal instructions for the assistance of the artist appeared on the screen below the aperture, while the microphone was in a convenient position to take control of the voice and thus complete the dual transmission.

Continual Improvement

Continual intensive research work gradually gave greater rein to the studio manager's art. A more intense spot-light beam from a mirror-drum transmitter gave an even larger area of action, while movable photo-electric cell stands, working in pairs suitably positioned, gave better and clearer signal response. Slightly improved sketches, physical culture demonstrations, special dances, black and white artists, and even conjurors, lent definite entertainment value to a television programme which became very different to its prototype of two years previously.

It was at this juncture that the B.B.C. became sufficiently convinced that television demanded a more active co-operation on their part. Unfortunately, no

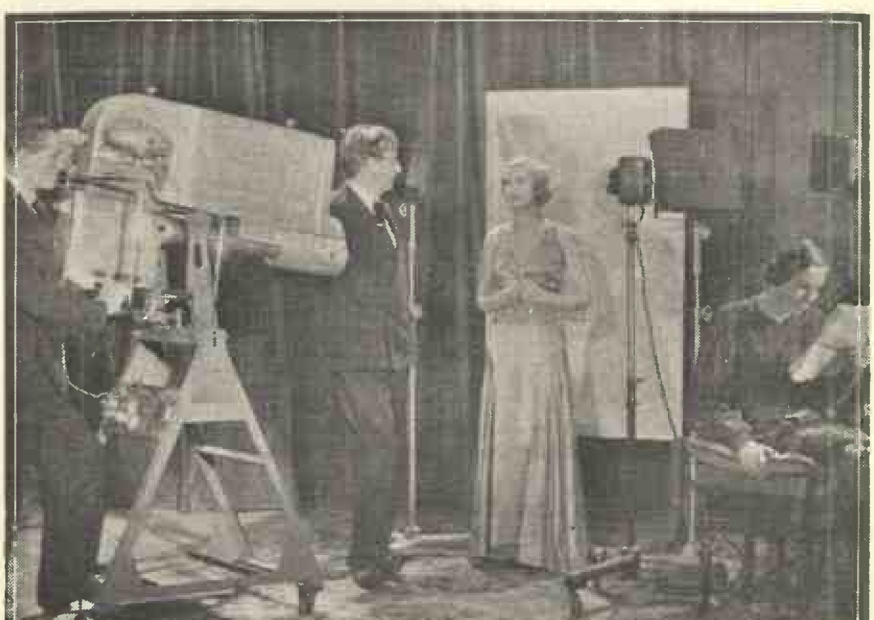


Fig. 2.—A photograph of an actual television transmission being carried out. On the left may be seen a portable transmitter.

provision had been made at Broadcasting House to accommodate a studio, control room and transmitting apparatus, but this was partly rectified by converting Henry Hall's Studio BB, together with the small adjoining listening room. This did service for a period of nearly eighteen months and under the able direction of Eustace Robb, quite a procession of notabilities made their debut before the camera-like structure of the new mirror-drum transmitter designed specially for the work.

The New Studio

Under the B.B.C.'s able direction, the art developed rapidly, and it soon became apparent that greater accommodation was necessary if better programmes were to be the order of the day. No space being available in an already overcrowded Broadcasting House, new premises were leased at No. 16 Portland Place, and after a long preparation these were made use of for the first time on Monday, February 26, 1934.

All the television programmes now emanate from this studio, which undoubtedly is a great improvement on the old one. A rough idea of the layout is given in Fig. 4, which is a plan view. First of all, the studio is at least 50 per cent. wider, and this factor alone will prove a great asset to the producer in arranging even more attractive programmes. The artistes who dance or perform acrobatic feats have greater freedom, and they can be "followed" over a wider area by means of the mirror drum transmitter.

Technical Details

Adjoining the studio is the control room which is at least four times as large as that provided at Broadcasting House. A large plate-glass window set at an angle separates this room from the studio, and against this is positioned the mirror drum spot light machine mounted bodily on rails for side movement, while it is also pivoted on a circular runner to allow the operator to turn it through quite a large angle. A high intensity carbon arc serves as the light source, and after emerging from an apertured metal shield, the light beam passes through an optical system to the revolving mirror drum, which traces out the scanned light area in vertical strips side by side.

Fig. 3.—One of the "scenes" and three artists taking part in the first play to be televised. Note the fixed cell positions and small signal indicator.

In addition to one or two individual photo-electric cells placed at vantage points there are four groups of cells mounted on movable stands. Each of these groups connect to a separate "A" amplifier of the two-stage type, a special form of low capacity cable being used for the purpose. The outputs from these four amplifiers pass to a mixing panel and master control desk at which sits a control engineer. By a careful manipulation of the controls at this stage of the process various fading and lighting effects are produced. In addition, it is possible to switch right over to the "caption" transmitter (see Fig. 4) whereby announcements, small scenes and objects are scanned to act as links in the complete programme.

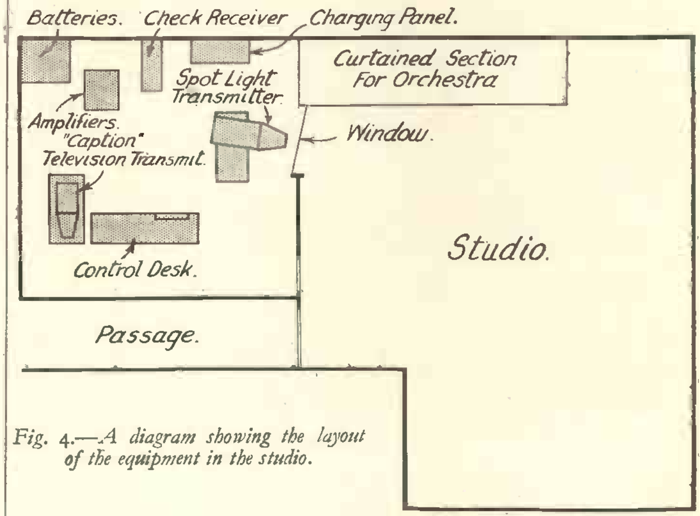


Fig. 4.—A diagram showing the layout of the equipment in the studio.

After the signals have passed the control desk they are fed to two "B" amplifiers of the three-stage type with double outputs, and this in turn connects with three "C" type amplifiers of three stages. On the input side of these "C's" is a corrector network, designed to compensate for high-frequency attenuation, including the scanning-aperture factor.

All the inputs and outputs of the amplifiers are brought to the control panel, which, with the mixer and master control, is on a desk-like frame quite separate from any amplifiers, as a precaution against valve microphony due to the handling of the different controls. An interesting point in the inter-connection of the amplifiers is that no transformers are used except those which feed the lines to the main control room.

The line vision monitor receiver (a mirror drum grid-cell machine) is immediately in front of the control engineer seated at the desk, and in addition a complete radio television receiver is positioned by its side so that an exact radio check on the images is provided.

The walls and ceiling of the studio have been covered with acoustic board, while the orchestra are screened off behind a large curtain in a section indicated in Fig. 4.

Undoubtedly this arrangement has had a most beneficial effect on the programmes, and this, in turn, has stimulated interest among a larger number of amateur constructors who have been encouraged to look in solely for the entertainment, quite apart from the scientific and practical fascination.

THE JEKYLL & HYDE OF BROADCASTING HOUSE

A RADIO STAR WITH TWO PERSONALITIES

Remember Rita Brunstrom—she is Jane Carr these days.

IT has been said that women are the driving force of progress, and the more I look at Jane Carr, the deeper sinks the truth of this utterance. Would Baird have invented television without the inspiring influence of such faces as hers ? Or Edison the cinema ? Surely, the thought which sent these illustrious gentlemen pursuing their experiments was : "Such faces as these must be shown to the world ; beauty must be exploited on a mass-production basis." A trifle fantastic ? Perhaps ; but Jane is certainly an inspiration.

I first met her about eighteen months ago when, after a period of revue and musical comedy work, she began to make a niche for herself in radioland. Her early broadcasts, a series of character impressions, were given under her real name—Rita Brunstrom (it's a Swedish name, for Jane, you see, is half Swedish, which perhaps explains her excessive blondness). She changed it for the following reason.

A New Role

For some months, listeners-in had enjoyed a number of fifteen-minute broadcasts by Rita Brunstrom, who gave impressions of factory girls, telephone operators, and American film stars in London. One day she was overheard making a gramophone record by one of the managers responsible for "The Jackpot," which was to be produced at the Prince of Wales Theatre. He at once offered her a part, and since in this show she was afterwards required to deputise for Marion Harris, it struck her that her reputation as a mimic made it difficult for her to adopt this new rôle. So she became Jane Carr.

The story has yet a further twist. Gerald Cock, the B.B.C. Director of Outside Broadcasts, happened to be "in front" one night and, impressed by Jane's performance, invited her to broadcast, unaware, of course, of her real identity. This was excellent for Jane, for as a Marion Harris crooner and mimic, she secured twice as many engagements with the B.B.C. In time, of course, it became known that Jane Carr and Rita Brunstrom were one and the same person—a sort of radio Jekyll-and-Hyde. But what did it matter ? Good luck to a girl whose versatility enables her to put over two entirely separate types of broadcast !

An all-round sportswoman, Jane was a county player in lacrosse before she took to the microphone, and a junior reserve tennis champion. She studied dancing after leaving school but never took it up professionally.

Her West-End Debut

She toured for a space and made her West-end debut in "Marriage By Purchase." Then came "The Jackpot," which more or less established her. Anyhow, from this juncture demands on her time from Broadcasting House and the film studios were heavy. Her first film was "Let Me Explain, Dear," in which she played opposite Gene Gerrard. (Incidentally, those two popular melodies, "Please Don't Mention It" and "Let Me Explain," were specially written by Harry S. Pepper for Jane.) Jane has also been a "Children's Hour" "cousin," and in one of her early broadcasts—a burlesque of a London telephone exchange—she incurred the indignation of the Union of Post Office Workers, who protested violently against the alleged libel.

In spite of their objection, however, Jane introduced the same sketch in Archie de Bear's revue, "Here We Are Again" ; for she sincerely felt that her impression of the telephone exchange and the gossip of the operators was a fairly true picture that did not merit the abuse it received. She's courageous.

Jane's broadcasts have lately been only very occasional, for during the past few months she has been busy making seven pictures. You saw her, surely, in "Dick Turpin" ? But she's coming back again, with new songs, new material and new sketches. She writes all her own stuff, by the way.

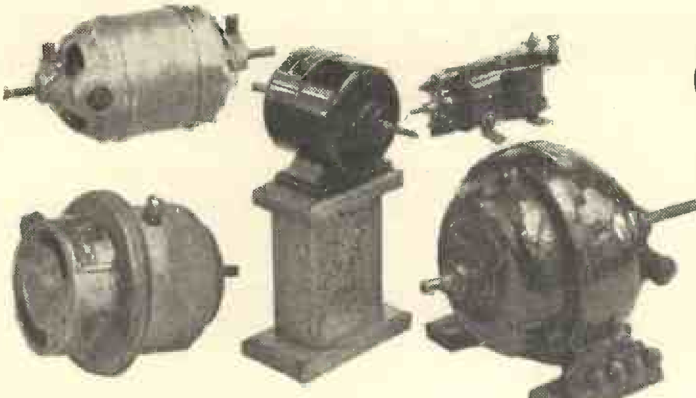
Looking Blue

While rehearsing for a television transmission a few weeks ago, she got her times mixed up and discovered, with dismay, that she was seriously behind time for a date with her hairdresser. So with lips and eyes dyed a deep blue for television purposes, and long blue shadows down her nose, she got into a taxi outside Broadcasting House. Of course, the taxi would get into a jam in Bond Street ! Striving to keep her appointment at any cost, Jane paid the driver and hurried down Bond Street, made up as she was, with a retinue of curious small boys, wide-eyed typists and policemen in her wake !

CHOOSING TELEVISION

A DESCRIPTION OF THE MOTOR, WITH SOME USEFUL

By H. J. BARTON CHAPPLE,



A few examples of the various types of motors which have been used for driving the disc at the receiving end.

FOR nearly all forms of television receivers, the principal exception being those employing a cathode-ray tube, a source of rotary motion is required, and the only practicable method of driving a scanning disc, mirror drum, mirror screw, or other form of exploring device, is by means of a small electric motor. Such machines are perhaps rather outside the experience of the average wireless amateur, so a few words of explanation concerning the principles upon which a motor works, the different types of motor available and hints on the selection and operation of a suitable machine will prove of value to readers.

To begin with, it is necessary to realise that an electric motor is merely a machine for converting electrical energy into mechanical energy, just as a dynamo is a machine for converting mechanical energy into electrical energy. In fact, the two types of machine are similar in design, and a dynamo can often be used as a motor and *vice versa.* Fundamentally, a motor consists of an arrangement of coils of wire pivoted in a strong magnetic field, means being provided for passing an electrical current through the coils.

First Principles

The action of the motor can readily be understood by making reference to Fig. 1, which shows a single loop coil A, mounted within the circular space between the two poles N and S of a magnet. The reader must imagine a number of lines of magnetic force connecting the two poles, as indicated. Provided that no electric current is allowed to pass through the coil A, these magnetic lines will be undisturbed, but if a current is passed through the loop the magnetic field will be distorted, as indicated in Figs. 2 and 3.

Here the small circles A and B represent sections through the upper and lower limbs of the coil, and we will suppose that the current is going down into the page in the case of the top limb and coming out of the page in the case of the lower limb. The magnetic effects of these currents will be as indicated by the concentric circles which represent the magnetic lines of force due to the current in the coil, the arrows showing the direction of the magnetic force. The diagram shows also the horizontal lines of force due to the poles of the field magnet.

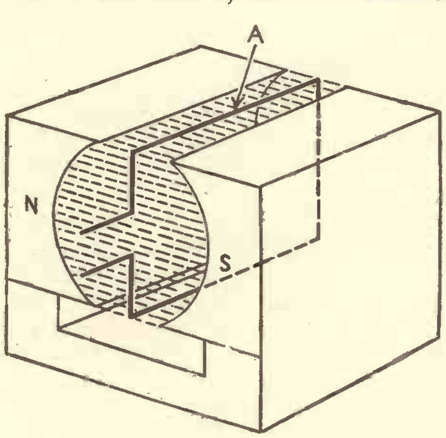


Fig. 1.—A simple coil loop in a magnetic field to illustrate the motor action.

It will be clear that above A and below B the magnetism due to the coil or "armature" is assisting the field due to the magnet, while below A and above B the armature field is in opposition to the field of the magnet. The resultant field will therefore be something like that indicated in Fig. 3. Now although it is not a strictly scientific way of thinking about these things, it is both correct and convenient to consider magnetic lines of force as always trying to shorten themselves, and we can imagine the "elastic" lines in Fig. 3 endeavouring to straighten themselves out, and in so doing driving A downwards and B upwards as indicated by the arrows.

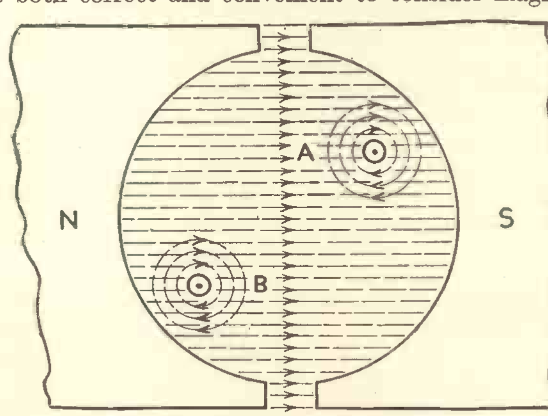


Fig. 2.—When a current is made to pass round the single-turn loop, a magnetic field is created round each limb of the loop.

This is exactly what occurs in a motor, and the movement of A and B and of the corresponding wires of the other coils which go to make up the complete armature constitute the rotation of the motor. There is, of course, much more than this in the full theory of electric motors, but enough has been said to give a slight insight into the operating principle.

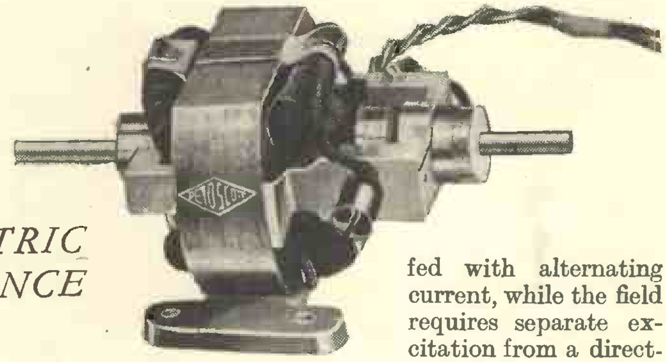
Suitable Types

Whether the motor be a tiny affair suitable for driving a toy railway, or a machine of several thousand horse-power driving a rolling-mill, similar principles are involved. For television purposes only a small amount

A SUITABLE MOTOR

FUNCTIONING OF AN ELECTRIC NOTES REGARDING its MAINTENANCE

Wh.Sch., B.Sc.(Hons.), A.M.I.E.E.



A very good low-priced motor, especially designed for Television purposes.

of power is required, amounting to only a fraction of one horse-power, the average value being about 1/30th of a horse-power, although slightly higher ratings are likely to be more reliable—say 1/20th to 1/15th of one horse-power.

In view of the fact that for satisfactory reception the motor has to be run in absolute synchronism with the scanning mechanism at the transmitting end, it is clear that what is required is a motor which normally runs at a steady and constant speed, thus requiring only a slight effort on the part of the synchronising mechanism to keep it in step. Certain types of motor are better suited in this respect than others.

Considering first those motors intended for operation on direct current, either D.C. mains or some form of battery, there are two main types—those in which the field magnet is energised by a coil of wire connected in series with the armature (known as a series-wound machine) and those in which the field winding is connected in parallel with the armature (known as shunt-wound motors). It is the shunt-wound machine which is the more suitable for television purposes, because, in the first place, it runs at an almost constant speed, and, secondly, preliminary speed adjustments can be made easily by connecting a variable resistance in the field circuit. Further reference to speed regulation will be made later in this article.

When we come to consider motors for running on alternating-current mains, there are several types from which to choose. The true synchronous motor is similar to a direct-current shunt motor, but the armature is fed with alternating current, while the field requires separate excitation from a direct-current source. This is a somewhat complicated arrangement for such a small motor, but the transmitter used by the B.B.C. includes one of these synchronous motors. Synchronous motors are ideal for those areas fed from the same network of A.C. mains which supply the power to this transmitting machine, but at the moment this area only embraces Marylebone and part of Hampstead. When other sections of the A.C. mains are linked up shortly, however, it is anticipated that this area will be extended considerably.

The pure induction motor, in which the rotor is not connected to the supply, but is simply a short-circuited winding, while fairly constant in speed when running under a constant load, is not amenable to close-speed regulation and must be ruled out for television, and we are thus left with what is known as the commutator-type A.C. motor, of which several types are made.

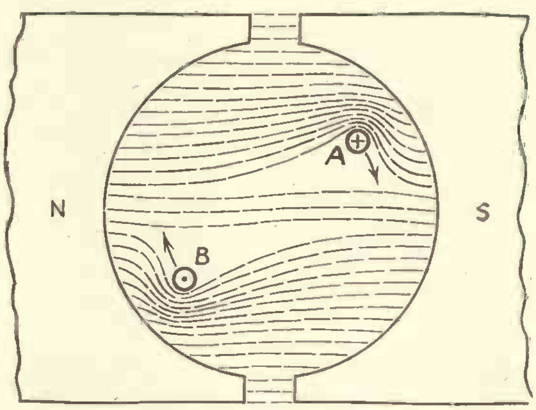


Fig. 3.—The resultant magnetic field assumes this shape.

For television purposes, however, the most satisfactory is that commonly known as a "universal" motor, because it can be used quite satisfactorily on either an alternating or a direct-current supply. In construction it is almost identical with an ordinary direct-current motor, with the exception that the field magnet is built up from a large number of thin plates or laminations in order to avoid losses due to the generation of "eddy currents" in the metal of the magnet and a certain type of distortion of the magnetic field.

Avoiding Sparking

It should be explained that in both direct-current and universal machines of the type described, it is necessary to introduce the mains current into the spinning coils of the armature by means of contacts called brushes which bear upon a metal ring attached to the armature. This ring is termed the commutator, and is divided up into segments according to the number of windings in the armature, the segments being separated from each other by mica insulation. As the brushes

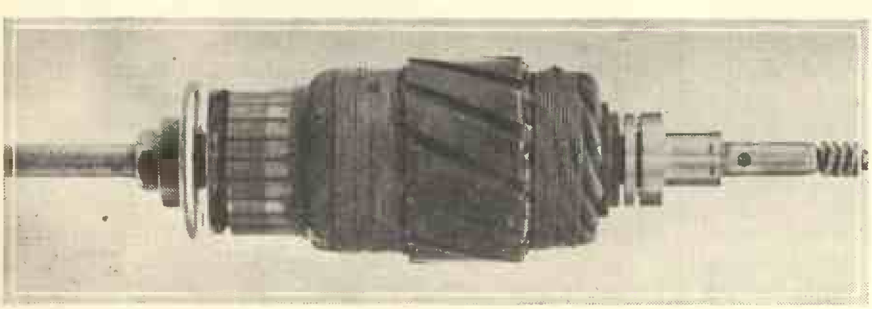


Fig. 4.—"Skewing" or inclining the armature slots of a television motor is sound practice.

(which are generally small blocks of soft carbon) make contact with successive bars or sections of the commutator, adjacent segments are momentarily short-circuited.

It is therefore essential that the mechanical design of the commutator and brushes and the electrical design of the machine is such as to avoid sparking at the brushes. In large motors many devices and tricks of design can be employed to this end, but in the small motor most of these are not practicable. For example, in big machines the brushgear can be "rocked" or moved in order that commutation shall occur in a strong magnetic field. Rocking gear cannot be fitted to very tiny motors, but a well-designed motor whose commutator and brushes are in good condition can generally be relied upon to run without sparking for long periods before any attention is required.

One device adopted in the design of many small motors is to incline the slots in the armature which hold the coils at an angle to the axis of the armature, and this is shown very clearly in Fig. 4, which depicts the armature of an actual motor I have used with great success in many of my experiments. This avoids certain periodic oscillation of the magnetic flux which is liable to cause sparking.

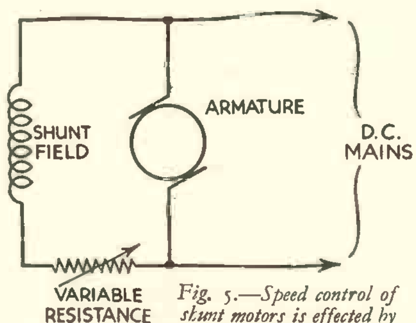


Fig. 5.—Speed control of shunt motors is effected by using a variable resistance in series with the field winding

Curing the Trouble

Sparking, if it does occur, has a bad effect on television reception, because the radiant energy of the sparks is picked up by the receiver and amplified, producing interference which is reproduced on the image screen as a series of white patches. The secret of sparkless running—provided the machine is of good design—is a smooth commutator, lightly lubricated, and well bedded brushes. The commutator should be cleaned initially with the finest emery cloth. Next, reverse the emery and turn the armature by hand so that the brushes are ground by the emery to the exact contour of the commutator.

Then wipe the commutator perfectly clean with a soft rag, and finally with a rag *very lightly* oiled. The motor should now be run for an hour or so on load, and the tension of the brush springs adjusted. Once running well, the only attention should be to hold a piece of dry, clean rag against the commutator very occasionally when running, to remove carbon dust which may have collected. After a period of use, the commutator will develop a hard, polished "skin" and will then run almost indefinitely without trouble.

Speed Control

The normal speed for a television drive to suit the present transmissions is 750 revolutions per minute, which is rather slow for a small motor, but machines rated to run at that speed are obtainable. It is, however, necessary to provide some method of making fairly accurate speed adjustments. For shunt-wound motors, a variable resistance in the field circuit is the best, see Fig. 5. Increasing the resistance weakens the field and increases the speed, and vice versa. Care must be taken, however, to see that the speed regulator has no "off" position, for if the field circuit of a shunt motor is broken, the machine "runs away" and develops a very high speed, which may cause it to fall to pieces.

With the universal motor, speed is best controlled by varying the voltage applied to the motor, and this can be effected by including a variable resistance in series with the machine. Though more wasteful than a field resistance, actual losses are not great, and the method is quite satisfactory; the resistance is rated sufficiently high to carry continuously the current the motor requires.

SYNCHRONISING WITH A.C. MAINS

THE 30-toothed wheel method of synchronisation is too well known now to need any detailed description. However, a recent modification of this scheme appears to have many possibilities and advantages, and is somewhat simpler in application.

Use is made of 50-cycle A.C. mains. The synchronising coils are designed to withstand the full mains voltage across them; the phonic wheel having only eight teeth for the present 30-line transmissions.

The advantage of this method appears to lie in the fact that greater "pull" can be obtained on the cogged wheel (depending on the design of the electromagnet), a very constant motor speed being thus maintained.

The system functions entirely independently of the received signal from the transmitter. It might be said that 100 per cent. synchronisation cannot be obtained unless both receiver and transmitter are using the same mains supply; this, of course, is perfectly true, but it has been found by experiment on different mains supplies that the image can be held dead-steady over 70 per cent of any transmission.

If in the future Television developed on the ultra-short waves, such as the recent 6-metre transmissions from the Crystal Palace, and stations were set up in various parts of the country, it would be practical to expect transmitter and receiver to be on the same mains supply owing to the limited range of transmission on these frequencies.

For the experimenter who wishes to try a mains synchroniser, it may be of interest to note that standard-type synchronising coils can be used, the two leads from the coils being taken direct to the mains supply.

It is an advantage to insert a quick-make-and-break type of on-off switch in one of the leads.

The motor should be switched on ten minutes or so before the actual transmission starts, and the speed adjusted by means of the usual motor resistance until 750 revolutions per minute is reached—as indicated by the lines on a stroboscope disc. The synchroniser is switched in and a faint hum may be heard due to the phonic wheel spinning in the fluctuating magnetic field.

No further adjustment should now be needed as regards motor speed, though the picture will have to be framed in the usual way by a slight movement of the magnet system as a whole, round the cogged wheel.

LONG DISTANCE OR LOCAL TELEVISION

AN EXPLANATION OF THE PROBLEMS SURROUNDING TELEVISION PROGRAMMES OVER LONG DISTANCES

Fig 2.—Showing the amateur transmitting station used in the first transatlantic television transmission of 1928

IT is known quite definitely that the television transmitters and receivers designed to suit different systems, of themselves work satisfactorily as individual pieces of apparatus and also in conjunction when operating in " short circuit " (linked by a short length of land line). Although this may be cited as irrefutable evidence that any or all of the television systems being developed in this country and abroad are all that is claimed for them, the evidence is insufficient, inasmuch that commercial application demands a method of signal distribution which will give a service to meet the needs of the majority.

Radio transmitters and receivers are therefore indissolubly linked with television transmitters and receivers, and since the allocation of radio wavelengths for aural purposes had such a big start over its visual brother, the rate of progress of television as far as the public are in a position to judge, may seem rather slow. This is not true, however, for the pioneers of high definition television have not only had to solve the television problems peculiar to their own particular system, but also develop an entirely new radio technique to enable the results to be portrayed efficiently. It is this factor which is bound up so intimately with the question of long distance or local television.

Fig. 3.—The operator and equipment used at Hartsdale, U.S.A., when receiving the 50-metre signal

Transmission Properties

To appreciate this, reference must be made to the transmission properties of the radio waves which carry the television signal as a form of modulation. Unless special directional aerials are used, the waves from a radio transmitter station are radiated in all directions. The wave energy which follows the earth's curvature is called the ground ray, and during its passage to any receiving station energy is lost due to absorption by the earth, changes in ground contour, buildings, etc. In addition to this ground ray, however, there are the rays which travel into space at an angle to the earth's curvature. At night time these rays reach what is termed the Heaviside layer, an ionised strata which scientists have proved surrounds our globe, and it acts like a mirror reflecting the rays back to the earth's surface, somewhat as indicated in Fig. 1.

During the daytime this strata appears to be diffused by the sun's rays and the ray energy is dissipated and little reflected back to earth. It is this property which has been used to prove how reception at night time, or under conditions of winter, is so much better than at daytime. Furthermore, since both the reflected

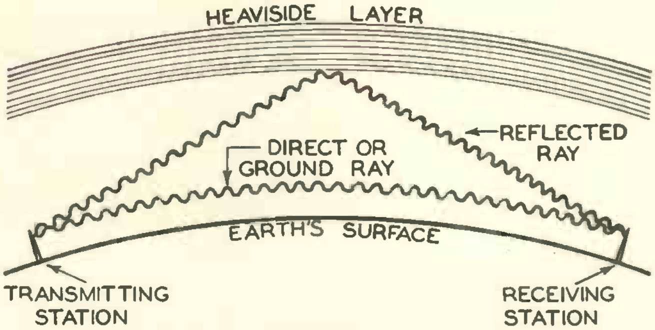


Fig. 1.—Diagram illustrating the passage of the ground ray, and the reflection by the upper layer, thus illustrating the cause of echoes.

and ground waves travel at the same speed it is easy to see from the increased distance travelled by any reflected ray that it will arrive at a certain distant point of reception *after* the ground ray. This gives rise to double or ghost images, but the most important point with which we are concerned is that the medium or long waves (200-550 and 1,000-2,000 metres) cover very large surface areas and for television purposes appear, at first sight, to be admirable for the purpose.

Bound by Convention

That is so, as far as conveying the signal is concerned, but as readers know, broadcasting in Europe is bound by an international convention which limits the sideband separation between transmitting stations to a figure of nine kilocycles. This is a sufficient frequency range to convey speech or music of reasonable quality, but absolutely no provision was made at the convention for the science of television, which is somewhat greedier in its demand for sideband width than ordinary sound.

A thirty-line television image of the type now radiated by the B.B.C. is just comfortably squeezed into the sideband used by the present London National Station, and as evidence of the area covered by this signal, mention must be made of the fact that the images have been seen in almost every European country. Fading troubles prove difficult, however, and prevent the reception from being anything of a true service except within, say, a 100 to 150 mile range. The London Regional would give superior results, for with a given power, the more marked is the wave energy attenuation as the wavelength is reduced.

Extended Frequency Demands

Assuming that one or two high-powered medium wave stations are capable of covering a very large service area in this country, why cannot we employ them for a really high-quality television service? Well, first of all, nearly every wavelength in this band has been allocated for the radiation of sound signals and the rapacious demands of listeners leave little or no time for their use to give television transmissions, but more important than that, as steps have been taken to improve television images by increasing the number of scanning lines and the picture repetitions per second, so the range of frequencies necessary to accommodate these improvements has extended very considerably.

As an example, if we desired to transmit an image dissected into 180 horizontal lines with a picture ratio of 3 vertical to 4 horizontal and a picture repetition of twenty-five per second, the sideband is over half a million cycles. If this transmission was radiated from the London National station it would nearly embrace the waveband of 180 to 500 metres, a situation which is, of course, quite out of the question. Long-distance high definition television embracing a system of this character is therefore a practical impossibility.

Alternatives

What alternatives present themselves, for obviously television has got to come and the situation from the radio transmission angle has to be faced. Why not use the short waves? Here, again, the restriction of a somewhat congested ether is met, but if this was not so, then the short wave region could be used in spite of the vagaries associated with the distances covered by the signals. As evidence of this, reference can be made to the first transatlantic transmission of television. This was undertaken by Baird in February, 1928, although only a thirty-line image was radiated.

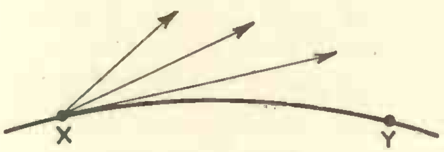
An amateur transmitting station situated at Coulsdon, Surrey, the aerial equipment of which is shown in Fig. 2, formed one end of the radio link, while reception was undertaken in Hartsdale, a suburb of New York, U.S.A. The receiving equipment was of quite the standard character in use six years ago, as will be seen in Fig. 3, which shows the radio set and operator, while the wavelength employed was 50 metres. This spanning of the Atlantic Ocean was hailed as an achievement ranking with Marconi's work at the beginning of this century, when he sent across the same ocean the single letter "S."

Ultra Shorts

To meet the case of the proposed high-definition television service, however, excursions into much lower wavelength regions have to be made, and the natural solution according to the results of present-day investigations is to use ultra short waves, that is, those with a wavelength below 10 metres. Now, although with short waves it is possible to cover enormous distances (as witness, for example, the achievements of amateurs using quite low powers), with ultra-short waves the situation is of quite a different character.

Referring back to the Heaviside layer, mentioned earlier, it has been found that these ultra-short waves, when radiated in all directions as for other wavelengths, are not reflected back to earth from this electrified belt. Any bending or reflection that does take place is insufficient to cause the wave to return to the earth's surface. Now, since the wave radiates in straight lines, say from point X in Fig. 4, and remembering that no reflections take place, then any receiving station beyond the horizon visible from the transmitting aerial, say at a point Y, will be incapable of receiving any signal at all. The ultra-short wave radiations are really very similar to that from an intense light beacon, hence the reason for the term "quasi optical" waves being used when referring to them, and theoretically any site which is not within sight of the transmitter is outside the *service* range of the signals.

Fig. 4.—Showing why some stations are inaudible at a short distance



The line of demarcation is not so rigid as this in practice, however, but hills, trees, tall buildings and so on influence the range very considerably, and this problem is being studied very carefully by the protagonists of ultra-short wave television.

It is possible to extend the signal range very considerably with special directional aerials, and vast experiment has already been undertaken in this connection. Assuming, however, that the service range for high definition television transmissions is of the local nature just described, how will it be possible to cover the whole country with signals? Owing to the extremely high frequencies which have to be handled, ordinary telephone cable is quite out of the question to link up radio transmitters which may be located in densely populated areas owing to the attenuation and phase distortion, but it is stated that a new cable has been developed which will handle frequencies up to a million cycles. If this is so, then it will solve part of the problem of signal distribution to distant radio transmitters from a central studio.

Another suggestion, however, is to have relay stations linking up the main transmitter with various local transmitters, the relay stations being operated by directional micro waves and serving only to repeat the signals.

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**With the prospects of increased
becoming much brighter owing to
the science which have taken place
abounds as to how we shall all**

AT the present moment nothing *definite* can be said regarding recent developments in television because the Television Committee of Inquiry appointed by the Postmaster General have not yet finished their deliberations. Furthermore, the secrecy with which they have undertaken their task makes it impossible to forecast the nature of the recommendations which they will make.

Irrespective of this, however, it is both interesting and instructive to see what proposals have been made in the past for television receivers which would suit a potential buying public. Naturally the designs have varied between fairly wide limits according to the form of scanning device and modulated light source which happened to be popular at each period.

Fig. 4.—An experimental mirror-drum television model for home use.

One of the First Efforts

One of the first really good efforts at providing an "all-in" machine for home entertainment is shown in Fig. 1. A dual radio receiver was incorporated in the large cabinet, the controls being situated near the bottom. It was for reception on the ordinary broadcast band, and the loud-speaker was positioned behind the fret on the left. A large diameter apertured scanning disc driven by a special fractional horse-power motor and working in conjunction with a large plate high voltage Neon lamp served to reproduce the image. To increase the image size to dimensions of comfort for looking-in, the large diameter lens on the right was incorporated. Finally, in a left-hand top compartment was placed the record turntable and electrical pick-up, while on the right was arranged the record-storing compartment. Unfortunately, this design, while quite sound electrically and mechanically, was suggested at a time when no real television service was available, and coupled with this was the fact that sufficient progress had not been made to give transmissions which approached those now being furnished by the B.B.C. As to the cost of the complete machine, no figures are available, but obviously, from its very nature, this "console model" would have been high priced.

Another Design

Fig. 2 shows a home-constructed disc machine complete with the radio receiver arranged on neat but less pretentious lines than Fig. 1. This model happens to be of foreign origin, but was capable of giving really good results within the range of the receiver incorporated. As in the Fig. 1 model, disc scanning was used, but the scanning member was of rather small diameter. In addition, arrangements had been made to take advantage of both the British and Continental television transmissions. The former uses vertical scanning so that the images were watched through the magnifying lens on the right. For the horizontally scanned Continental transmissions the centre top lens was employed. A simple, neat complete receiver of this character has many points in its favour, not the least of which is the relatively low cost of assembly and ease of control. When mirror drum scanning is used so that the image is built up by back projection on to a translucent frosted glass screen, the designs for a complete receiver can take on an entirely different character. When the television receiver only is required, the radio set employed for the reception of the actual broadcast signals functioning as a distinct unit, the equipment can be accommodated in quite a small compass. For low definition television, Fig. 3 shows a proposed German design which is solid in character, with only two controls to handle once the machine has been set up. Fig. 4 shows another design which used a mirror drum scanner. This was a Baird experimental "Televisor"

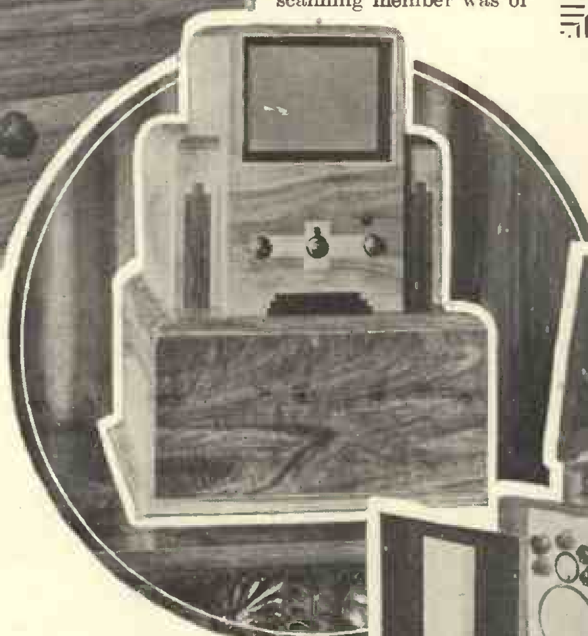


Fig. 5.—A high-quality television receiver design of very pleasing character.

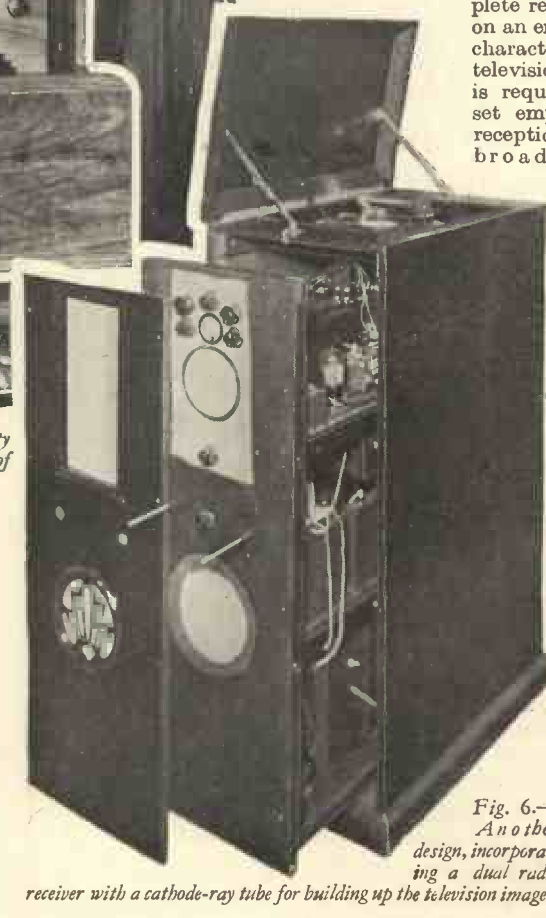


Fig. 6.—Another design, incorporating a dual radio receiver with a cathode-ray tube for building up the television images.

CIAL ISION ECEIVERS

elevision reception in the home the nature of developments in recently, considerable speculation look-in to the programmes.

used for demonstration purposes, and included the low frequency amplifier inside the cabinet. The image was seen on the right-hand rectangular screen, while the amplifier controls were mounted on the left-hand panel, leaving the framing and phasing knobs in the centre. It must be admitted that a receiver of this character looks particularly neat, and would make a good table model for use in conjunction with a separate H.F. amplifier and detector unit.

A Table Model

Fig. 5 is a table model which would grace any drawing room and shows a singular absence of stray leads, while the controls are reduced to bare essentials. The relatively large translucent screen at the top is for portraying the television images (mirror drum or similar scanning arrangements have been catered for here), and a home screen of this size would amply meet the requirements of a large section of a radio and television-minded public. Immediately below the screen is the radio receiver, an all-mains model, the tuning control and indicating aperture being positioned in the centre. The other two controls can serve a variety of purposes—combined framing and phasing adjustment, image intensity regulation, volume control, etc.

Undoubtedly the present trend is to reduce working controls to the barest minimum, it being assumed that all other essential adjustments can be undertaken at the time the equipment is installed. Once these initial settings have been made, then the user is only called upon to manipulate two or three knobs to suit his own personal tastes.

Reverting to Fig. 5, the large rectangular wooden cabinet base would house all the mains eliminator equipment together with the low-frequency amplifier. Questions of cost for a design of this nature cannot be considered, for they would depend naturally on the extent of the plans of production. One objection that might be raised is the absence of any provision for accommodating the sound side of the complete television programme. Each television transmission to be complete is of a dual character, and unless the loud-speaker reproducing the music, song or speech is in close proximity to the image screen, the illusion of a "talking picture" is lost.

Needs of the Future

One suggestion for meeting the needs of the latter class appears in Fig. 6. Here is a large console model shown partly dismantled and built with an eye to any possible high definition television service demanding the use of a cathode-ray tube. Within the past twelve months the earlier despised cathode-ray tube has returned to marked favour for the purpose of reproducing television images. Intense activity is being displayed by those manufacturers having facilities for producing these tubes, and undoubtedly the result of this work will manifest itself in the marketing of tubes which possess none of the inherent disadvantages of their early prototypes. Limitation of image area size on the tube's fluorescent screen end seems to be one of the prime objections put forward by mechanical scanning protagonists, and research is being directed towards a complete solution of this point. Absolute silence in operation is an outstanding advantage, together with the comparative ease of change to accommodate the receiving apparatus to any alterations which might take place in the number of scanning lines, image area shape, and so on.

Returning to Fig. 6, the tube's fluorescent end is shown as the white disc encompassed by a black circle immediately below the controls at

Fig. 1 (left)

Fig. 2 (above)

Fig. 3 (right)

Figs. 1, 2, and 3.—(Top) One of the first proposals for an "all-in" television receiver. (Left) A suggested design for a home-constructed disc receiver. (Right) A neat mirror-drum television receiver.

the top of the intermediate vertical panel support. The radio receiver, time bases and amplifiers are housed in sections with their appropriate connections, while the loud-speaker is covered by a figured fret near the bottom of the panel. To add to the scope of usefulness of a set of this character, a gramophone turntable, together with an electrical pick-up is incorporated in a top compartment immediately beneath the lid.

Meeting Special Conditions

Of course, a scheme of this character is capable of numerous modifications, and the following design of receiver is suggested to meet the conditions of "this new television" when any form of long and regular service of transmissions becomes available to the general public on a wholly acceptable basis. A dual sound and vision receiver is desired, the actual cabinet design being one which will tone with the average modern room furnishings.

The image screen is located near the cabinet top, being a comfortable eye level when viewed from a few feet distant. Either a cathode-ray tube or one of the suggested mechanical forms of scanning would be suitable here, the cabinet depth being governed by the methods used for image integration. Below this could be grouped the actual radio and television receiver essential controls, symmetrically disposed on the slightly projecting upright wooden panel. A little lower could be placed the sound radio receiver controls with the loud-speaker underneath. Ample accommodation would be available for low-frequency amplifiers, H.T. and L.T. supplies, together with the auxiliaries essential to a scheme of this nature. Undoubtedly we shall see models of similar character to this on the market, and it must be agreed that any attempt made to provide home entertainment in this form is sure to meet with the approbation of the buying public, even if the price rules high when compared with the radio receiver alone now doing service in the home.

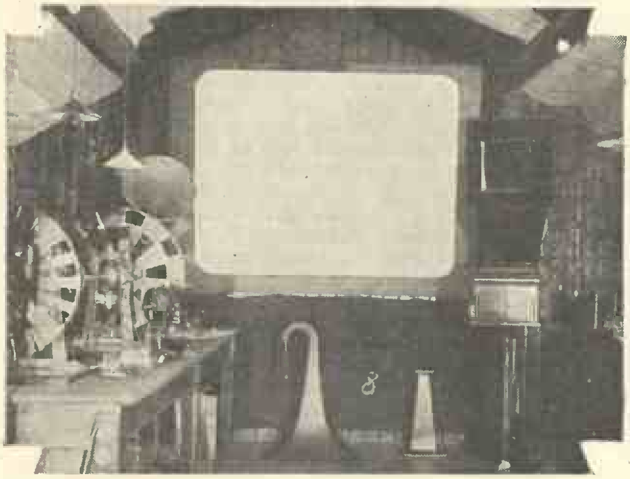


Fig. 7.—How soon will it be before the television images received in the house will be projected on to the small cinema screen of this size?

Of course, there are still many who look forward to the day when the received television images will be projected on to a home screen comparable in size with that illustrated in Fig. 7. Here we see the white screen of normal home talkie dimensions, and many of the television schemes now being investigated show promise of giving brilliant high-definition pictures suitable for this purpose. At present, however, the apparatus required is costly and needs the services of a skilled operator. This stage in the process of evolution towards the mass produced commercial product is inevitable, however, and a measure of patience leavened with a little helpful criticism will do much to stimulate the pioneer efforts now being directed to give "this new television" the status it deserves in the home life of the average household.

A NEW TYPE OF TELEVISION RECEIVER

A NOVEL AND INEXPENSIVE TELEVISION RECEIVER

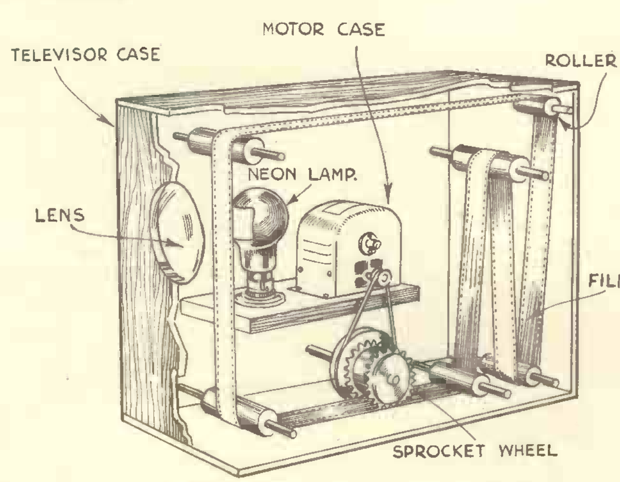
AT the present time there are only three main types of television receivers in general use, and these are the disc, mirror-drum, and cathode-ray receivers. While the last has many good points, it also has two great disadvantages, which are its high cost and its complexity of design. The two former systems are the most popular, but even they have their disadvantages. The disc receiver is rather large and unwieldy, and while the mirror-drum receiver is less bulky, it is more expensive and quite a strong motor is needed to rotate the mirror drum. Here is an entirely new type of receiver, however, that has two very good points, its low cost and compactness.

Instead of using a large disc or heavy drum as the scanning medium, a thin light strip of black celluloid or film is used instead. This film is perforated with a number of small holes spaced at regular intervals in just the same manner as is the disc of a disc receiver. The accompanying illustration shows the general construction of the receiver, and it will be seen that it closely resembles the principle of a small cinematograph projector. Square holes punched at each side of the film enable two sprocket wheels, one of which is mounted at each side of the driving motor, to drive the film past the Neon lamp at the correct speed.

There would be no stretching or buckling of the film, for modern methods of manufacture ensure that it maintains its original size and shape under the most adverse conditions.

As regards driving of the film, an adapted version of the system used in home-movie projectors would be eminently suitable, for such does not vary the position of the film to the lens by even a thousandth of an inch.

In a home-movie projector, even the slightest diversion of the film from its correct position would be magnified hundreds or even thousands of times on the screen, and as no flickering can be discerned even then, the great accuracy of the film driving system can be realised.



The general construction of the receiver

SOUND BY SYNTHESIS

HOW SOUND IS MADE BY ARTIFICIAL MEANS

Fig. 2.—A section of the first talking film to be publicly televised nearly five years ago.

WITH any ordinary talking film used in the cinema, or for transmitting television images, the sound which accompanies the picture is recorded electrically on a narrow strip running down one side of the film. A representative example of this is shown in Fig. 1, the sound track being seen on the right between the film sprocket holes and the individual pictures.

Now in modern sound film technique two distinct methods are used for recording the sound on the film. One method is known as the variable density constant width, and the other the variable width constant density. In the case of the former the track looks like a shaded band across which is a series of dark or light bars spaced at varying intervals. A photographic example of this is shown in Fig. 2, and the differences in sound intensity or loudness are actually recorded by means of a special lamp functioning in sympathy with the amplified sounds picked up by the microphones, as differences in density. The pitch of the notes corresponds to the number of light-to-dark variations per unit length of film, or shading changes per second.

With the second type of sound recording—that indicated in Fig. 1—sound intensity makes its record by the direct ratio of light to dark across any section of the sound track, while the pitch is given by the number of " peaks " per length of film. This method is perhaps the easier of the two to comprehend, for the sound " waves " appear as actual waves of complex contour on the film track. It was while examining these waveforms by means of an oscillograph that Herr Pfenninger conceived the idea that he could build up such tracks in an intelligible manner by actually drawing them.

Pure and Complex Notes

Sounds of different pitch have wavelengths of differing frequency, the high notes being those represented by short wavelengths, while the long wavelengths indicate the bass or low notes. To illustrate pure notes of various pitches was therefore a straightforward matter, for it involved merely the drawing of a sine wave such as shown on the left of Fig. 3, the amplitude of this wave being a measure of the loudness or intensity it was desired to portray. In nearly every form of sound, however, the notes to be recorded are complex in character and correspondingly the work involved in making the drawings is intricate and rather laborious. The sketch on the right of Fig. 3 is an attempt to illustrate a complex note or sound.

At the beginning of his work Herr Pfenninger drew a large number of pure sine-wave curves, filling in with black paint the area between a straight edge and the envelope of the curve (Fig. 3, left). One or more of this library of sine-wave patterns or strips, each having different pitches and intensities, could then be photographed on to the sound track section of the film with an ordinary ciné camera, and when run through the projector proper gave a pure note. A pure sine-wave note is not really pleasant to listen to, however.

New Noises

Furthermore, it is possible to prove quite simply that a sustained note of identical frequency when played by various musical instruments is different to the ear. That is to say, its fundamental frequency is the same in every case, a fact borne out by observing on a sound track that there are the same number of prime " hills and valleys," but superimposed on this are a number of complex shapes. These, of course, are harmonics or multiple frequencies and overtone submultiples which serve to give the distinction between the various instruments. If this situation holds for a single sustained note on various instruments, readers will appreciate that chords and varying notes call for a very rigorous and intimate study.

The real aim of the inventor, however, is not so much to reproduce the tones of established musical instruments, but rather to bring into being music or noises of an entirely new timbre, sounds which are truly unborn and quite different to anything else which has been heard. One of his contentions is that a drawn cartoon film to be truly effective should not be accompanied

(Contd. on page 122)

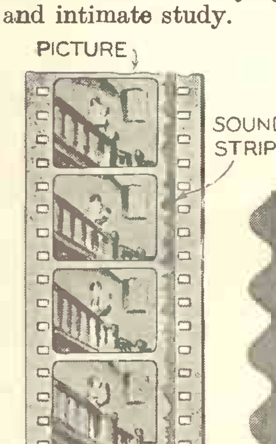


Fig. 1.—Showing the appearance of a variable area sound-track talkie film.

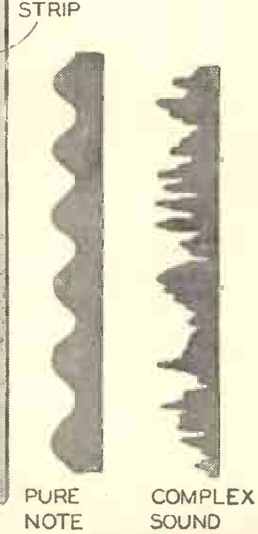


Fig. 3.—This sketch gives an idea of how the synthetic sounds appear on the sound tape.

SCANNING DISCS

By W. H. DELLER

Constructional Details of a Most Important Television Component Are Given Here.

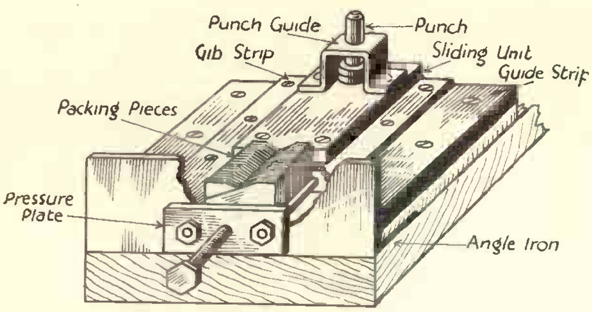


Fig. 5.—Details of the jig described in the text.

FOR transmission purposes the subject being televised is broken up into thirty vertical strips; each strip contains appropriate portions of light and shade in the form of signals, the complete pictures being strung out as it were into a line of fluctuating light values in signal form. To allow for the portrayal of moving subjects, and in order to ensure that the movement does not appear jerky in reproduction, complete pictures are transmitted at the rate of 12½ every second, that is, three hundred and seventy-five strips a second. The resulting signals are picked up on the wireless receiver, the output from which causes the plate of a neon lamp to glow with varying intensity according to the strength of the signal imposed upon it; in other words, the original light and shade is more or less faithfully reproduced in the lamp by a series of flashes.

Thus the problem is to replace these flashes into strips and distribute them over a certain area in their original order and so build up the picture. It is for this purpose, then, that the scanning disc is employed, and in this method it is in reality the main part of the apparatus. The outer part or rim of the disc is pierced with thirty holes. Each hole is on a radial line exactly 12 degrees from its neighbour, the first hole being made at a certain distance from the centre of the disc, and every succeeding hole closer to the centre than the previous one by an amount exactly equal to the size of the hole. The distance between the outer edges of the first and last holes represents the width of the picture, and so every complete revolution of the disc past a given opening is one picture. As the pictures are transmitted at the rate of 12½ per second, it means that the disc has to revolve at the same speed, namely, 750 r.p.m. It will be readily understood that when revolving at this speed the holes in the disc will appear to have merged into one broad band and anything held behind at a short distance, such as printed matter, will be visible. This is, of course, presuming that the inner edge of every succeeding hole is exactly in line with the outer edge of the previous one. Say, as a typical example that this is not so, and that these edges, instead of being in line, are away from one another by 1/64 in.; the effect will then be to break up the print by a series of lines equal in width to the track of the material between the holes. This, then, is what would happen when viewing the television programme. The field of vision would be broken up by a series of black vertical lines, this quite apart from the fact of the troubles that would be introduced by the multiple errors in spacing increasing the overall width of the light track.

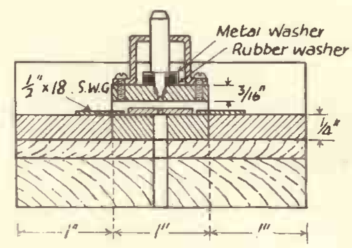


Fig. 2.—A sectional end view of the jig.

From the foregoing remarks it may be gathered that not only is the spacing of the holes a matter of importance, but also the finished disc must run absolutely true off the centre that is used to determine the hole positions; in other words, it is best to mark everything off from the hole in the boss itself that is used to attach the disc to the driving spindle. By so doing not only is the hole positioning made more certain but the whole of the making is simplified and more likely to be attended with success.

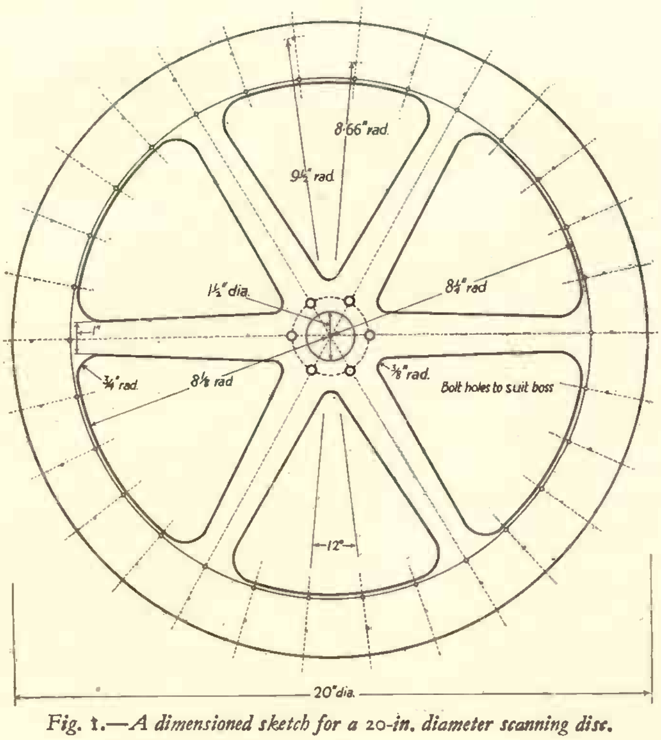


Fig. 1.—A dimensioned sketch for a 20-in. diameter scanning disc.

Making a Scanning Disc

The dimensioned drawing, Fig. 1, is for a 20-inch diameter scanning disc. This is made from No. 30 to 32 s.w.g. sheet aluminium. It will be realised that these gauges are very light; in fact, one is 0.0124 in. and the other 0.0108 in. in thickness, and will therefore kink and buckle easily. On this account do not have the material rolled up, but at the same time see that it is properly protected by packing to keep it flat.

A boss having a hole in it to suit the motor spindle is the next item. One that is made in two pieces like that shown in Fig. 2 is a good type. These halves are registered together to ensure that the centre holes line up accurately when the disc is bolted between the

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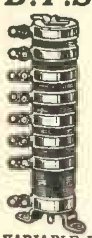

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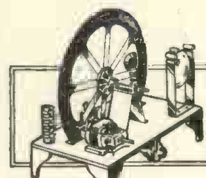

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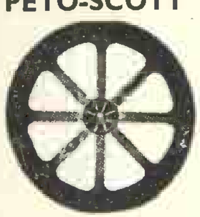

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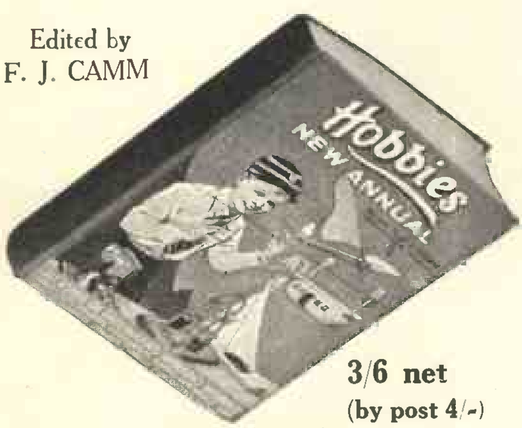

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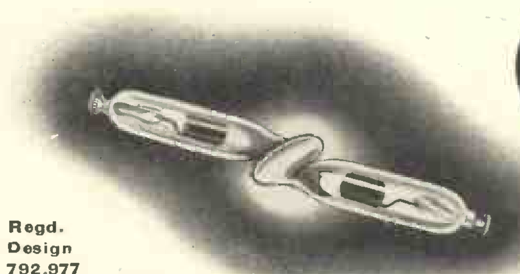

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flanges. Mark a circle on the aluminium sheet about $20\frac{1}{4}$ in. diameter and cut out with a pair of sharp snips or scissors. From the same centre mark out a circle equal in diameter to the male portion of the register on the face of one half of the boss. Cut out the hole by making a series of incisions on the circumference of the circle with the point of a sharp penknife, supporting the metal on a hardwood surface while so doing, and remove any jaggedness on the face by rubbing down with the face of a hammer.

See that this hole fits neatly over the register and make holes for the bolts and bolt up the partly finished disc securely between the halves of the boss.

Arrangements for Cutting and Punching

A jig for cutting and punching discs is seen in Fig. 3. For the base of this a piece of prepared dry hardwood 3 in. in width by not less than $\frac{1}{2}$ in. in thickness and 2 ft. in length is required. A spindle consisting of a bright steel bolt of the same diameter as the motor spindle is sweated into a plate, and the bolt passed through a hole in the centre of the board and secured by screws passing through the plate.

Before continuing, it is pointed out that for the purpose of finishing the disc this spindle acts as a dummy motor spindle, and therefore care must be taken to see that the bolt, if such be used, is a good running fit in the hole in the boss, and also that it projects through the baseboard in an absolutely vertical direction.

The fitting seen at the left-hand side is made from three pieces of mild steel, one 3 in. by 1 in. by $\frac{1}{8}$ in., another 3 in. by 1 in. by 1/16 in., and the third 1 in. by $\frac{1}{2}$ in. by 18 or 20 s.w.g. Place the thickest piece at the top with the short piece in between at the end to form a distance piece. Fixing screw holes are drilled at the end passing through all the three plates. A packing block thick enough to raise the top of the 1/16 in. plate flush with the underside of the disc is placed underneath the plates before screwing them to the baseboard. Set the plates central and at a distance of $10\frac{1}{4}$ in. from the centre of the spindle to the inside edge of the distance piece. Mark a centre line along the top plate and 10 in. from the centre of the spindle on this line drill a 1/16 in. hole through the $\frac{1}{8}$ in. plate, and at $8\frac{1}{4}$ in. from the centre drill another hole of the same size through both plates and the wood, afterwards opening out the hole in the wood from the back to $\frac{1}{8}$ in. diameter.

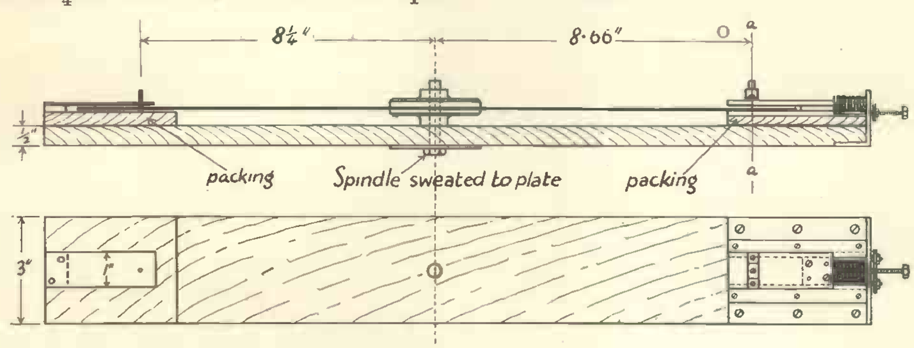


Fig. 3.—A plan and side view of the jig.

Place the disc in position and pass a piece of hardened 1/16 in. diameter silver steel, sharpened at the end to a 60 degree point, through the extreme left-hand hole and press down in contact with the surface of the disc. By turning the disc with the other hand, a circle will be scribed true with the centre spindle. Transfer the scriber to the inner hole and repeat the process, only this time do not press hard on the scriber as only a light marking is required.

Remove the disc and carefully trim off on the outside diameter to the line first made. Next divide the second circle into thirty equal parts, using a pair of fine pointed dividers for the purpose. The next stage is to cut away the metal between the spokes. To do this first made a template from 3/16 in. plywood, having a hole cut in it the same shape as the opening between the spokes. (See Fig. 4.) Remove the metal parts and wood packing from the left-hand side of the jig, and arrange a wider packing at this end under the disc. Place the template in position over the disc and screw down with round-headed screws through the packing and into the baseboard. See that the screw holes are far enough back to clear the edge of the disc. The action of tightening the screws will clamp the disc, loosen the screws and move the disc until one of the thirty divisions is in line with the outside edge of the template and retighten the screws. Run a scriber firmly round the opening in the template several times until the metal is severed. Move the disc five divisions and repeat the process and continue to do so until the six openings have been cut out.

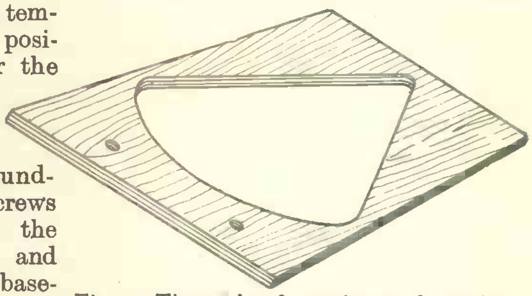


Fig. 4.—The template for cutting cut the openings between the spokes of the disc.

Discard the template and packing and replace the parts previously removed in exactly the same position. The next move is to punch thirty equally spaced 1/16 in. diameter holes on the $16\frac{1}{2}$ in. pitch circle. To do this, bring the divider marks one at a time exactly up to one edge of the $\frac{1}{8}$ in. top plate, punching the holes with a 1/16 in. flat-ended silver steel punch. These holes are the means by which the blank is indexed for punching the remaining holes, so that care must be taken to see that they are equally spaced. Provision has been made for punching the square holes by the arrangement at the right-hand side of the jig. This consists of a simple puncheon and die that can be moved away from the centre pin by the required amount as each successive hole is punched. Reference to the sectional view in Fig. 3 and also Fig. 5 should make the construction clear.

The die consists of 3 in. of 1 in. by $\frac{1}{4}$ in. bright mild steel bar. On top of this and immediately under the punch is screwed a small piece of 1/16 in. steel for the die plate. Above is fixed a piece of 3/16 in. bright steel of the same size with a distance piece in between at the back, the right hand end as drawn. This distance piece is $\frac{3}{4}$ in. square by 3/32 in. in thickness. Screws pass through the punch plates and distance piece into holes tapped in the die plate, dowel pins being fitted to prevent movement.

Guide strips for the punch plate are of 1 in. by $\frac{1}{4}$ in. bright steel 4 in. in length. Gib strips of $\frac{1}{2}$ in. by 18 s.w.g. steel are screwed to the guide strips so as to overlap the punch plate on either side, but are arranged so as to clear the sides of the distance piece. A wood packing block raises the top of the guide plate level with the bottom, or underside, of the disc.

Two small studs are fitted into tapped holes in the back of the die plate, the studs passing through clearance holes drilled in the 1 in. by $\frac{1}{8}$ in. angle iron screwed to the end of the baseboard. A pressure plate with a tapped hole in the centre to take a longish set screw is nutted on to the end of the studs, the end of the pressure screw bearing against the outside of the angle iron.

With the die plate drawn back against the angle iron, make a centre dot at rather more, but only a shade more, than $9\frac{1}{2}$ in. from the centre of the centre spindle and absolutely central on the top plate. Drill, with a No. 70 drill, a hole through the punch plate and 1/16 in. die plate and counterbore the top hole $\frac{1}{8}$ in. diameter by $\frac{1}{8}$ in. deep. The punch is of $\frac{1}{4}$ in. diameter silver steel turned down true on the end to $\frac{1}{8}$ in. diameter, and a portion on the extreme end for a length of $\frac{1}{8}$ in. is made 0.028 in. square. Harden the punch on the end and let it well down. Square out the remaining portion of the No. 70 hole in the punch plate to suit the punch.

To keep the punch vertical, a guide of $\frac{1}{2}$ in. by 1/16 in. material is fitted to the top of the punch plate, a metal washer and a soft rubber washer is fitted beneath the shoulder on the punch to act as a stripper. When the punch is free, as in the sectional view, the end should not project below the underside of the punch plate. Tap the punch down lightly on to the face of the die plate so that a square impression is made, and finish the hole out so that it closely fits the punch. Drill a hole about $\frac{1}{8}$ in. diameter through the $\frac{1}{4}$ in. plate below the die, and also cut a slot through the wood below, of a sufficient length to clear the travel of the hole in the die plate. The die may be left soft.

Next insert one or two pieces of metal packing between the back of the die plate and the face of the angle iron until the distance from the centre spindle to the centre of the punch is exactly $9\frac{1}{2}$ in. Cut twenty-nine pieces of 22 gauge cold rolled metal; these must be of such a length that they will pass between the studs comfortably and about 1 in. in height. For convenience in handling, cut them wedge-shape like the pieces marked "packing pieces" in Fig. 5. See that these pieces are flat and cleanly cut, also the metal must be exactly up to gauge—0.028 in. in thickness. Arrange these pieces between the back of the die plate and the face of the angle iron alternately so that the widest ends always come to the outside. Tighten the pressure screw and proceed to punch the disc.

Put the disc in position and pass the index pin through one of the 1/16 in. holes in the edge of the disc and lightly strike the punch, to punch the first square hole. Remove the index pin and turn the disc in an anti-clockwise direction until the next indexing hole is reached. Loosen the pressure screw, remove one packing piece, then retighten the screw and punch the hole. Proceed in this order, indexing the disc and removing a packing piece, until the thirty holes are pierced.

PERISCOPIC IMAGE OBSERVATION

OWING to exigencies of space or difficulty in layout, cases sometimes arise where it is awkward to observe the television image built up by the receiver directly, that is, through a lens focused on to the scanning disc in the case of the simplest set, or on the fluorescent screen when working with a projected image *via* a mirror drum. Under these circumstances it is often possible to observe the image periscopically.

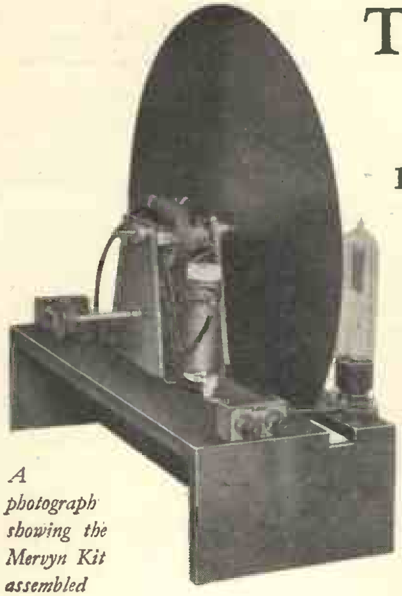
For example, if the scanning disc is not a very light-spoked one, which will bend easily when laid horizontally, the apparatus can work as shown in Fig. 1. Here the driving motor is mounted with a vertical driving shaft to which is attached the horizontal disc. Immediately above the normal observation aperture in the receiver casing is a rectangular metal cowl, having at the top an inclined mirror which is viewed by the observer, and in this mirror is seen a reflection of the image built up by the set.

The arrangement has application in the case of a mirror-drum machine, where the screen on which the image is seen has to be pulled out for focusing purposes. By mounting the whole equipment in a vertical cabinet, the periscopic arm or cowl can take the place of the focusing stand, and by proper adjustment only the top cover with the mirror will be visible to the eye. Schemes of this nature were used on the Continent in the early days of the disc machines, while in America sets have been demonstrated where a cathode-ray tube was mounted vertically, and the resultant horizontal fluorescent screen on which the image is traced seen in an inclined periscopic mirror let into the cabinet lid.

Fig. 1.—By mounting the motor vertically and the disc and neon lamp horizontally, the image can be observed at the top of the cowl via a periscopic mirror

THE MERVYN 60/- TELEVISION KIT

DETAILS OF A VERY EFFICIENT YET LOW-PRICED KIT FOR BUILDING YOUR OWN TELEVISION RECEIVER



A photograph showing the Mervyn Kit assembled

CONSTRUCTION has been reduced to the very simplest in this particular kit, the makers having gone so far as to drill the fixing holes in the wooden base. This is stained black and is very well finished, having no rough edges or other unfinished appearance. The base is in the form of a skeleton, thus avoiding the necessity for cutting the long slit through which the disc projects, and it thus reduces the cost slightly. In addition to the base, the kit contains a Mervyn series-wound motor ; a 15½ in. scanning disc ; a motor control and series resistance ; a pair of motor supports ; a "Nu-glo" lamp and holder, and two pairs of terminals, mounts, screws, connecting wire, etc. Thus the constructor has only to assemble these parts when he is ready to look in. The motor is of sound construction, with capped bearings, and it runs very smoothly without shake or tremble. The commutator is nicely finished and should give no trouble. The brushes are of carbon and means for adjustment are provided. The spindle is only 3/16ths in. diameter, but as only a 15½ in. disc is used this is stout enough and naturally reduces the inertia of the motor somewhat.

The Disc

The disc is a solid sheet of aluminium, which in the particular size mentioned gives no trouble from whip or wobble, and the slight increase of weight which is obtained due to the fact that no part has been cut away is unnoticeable with the particular motor employed. There is, of course, an advantage to be gained from the solid disc formation. When mounted in a suitable cabinet, all light from the neon may be confined to the rear of the disc and there is no leakage such as sometimes occurs with a "ribbed" disc, to spoil the brilliancy of the picture. The whole of the surface of the disc facing the operator is finished in "camera black" and it presents a very neat appearance. The holes are cleanly cut and a brass bush is firmly attached to the centre. This is of the single-screw locking type. To support the motor two sheet steel supports are employed, and these are finished in a blue colour, so that when the complete apparatus is assembled, even if no cabinet is employed, there is no amateur rough-assembly appearance in the parts and a cabinet is not necessary.

Full instructions are given, and hints on adjusting the apparatus as to obtain best results.

The "Nu-Glow" Lamp

The neon lamp is of unusual construction, a flat metal plate having a fine wire mesh backing it and a metal frame between these two. Thus it is possible to use either type according to the individual's particular requirements. The current required for each individual electrode is 30 ma., but when both are connected the consumption is 55 ma. The makers claim that with only 17 ma. good pictures are obtained with the plate electrode.

The makers are Mervyn Sound and Vision Co., Ltd., 4, Holborn Place, London, W.C.1.

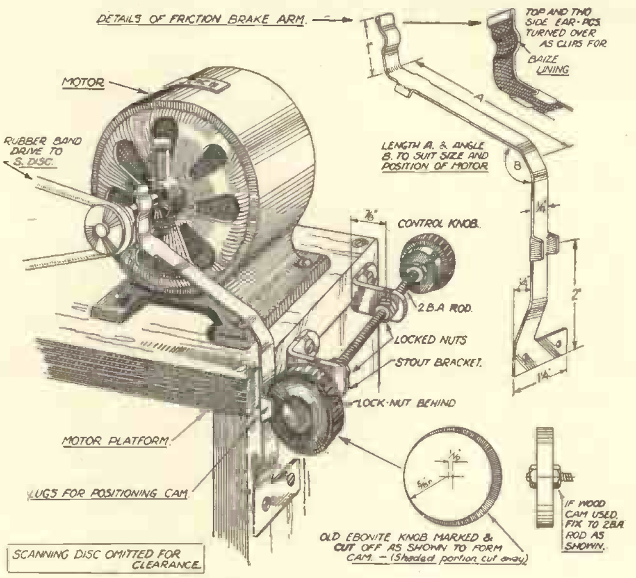
USING A VISION RECEIVER WITH A COMMERCIAL SET

MANY readers and amateurs are anxious to try out television reception, but are in possession of a commercial receiver in which either the method of assembly is too complex or the screening is so complete that it is not an easy matter to obtain access to the appropriate leads. Furthermore, it is often felt undesirable that such a receiver should be interfered with in view of the fact that the guarantee might be rendered void. The following hints will be found of use in such cases, and the information is that which Messrs. Mervyn give to their clients who wish to employ their kits, etc., with such receivers.

First of all, a split-anode adaptor is required. This is in the form of a valve base, with the grid and filament pins continued to form sockets on the opposite side. The anode pin is short, however, and terminates in a small screw terminal at the side of the base. Immediately above this is a further terminal which is fixed to the anode socket on the top of the base, and thus, if the adaptor is plugged into a valveholder, and a valve inserted into the adaptor, the electrodes are continued through the adaptor with the exception of the anode. A meter or other device may then be joined across the two terminals to complete the anode circuit and enable the valve to function. To use the neon lamp, plug the adaptor into one of the valveholders in the receiver (preferably the output valve), and connect the top of the two terminals to the neon lamp. The other side of the lamp is then joined to H.T. maximum. This may be found by means of a voltmeter, or with the aid of the following hint. Tune to a station, and then connect the free lead from the lamp to each terminal on the transformer fitted to the loudspeaker. Music will only be heard when one point is touched. The correct H.T. lead is joined to that point where no music is obtained. If this point is then connected to the lamp it will cut out the loudspeaker and any filters which are joined in circuit and thus give a direct feed for the neon lamp.

A CAM - OPERATED FRICTION CONTROL

An effective frictional control that will give a very smooth control of the image



Constructional details of the Control

THE accompanying drawing shows a simple but effective frictional control for use where approximately correct scanning-disc speed has been attained, and it will be found to give a very smooth control of the image. As will be seen from the drawing, a friction arm, made from springy brass, bears on the motor spindle, the pressure being varied by means of a cam end, operated from the front of the televisor.

As much will depend upon the size and position of the motor, and the amount of control required, only a few sizes are given as general guidance, and these can be modified to suit the reader's own apparatus. One important point should, however, be noted, and that is that the brake arm should be fairly thin and springy, as on this depends the smoothness of control. For clearness in the drawing the arm is shown rather exaggerated in thickness. The cam was made from an old ebonite knob, $1\frac{1}{2}$ in. in diameter, a portion of the rim being removed as follows : The centre was found on the front moulded face, and a point marked 1/16 in. from this. With one point of the compass on this point and the other just touching the nearest side of the rim a circle was marked, and the crescent-shaped piece cut away. If preferred a wooden cam may be made up quite simply, by cutting out a disc $1\frac{3}{8}$ in. in diameter, making a new centre 1/16 in. from the original one, and drilling for the 2 B.A. rod. A nut on each side of the disc will secure.

The springy brass friction arm should be cut out of one piece of thin sheet brass, and bent as shown, the top or brake-end being lined with a strip of green baize, using the ear-pieces to clip this in position. The arm should next be screwed to the side of the motor platform (the correct position being found by trial) and the two brackets for the cam and rod fixed in line with the two lugs on the friction arm. The rod and cam-end can then be fitted, the latter just touching the arm (inside lugs) with its smallest radius, whilst the top of the arm nearly touches the motor spindle. The pressure on the latter will then be varied as the cam is rotated.

The arrangement just described was used in conjunction with the reduction-gear system illustrated in the November issue, and with this gave a very smooth control, though no doubt it would be equally effective where the scanning disc is fitted direct to the motor spindle.

SOUND BY SYNTHESIS

(*Continued from page* 115)

with ordinary song, music or speech, but should be constructed with true synthetic sound designed to suit the subject matter of the film. His success in this connection was borne out very clearly in the films which he has made in order to support his contention.

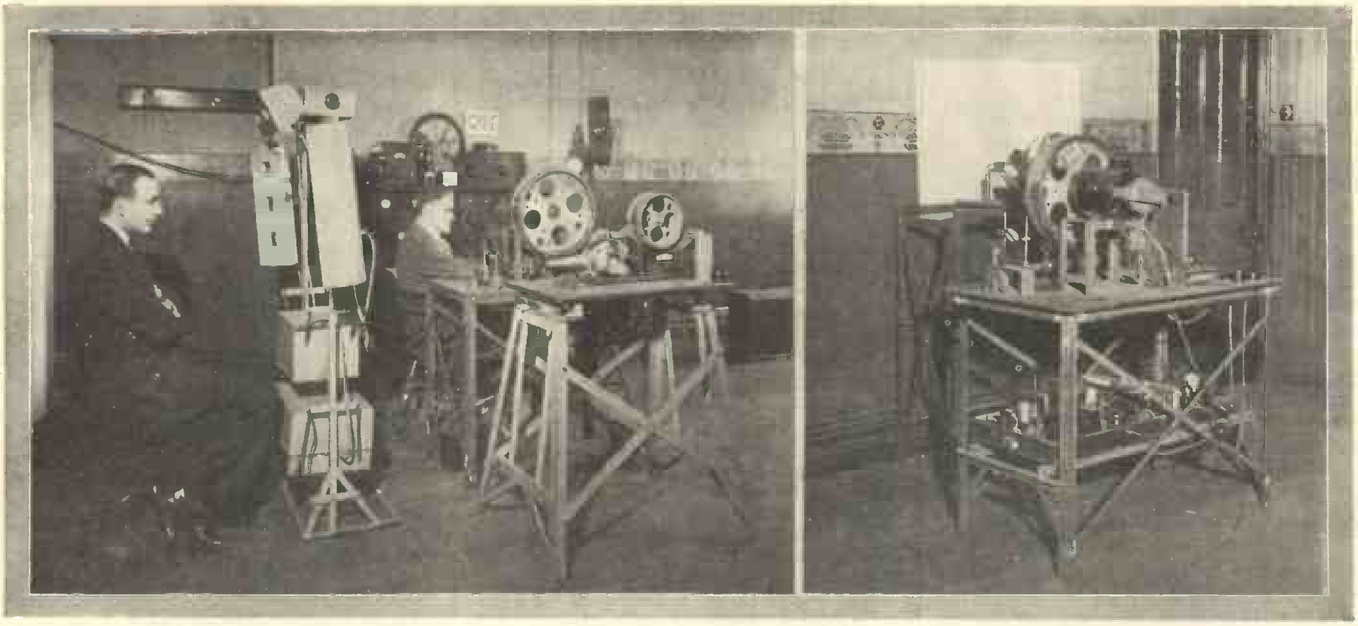
To add to the interest of the demonstration, the actual prepared sound track of photographed drawings was projected on to the cinema screen together with the pictures. The patterns producing the sounds were seen just one second (between 19 and 20 picture frames) before they were heard, although, of course, picture and sound were properly synchronised to give the true illusion of a talking film.

A Special Machine

"Drawn music," giving classical melodies, was recently heard by the writer, and although in no way jarring to the ears, it seemed as if the sound lacked something to give a really pleasing effect. This was no doubt due to the absence of echo, but it must be remembered that the development work on synthetic sound is of comparative recent growth, and many improvements will be effected. The sound patterns seen on the film were extremely weird and nearly all of triangular formation. This was no doubt done to produce the harmonics together with the fundamental. In addition, sound intensity was brought about by fine grey shading, and with complex sound expressions as many as five or six sound track patterns were interleaved one with the other.

It is learned that steps are being taken to produce a machine which resembles somewhat a typewriter in principle, but which will assemble together wave signs instead of letters on an endless band when the appropriate machine keys are struck. No doubt this will reduce very considerably the labour involved, and when the whole technique of "unborn sound" is more thoroughly understood it will surely open up new ideas of real value.

TELEVISION IN MANCHESTER



(Left) The G2UF transmitter at Denton, Manchester, showing Mr. Harold Bailey at the control desk. The 60 and 30 line scanning machines can be seen with the covers removed. The 10 metre oscillator is immediately behind the 60 line drum. On the shelf above the transmitter is a short-wave receiving set fixed to a disc set. The light projects through the photo cell stand and on to the artist seated. To transfer from 60 line to 30 is merely a matter of moving the photo cell stand from one to the other machine. (Right) The 60 and 30 line receivers. The large screen on the left shows the large image received on the 60 line transmitter. The amplifiers are in trays under the machine and are arranged that stages can be cut out quickly for the changing from 60 to 30 line transmissions

Television Activity in the North

IT will no doubt be of great interest to readers to know that the first amateur television transmitting studio is shortly to be opened at Denton, Manchester. Our old friend, G2UF, whom many of you will remember in the early wireless transmitting days, is shortly to commence a series of transmissions on the new ultra-short wave length. The man behind G2UF is Mr. Harold Bailey, the well-known inventor and experimenter. His experiments included Trans-Oceanic and Trans-Atlantic messages, and as far back as 1923 he was in constant communication with other experimenters in the United States and Canada. Realising the weakness of the signal from the B.B.C. transmissions in the North, he has decided to utilise his licence granted to him some few months ago, and "lookers-in" will for the most part be able to receive his transmissions. They will for the most part consist of three-dimensional objects, although films will be transmitted at intervals. These will alternatively be on 30 and 60 line scanning. Mr. E. Reader, who is Mr. Bailey's engineer, has been concentrating on this new 60 line scanning mirror drum transmitter and receiver. The most recent and powerful light sources are being used and the apparatus when complete will surpass anything available at the time for detail, brilliancy and steadiness of image. There will be no flicker due to the high speed scanning and perfect synchronising which is one of the features of the new machine. The amplifiers have been designed to give a maximum of low and high frequency response, and have been decided upon after much research. Vision will be transmitted on the bands 30,000-31,950 kcs. (10.00-9.390 metres) and 28,035-29,965 (10.70-10.01 metres) for sound or control.

The 30 line scanning machine, built at the works of Messrs. H. Bailey & Co. at Denton, produced amazing results, the image being 14 in. x 27 in., the definition being so remarkable that it was difficult to believe that these transmissions were only on the 30 line scanning.

"Lookers-in" will be helped in their television and radio trouble by communicating with the Secretary, H. Bailey & Co., Ltd., Television and Radio Engineers, Manchester Road, Denton, Manchester.

Television Transmission for Amateurs

STILL further evidence of the great interest that television is arousing in official circles is shown by the fact that the Postmaster-General, Sir H. Kingsley-Wood, has now authorised the Post Office to consider applications from amateur transmitters who wish to experiment in the transmission of television.

This is a great step in the right direction, for the great pioneering work that amateurs did for broadcasting, they can also repeat for television.

But that is not the only side to the question. It is not expected that large numbers of amateur transmitters will take advantage of this opportunity, but *some* certainly will, and thus the owners of television receivers will have additional programmes to turn to, besides the short transmissions given by the B.B.C.

The Postmaster General is also extending to a large degree the frequency bands in which amateurs may transmit, and he states that his reason for so doing is that amateurs in the past have kept to their allotted frequency with very great accuracy indeed. The new frequency bands in which amateur transmitters may operate are as follow, and these are, of course, also available for amateur television transmission. 1,720 to 1,995 kc., 3,505 to 3,730 kc., 7,005 to 7,295 kc., 14,005 to 14,395 kc., 28,005 to 29,995 kc., 56,005 to 59,995 kc.

A.B.C. of Television

A Dictionary of definitions of the more important Television Terms.

(*Continued from page 100 December issue*)

BEEHIVE LAMP.—Name sometimes applied to the ordinary commercial form of neon lamp in which a spiral or "beehive" of wire encloses a flat metal disc, these forming the electrodes of the lamp. For simple experiments in television, "beehive" neon lamps are quite suitable after the resistance mounted at the base has been removed.

BELIN AND HOLWECK'S SYSTEM.—One of the earlier systems of television devised in France by MM. Belin and Holweck. In this system, two vibrating mirrors set at right angles to each other caused a reflection of the image to be televised to fall upon a light-sensitive cell. The fluctuating current from this cell was transmitted to the receiving apparatus by landline, where, by an electro-magnetic device, it was made to control the intensity of the light spot in a cathode-ray tube, thus setting up a very crude reproduction of the original image.

BELT DRUM.—See *Belt Scanner.*

BELT SCANNER.—Name given to a flexible belt having a series of holes punched at equal intervals diagonally across it. The ends of the belt are fastened together, and it is caused to move rapidly over two or three pulleys. A light source is situated between the pulleys and the televised image is projected or observed in the normal way. Synonym: *Belt Drum.* See *Film Scanner.*

BERYLLIUM.—Chemical symbol, Be. Atomic weight, 9. Melting point, 960 deg. C. A silvery-white metal, closely related in properties to magnesium. It is sometimes called "Glucinum." Beryllium has been used in connection with television for the coating of the cathode of certain types of neon lamps which have to deal with high-power currents. It is found that the beryllium coating considerably lengthens the life of such lamps. In the Bell Telephone Company's system of television water-cooled neon lamps are employed. These contain beryllium-coated cathodes.

BETA-SELENIUM.—Beta-selenium (β-selenium) is the good conducting variety of selenium which, according to one of the theories of the light-sensitivity of selenium, is present in a mass of light-sensitive selenium when the material is illuminated. As soon as the illumination ceases, the β-selenium changes back again to the more staple and poorly-conducting variety, α-selenium. See *Alpha-Selenium.*

BI-CONCAVE LENS.—A lens both surfaces of which are concave. A bi-concave lens (also known as a "double-concave" lens) sometimes forms one of the components of a compound lens.

BI-CONVEX LENS.—A lens whose opposite surfaces are convex. In other words, a lens which bulges out on both sides.

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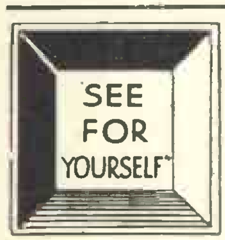

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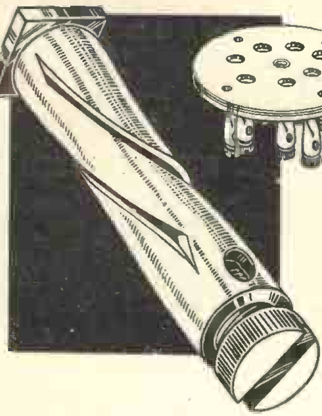

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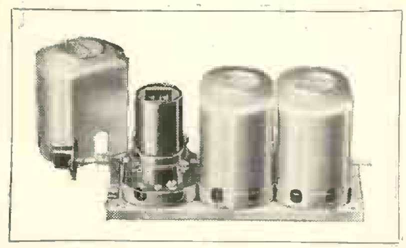

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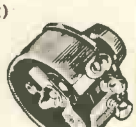
A Universal Resistance for controlling Television Motors on either A.C. or D.C. from 200-240 volts. Accurately wound on air cored former to a total resistance of 1,600 ohms, tapped at 600 ohms, plus 250 ohms, plus 150, plus 150, plus 150, plus 150, carrying capacity 0.25 amps. at 240 volts without undue overheating. Cat. No. R/9. Price **6/6**

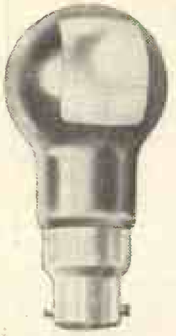
VARIABLE RESISTANCE (Panel Mounting)



A perfect variable controlling resistance wound to 150 ohms and carrying safely 0.25 amps. Cat. No. R/10. Price **5/6**

When using B.T.S. Type M/2 6-volt Battery Motor, a 2-ohm Variable Resistance only is required. Price 3/6. Cat No. R/11

TELELUX FOR BRIGHTER PICTURES



Invented to Perfect Disc Television.—The process of manufacturing TELELUX is one of the latest Television patents, and results in a very highly-developed lamp essential to perfect Disc Television reception.

6/6

Due to the special opaque external coating, "glare" and "beehive" lines are entirely eliminated. Bright, clear and well-defined images. For use with 16 in. and 20 in. discs, TELELUX lights at 180 volts, and operates with only 18m/a passing through it.

Provisional Patent No. 15269

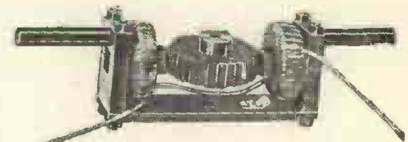
B.T.S. INDIRECT DRIVE DISC TELEVISION KIT

FROM ALL RADIO DEALERS

THE *B.T.S.* DISC TELEVISION KIT comprises EVERY PART for instant assembly, including *B.T.S.* Universal Ball-Bearing Television Motor for either Mains or Battery operation as required; controlling resistances; laminated and ready-assembled chassis, with all component fixing holes marked. Stroboscopic 16 in. Scanning disc and stand; lens and lens-holder; improved type TELELUX Neon Lamp and Holder. FULL-SIZE BLUE PRINT WITH ASSEMBLY WIRING AND OPERATING INSTRUCTIONS WITH EVERY KIT. TYPE K12 for A.C. (40-60 cycles) and D.C. Mains **84/-**
TYPE K13 for 6-volt Battery 78s. If required with B.T.S. Synchronising Gear, 27s. 6d. extra.

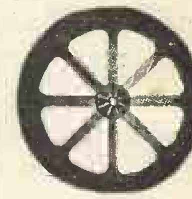
● *All B.T.S. Television and Short Wave Kits and Components are obtainable from all Radio Dealers. In cases of difficulty send direct.*

B.T.S. SYNCHRONISING GEAR KIT



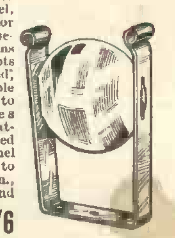
Perfect synchronisation, with floating images reduced to a minimum. Expertly designed and constructed. Quickly and easily assembled. For mounting on either end of B.T.S. Universal Motor. In carton with assembly instructions. Cat. No. S/8. Complete Kit **27/6**

B.T.S. SCANNING DISCS



Light gauge aluminium. Centre-boss is an 8-ribbed black Bakelite moulding faced white to give true Stroboscopic effect, and thereby visual speed indication. Scanning holes perfectly punched to secure uniform scanning without preventable lines. Made in 2 sizes, and ready for immediate use. 16 in. diam. Cat. No. D/3. **7/6**
20 in. diam. Cat. No. D/4, 12s. 6d.

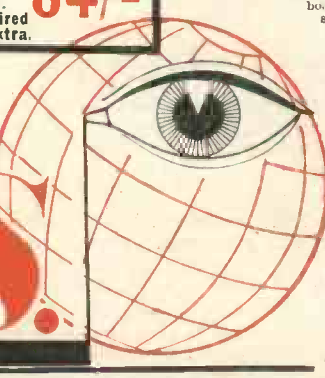
B.T.S. LENS HOLDER



Soundly constructed of good quality steel, slotted and drilled for easy fixing to baseboard. The lens supporting slots are felt lined, giving ample protection to the lenses from scratches. Finished in grey enamel in sizes to fit 2 in., 3 in., 4 in., 5 in. and 6 in. lens Cat. No. L/5. **1/6** (without lens)

B.T.S. LENS

Guaranteed of high optical accuracy, ensuring undistorted magnification of the image. All types are stocked, and any individual requirement can be supplied on application. 4 in. lens suitable for any disc receiver. Cat No. L/6. Price **6/6**
2 in. Special lens for use with Mirror Drum receiver, 4/- each. Cat. No. L 7.



B.T.S.

●MANUFACTURERS of TELEVISION APPARATUS●

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