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RADIO PUBLICATIONS

May-June, 1931

245-T GREENWICH STREET NEW YORK, N. Y.
An Open Letter to the
FEDERAL RADIO COMMISSION

Gentlemen:

THERE exists in the new art of television, at the present time, a condition which the general radio trade and the experimenters in television are most anxious to see remedied as soon as may be feasible. This condition is well-known to your honorable body but has not, I believe, yet received the attention it deserves.

From all indications, television has reached a most critical stage at the present time, and continued repression of the art will serve no good purpose.

At the present time, some twenty radio stations are already broadcasting television daily. Two of our largest broadcasting chains have fitted out their broadcast studios, and are ready to broadcast television.

A large chain of stores is already selling television parts to radio experimenters and to the public, and a number of radio stores are pushing television progressively.

Yet, anxious as are the broadcasters to go ahead and give the public the best service, the Federal Radio Commission has so far refused, for reasons not well understood by the radio trade, to allow the broadcasting of commercial programs.

It is believed that this unwarranted restriction should be removed at once, because it is actually preventing the normal growth of television.

No such impediment was placed upon radio broadcasting when it began in 1920, and no obstacles of this kind should be put before the television broadcast stations today.

While it is admitted by all intelligent investigators that television is not as yet ripe for the public at large, yet there are in this country today several hundred thousand serious experimenters who are willing and anxious to experiment with television. These experimenters are buying equipment and are entitled to a real program, which they cannot get today for the simple reason that television broadcasters are not allowed to put on commercial programs, which would ensure the quality of entertainment that they cannot afford on the present non-commercial basis. The present showings of films and poor direct pickups are not conducive to stimulation of the new art. What is needed is real talent, the counterpart of which we have in oral broadcasting today. This, however, can come about only if the Federal Radio Commission will remove the present restrictions.

It is also felt that the Commission should allow television transmissions on the broadcast band (that is, between 200 and 545 meters) after midnight, local time. It is a hardship to many experimenters in television to acquire a separate short-wave set, in order to do experimental television work, when actual television reception for experimental purposes could be accomplished after midnight with existing facilities.

Several years ago, that is, about 1927, a number of broadcasters were permitted to use the broadcast band for television purposes; but the Commission has since then objected to the use of these channels for such purposes.

It is felt by many that television in its final stage will certainly be accomplished (by some means not known today), in the broadcast band. For that reason the Commission should give the experimenters full facilities; at least after midnight, when the signals would not annoy the listening public.

While it is admitted by the trade that the present results achieved in television are by no means good enough to encourage the general public to buy complete television receivers (primarily because of the small size of the received image), yet it is felt by them that, if the various artificial obstacles were removed, experimenters would take hold of television just as they took hold of radio broadcasting from 1920 to 1924; and, when a sufficiently large number of experimenters become interested in the new art, rapid strides in television must be made.

It is to be hoped that the Federal Radio Commission will give this plea, which is that of the many television interestants of the trade, due consideration at its earliest convenience.

Hugo Gernsback
Publisher.

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THE NEXT ISSUE COMES OUT JUNE 15TH

85
Chicago is very active in broadcasting television images as well as voice to accompany them. "Audiovision" programs are broadcast daily and are featured in the Chicago newspapers.

"Lookers-in" residing within several hundred miles of Chicago have had many rare treats in the past few months, thanks to the elaborate television as well as combination "audio-

One of the television receivers of the type designed by the Western Television Corporation, in which the image is projected from a cabinet on to a translucent screen.

This picture shows how the large photo cells pick up the image of the man's face, while the microphone in front of him picks up the voice, both being broadcast simultaneously.

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TYPICAL DAILY SCHEDULE

At 12:00 Noon—WMAG synchronized with W9XAP broadcasting a religious service which consists merely of a preacher and his sermons and heard for ten or fifteen minutes.

Immediately following this, there are cartoons drawn by one of the Daily News staff artists. This program does not have sound and is like the old-fashioned chalk talks.

1:20 There are news flashes. This is a sight and sound or "audiovision" program which shows an announcer reading the news flashes. This is again followed by a staff cartoonist drawing silent pictures for fifteen minutes.

1:45 from WIBO and W9XAO there is an audiovision program featuring Wesly Long, who plays the guitar and sings blues songs. In this program the audience sees the performer in close-up and full-length pictures.

3:00 Bob, Pratt and Sherman, the most popular local comedy team in the audiovision program from W9XAP and WMAQ.

4:00 In the afternoon, there are more cartoons from W9XAP.

4:15 More news flashes and audiovision program from the same stations.

4:30 In the afternoon, Television Varieties, audiovision from W9XAO and WIBO. This program features ballet dancers, tap dancers, harmony singers; sometimes it carries tumbling acts, miniature minstrel show, jugglers and a Scotch Highland act in costume.

7:00 W9XAP has a silent show on the order of the old silent movies.

7:30 More cartoons from W9XAO.

8:00 Synchronized sight and sound program from W9XAP and WMAQ. This program features ballet dancers, tap dancers, harmony singers; sometimes it carries tumbling acts, miniature minstrel show, jugglers and a Scotch Highland act in costume.

Here we see the relative size of one of the huge photo-electric cells used at Chicago transmitting station W9XAO.

with the editor that they now know that the problem in broadcasting television programs is "studio technique." Mr. Wade said:

"I know now that the big problem in broadcasting television programs is studio technique, placing of the microphones, especially the placing of microvisors (photo-electric cell units), the education of the radio entertainer to a realization that people see him; and the changing of lenses in the cameras to switch from full-length to close-ups and back again, are the present real problems. A television show requires sound to make it real entertainment. Even sight and sound pictures require action. It is no different than the movies. Action, action and more action is necessary! A couple waltzing slowly on a stage is a dull picture but tap dancers, ballet dancers, eccentric dancers, quick movements by the actors and any moving-entertainer makes a television show just as it makes the movies.

"Full length pictures are good and are getting better. Lately from W9XAO and occasionally from W9XAP, we broadcast short boxing exhibitions. These are mighty good, even without sound, because there is plenty of action. Per-

reports of satisfactory reception from Tulsa, Oklahoma City, St. Louis, Minneapolis, Iowa City, Kansas City, Toledo, Cincinnati, Detroit, and Pittsburgh. The man at Albuquerque insists that the picture is better than it is at Chicago. Personally, I think he's crazy but he certainly was able to tell us a lot about our programs and when this man came to Chicago, he identified announcers and artists he had seen at Albuquerque!"

The broadcasting of television images utilizing Western Television apparatus involves the use of a three-spiral disc—that is, a disc which con-

(Continued on page 156)
COLUMBIA

By A. B. CHAMBERLAIN
Chief Engineer, Columbia Broadcasting System

New York City and the surrounding territory will shortly be served by a new and powerful television transmitter, which will be operated by the Columbia Broadcasting System.

The very latest image pick-up system will be used.

The engineers connected with this organization are conducting tests at various outlying receiving stations.

The Columbia Broadcasting System, wishing to make its contribution as a large broadcast engineering organization, will soon have in operation an experimental television station, to be located at 485 Madison Avenue, City of New York. This new unit of the Columbia System will occupy four rooms adjacent to one another on the twenty-third floor of the Columbia building, and consisting of scanning room, studio, control room and transmitter room.

To date, other large laboratory groups have concentrated their efforts, so far as television transmission and reception equipment is concerned, on the design of suitable terminal equipment. The engineering staff of Columbia will undertake an exhaustive study of transmission characteristics, particularly as related to metropolitan areas. A special study of operating technique from the standpoints of organization, management and production will be made. Due attention to the improvement of basic terminal equipment will also be included in the experimental program.

In connection with the basic installation, it will interest the reader to know that only the most modern equipment will be used—equipment which is the product of many years of extensive laboratory experiments. Some of the more desirable characteristics included are indirect-scanning; sensitive pick-up equipment; audio- and radio-frequency equipment capable of reproducing within plus or minus 1 D.C. all audio frequencies.
from 20 to 50,000 cycles with minimum distortion; a complete three-point interlocking relay signal and control system; and a complete speech-input channel, including condenser transmitters.

Automatic-temperature quartz-crystal control and full 100% modulation on the peaks are but two of the many features incorporated in the new television radio transmitter.

Fig. 1 shows the scanner unit which includes a low-intensity reflector carbon-type arc as a source of illumination. A scanning disc attached directly to a synchronous motor is housed in a dustproof compartment. Attached to the front of the disc housing is a projection lens which is used to focus the light, transmitted through the disc holes, on the object to be scanned. The lens' position is adjustable to facilitate proper scanning. There are 60 holes (each .012-inch square) in a spiral so arranged around the disc that the dimensions of the area scanned are in a 5:6 ratio.

Fig. 2 shows the photo-tube and amplifier equipment, commonly designated as the "pickup unit". Eight photoelectric tubes will be used.

(Continued on page 146)
**How I Put the Cathode Ray to Work and Cause Electron Brush To Paint**

By Baron Manfred Von Ardenne
Famous European Television Expert

**The Braun tube has a number of basic advantages as a television receiver.** It operates quite without mass or inertia; it requires only minimum power for control and synchronizing. It fundamentally offers the commercial possibility of arriving on the market, in a suitable stage of development, for use in television receivers, whose cost will not exceed that of a modern radio set with loud speaker. The cathode-ray tube has long been proposed for television reception and has been used in many more or less successful laboratory experiments. In spite of these extremely advantageous characteristics, television has thus far been obtained only with mechano-optical means. The reason lies in the fact that perfect light control was not obtainable with the usual Braun tubes.

**The Problem of Light Control**

Even with the use of rather complicated methods, it has not heretofore been found possible to prevent the initial direction and concentration of the ray from being simultaneously somewhat changed, with changes of the intensity of the cathode ray. With other less complicated methods, the light control added also a change in velocity of the cathode ray. The difficulties described resulted in a condition whereby it was possible to show only silhouettes or very faulty pictures, which were much inferior to those attained by mechanical (disc-scanning) systems. By a new method, the author has succeeded in avoiding all the faults mentioned and in obtaining a light control with Braun tubes (of commercial make) which no longer results in picture distortion.

**A Braun Tube Television Transmitter**

After it could be seen, from static measurements on cathode ray tubes, that light control offered difficulties no longer, it was a question of building a transmitter which could be easily utilized with the receiving tube. Most promising of all seemed to be a transmitter operating also with Braun tubes. Indeed the work undertaken in this direction showed that a transmitter can be built in this way, with very simple means, which accomplishes about the same results as the usual mechanical (disc or mirror) transmitter, and is extremely easy to synchronize with the receiving tube.

The author's principle of the Braun-tube transmitter is made clear by Fig. 1. While the transmitting and receiving tubes are given the same horizontal and vertical potentials (line potentials and picture voltages), there result on the fluorescent screens of

---

**Fig. 3—Shows Von Ardenne's set-up of Cathode Ray tube for transmitting television images, the image in this case being on a photo negative, placed against the end of the tube.**
The latest results achieved in reproducing a television image with the Cathode Ray tube are here described by Baron Von Ardenne, who uses these tubes for both transmitting and receiving.

Both tubes, in the case of suitably chosen frequencies, sharply-outlined rectangles. The luminous rectangle on the transmitting tube, visible in Fig. 1, is sharply reproduced on the dia positive or transparent-film strip to be transmitted by means of an optical device strongly illuminated. Behind the diapositive, visible in Fig. 1, is arranged a photo-cell, especially free from inertia, with an aperiodic amplifier following.

The rectangle on the fluorescent screen results from the fact that the cathode ray scans the corresponding surface very fast—about 20-25 times a second. To each momentary position of the fluorescent point there corresponds a stream of light, which strikes the photo-cell. The amount of the incident quantity of light depends only on the transparency of the dia positive (film image) to be transmitted, at the point where the fluorescent point is momentarily formed over the optical device. With sufficient inertialess amplification of the photo-cell's current, there is available a potential of some ten volts, which serves for light control in the receiving tube. This extremely simple sending process could hardly have been employed hitherto, because the brightness of the fluorescent spot had been too slight to produce photo-currents which could be amplified without distortion. In no case was the amount of light sufficient to ensure the transmitting of half-tones.

The oscillographs developed in the author's laboratory for measuring purposes, with a brightness of fluorescent spot sufficient for continuous photographic registration, seemed to make possible basic advances here. In fact, the transmitter succeeded, even in the first experiments. The excess of light was not only sufficient for the transmitting of half-tones, but it further even permitted putting up with certain losses on the optical side.

Another optical arrangement frequently used for the experiments, in which a ground-glass screen is placed before the photo-cell, is shown in Fig. 2. Here the diapositive (film with image), together with the luminous rectangle formed behind it on the fluorescent screen, is reproduced through the optical device (lens) on the glass screen.

The total make-up of the Braun-tube transmitter in the laboratory of the author is shown in Fig. 3. At the left is the cathode-ray arrangement, completely operated from the electric light-line; while at the right is the aperiodic, multi-stage photo-cell amplifier. At the high factor of voltage amplification used, which is most efficient between 100,000 and 1,000,000, special couplings had to be used in the amplifier and an excellent design of shielding was required. The screening of the photocell by a series of wires may be seen from Fig. 4; which shows the individually-shielded box with the photo-cell and first stage of amplification.

The Pictures Obtained

After the connecting of the potentials (furnished by the photo-cell's amplifier) to the light control of the synchronized receiving tube, there appears on the screen of that tube the picture sent by the transmitter. According to the number of stages of the photo-current amplifier (or the receiving amplifier) the picture appears as a positive or negative. It is one of the most important properties of the new light control that, by a slight adjustment, the generally-undesired negative can be changed into a positive.

One of the first pictures produced a short time ago by the apparatus described is reproduced, unretouched, in Fig. 5, which shows two girls' heads. In spite of the inertia-less quality of the cathode ray tubes, of the very slight inertia of the special photo-cells used and of the aperiodic resistance amplifier used, the quality of the picture obtained is only about that of the usual mechanical (disc or mirror) system. The reason for this is not the light control (which should permit much better pictures) but, as measurements have shown, it lies in an inertia of the transmitter. This is in the fluorescent screen of the Braun tube which, after stimulation by the cathode ray, requires a certain time to become neutral again. With the most favorable screen materials, this time is about 1/10,000 of a second. This inertia is about the same as in former television systems, and it is therefore not surprising that better results were not attained... At present there are being built in the laboratory of the author some mechanical sending apparatus for very much higher numbers of pictorial elements (5,000 and 10,000 per frame). Results obtained with the latter apparatus will be reported in this magazine.
The Pictorial Brightness Attained

Very noteworthy is the great brightness of the pictures attained with the Braun tube. The total energy peculiar to the cathode ray is reduced only by the losses in the fluorescent screen, and is converted into light energy. The efficiency is far better than with most mechanical systems. Even a power of a few watts suffices to produce pictures which can be observed even in bright rooms. With special tubes, containing a newly-discovered material for the fluorescent screens, projections could even be made successfully as large as 24 to 30 cm. (10 to 12 inches) on a side. The screen material mentioned gives a bluish-green light, can be kept free from afterglow, and is about ten times as bright to the eye as, for example, calcium-tungstate screens, and photographically about twice as effective as the latter. In contrast with zinc-silicate screens, the new material shows a similar gradation curve to calcium tungstate and gives sufficiently contrasted pictures. The size of the pictures thrown on the fluorescent screen is easily alterable, by changing the control potentials and the anode current used. One of the chief advantages of the Braun-tube apparatus over all mechanical systems lies in the fact that a constant development and improvement appears possible, when television has reached a popularity equivalent to that of radio. By exchanging the tubes, the owner can always adapt his set to the latest inventions. If transmitters in the course of development change to a higher number of pictorial elements, the main parts will not be worthless, as in mechanical systems but the greatest demands will be changes in condensers or resistances; all this in case the set does not automatically adjust itself to the characteristics of the new transmitter.

The prospects of television in general depend most strongly on the properties and technique of ultra-short waves.

$50.00 For a New Word — Why “Lookers-in”? 

Here are the rules:

The word should be euphonious, sound well and be short rather than long. This contest closes Noon—May 1st, 1931. All letters containing entries to this contest must be post-marked not later than the time specified. In the event that two or more persons should submit the name selected as the best, each of those persons will be awarded the full amount of the prize offered.

“New Word” Editor, TELEVISION NEWS, 98 Park Place, New York City, N. Y.
How the GERMANS TELEVISE

To obtain standard television apparatus, the following specifications have been adopted by the three German companies which are working in its development: clockwise scanning, as seen by the observer, from top to bottom; a ratio of 4 units of breadth to 3 in height for the image; a 30-line image reproduced at the rate of 12 1/2 "frames" a second, or 750 a minute. In addition, each line of the image is to be scanned in the same time; that is, the holes in the disc are to be spaced at equal angles, between the radii.

It is noteworthy that this does not correspond to the system of scanning used in the English transmission (or the American). Its selection is dictated by the fact that broadcast waves must be used for television, under the present European allotment of 9-kilocycle channels, which cannot be changed for two years; and the modulating frequency is thereby automatically limited, which restricts the detail of the image.

The progress of television demands, primarily, low prices and easy operation of receivers; which we cannot have with the short waves, which would permit the use of higher frequencies, giving more detailed pictures. In addition to this, short-wave reception in the near neighborhood of the transmitter is subject to great fluctuations due to fading, echoing, etc. The ultra-short waves, according to Prof. Esau, the great authority on that subject, are not yet sufficiently understood for practical use.

While the technicians express the opinion that the pictorial quality of ordinary television, under these conditions, is too poor to satisfy the general public, we must make a start with what we have now. After all, the question is, what does the public want? For these technical reasons, however, the Telefunken Co. is not at present undertaking to make televisors for general use; and the Deutsche Fernsehgesellschaft ("German Television Company") hesitates to do so. The Telehor Company is the only one undertaking this on a production basis. The systems developed by these three are:

The Telefunken Co. will retain the mirror-wheel system, which offers great possibilities of development, and almost unlimited illumination. Yet its price cannot be lowered, below a certain figure.

The Deutsche Fernsehgesellschaft system includes the scanning disc which is most familiar in England and America. An image-frequency (normally 375 cycles) is used to obtain synchronization.

(Continued on page 144)

By Dr. Fr. Noack
(Berlin, Germany)

Among the unique methods of televising described, are those involving the use of mirror-wheels; unique methods of synchronizing the receiving apparatus with the transmitter are described as well.

Fig. I (right)
The equipment shown here is a design of the Telehor Company, for the purpose of scanning images illuminated by daylight, to be broadcast through a portable transmitter. The mirror 1 reflects the rays, from the object to be televised, through the lens 2 which concentrates them on the scanning disc 3. The lens 4, screen 5 and lens 6 pass on the ray to the photo-cell 7, which is connected to an amplifier. The tube 8 contains a magnifying glass through which the scanned image may be observed.

Fig. P (above)
A monopulse television transmitter: A, motor; B, film reel; C, frame; D, mirror; E, exciter lamp; F, photo-cell housing.

Fig. G (center)
Telefunken-Karolus television receiver: A, arc lamp; B, cooling cell; C, Kerr cell; D, lens; E, mirror scanning wheel; F, synchronizing motor; G, phase control; H, Dynamic speaker.

Fig. H (right)
The corresponding transmitter: B, arc lamp to illuminate subject; A, mirror-wheel, scanning subject with light spot. The illumination is reflected, as indicated by the dotted lines, to the photo-cell C, which is really in the triangular box.
TELEVISION—

A CHALLENGE

To the Inventor

By C. P. MASON

Bell in 1876, the Centennial year, the minds of scientists and inventors throughout the world were turned at once to the possibility of sight, as well as hearing, at a distance. Three years before, a cable operator, named May, had detected the fact that the element selenium alters its electrical resistance, in presence of light; and the fact had been investigated scientifically by Willoughby Smith.

Immediately, inventive minds throughout the world grasped the implications of the two facts. Bell—and others, be it remembered—had shown that modulated currents can be used to actuate a receiver at a distance from the transmitter; and, since it was known that light could be used to vary the strength of an electric current, why could not light be recorded electically at a distance! The number of inventors who conceived the fundamental principles of wired image transmission is unknown; but there must have been hundreds of them.

It would appear that Prof. De Paiva, of Oporto, in Portugal, suggested something of the kind in 1878. In the following year Dr. Carlo Mario Perosino, an Italian physicist, presented to the Royal Academy at Turin the plans of a “teleroscope,” or “telephotograph,” for single-wire transmission of a scene to be focused on the rear surface wall of a camera, which a bit of selenium was caused to scan. The variation in the current passed through the selenium, and thence over a telegraph line, was to be impressed on paper which had been sensitized with potassium ferrocyanide. The transmission of line drawings, made with a suitable insulating ink, by telegraph, had been known for some years; although it had found no commercial application since its demonstration in 1862 by Caselli.

Dr. Perosino’s system employed a reciprocating or slide-arm motion, which caused the selenium point to scan the image in the back of the camera horizontally, while vertical motion was obtained by clockwork. It is not probable, however, that a model was ever attempted. At the same time a Frenchman, Monsieur Senlecq, of Ardes, had a similar idea for an “electrical telescope,” which he communicated to the press; and which received a few lines mention in Les Mondes, of Paris, and Nature, of London, early in 1879.

Mr. Senlecq had also the idea of tracing the ground-glass screen, of a camera, with a piece of selenium held between two electrical contact springs. But, at his receiver, he planned to use a pencil-point of graphite, moving in synchronism with the transmitting...
scanner. The pencil was to be connected with an armature diaphragm of soft iron, normally pressing it against the paper; when the current was strong, because of the greater conductivity of the selenium in a light area, the electromagnet of the receiver would draw back the diaphragm until the pencil cleared the paper. When, on the contrary, the selenium crossed a dark area, the increased resistance of the scanner would weaken the current; the magnet would lose its grip, and the pencil would make a full black line on the paper. Senlecq had also worked with the idea of the multiple cell. But, for various reasons, his invention, like those previously mentioned, failed to make much of an impression on the public mind.

A Year of Inventions

However, the announcement early in 1880 that Graham Bell had deposited with the Franklin Institute a sealed paper, discussing a system of "seeing by telegraph," commanded interest at once; because the inventor of the telephone had won his spurs in the field of practical achievement. At once those who had invented television systems bobbed up in all directions.

The first method to be described in detail in a magazine appears to have been that of George R. Corey, of Boston, Mass., on whose behalf the Scientific American stated that his plans had been in the publisher's hands for some time.

His first idea—and that which has occurred to everyone starting with the idea of television—was to imitate the construction of the human eye by a great number of sensitive points at the back of a camera chamber. Each of these was to be connected by a wire line with an electrode—a platinum or carbon point which would produce an impression on sensitized paper.

However, since a consideration of the number of lines required rules out such a system, except for a very short distance, he conceived also a system in which a scanning arm should carry a point, drawn back and forth over the length of the rod while it was revolved by a shaft to which it was fixed at right angles (Fig. 1). Two such systems, in synchronism, one scanning while the other reproduced a scene, would provide instantaneous photography, if not sight, at a distance.

"The art of transmitting images by means of electric currents," said the Scientific American of May 5, 1880, announcing this invention, "is in about the same stage of advancement that the art of transmitting speech by telephone had attained in 1876; and it remains to be seen whether it will develop as rapidly and successfully as the art of telephony."

In 1880, however, several improvements remained to be made in the art of telephony; and it is an interesting coincidence that in this same issue we find described the "holographoscope,"

(Continued on page 155)
This Disc Indicates Its Speed Automatically

By PAUL L. CLARK

This novel scanning disc has a direct-reading "speed indicator" of the familiar centrifugal type built into it; this feature will be highly appreciated by the experimenter who has actually tried "looking in."

Why Is Synchronization Necessary?

Provided the experimenter's equipment is complete, as outlined in the above paragraphs, synchronization—speed control—remains undoubtedly the only single factor affecting television reception. And it was with the idea of simplifying the speed problem of the television engineer, that this disc has been developed during the last year.

The standard scanning speed of stations now broadcasting television is 900 r.p.m.; and (by referring to Figs. A and B) it will be seen that the disc has built into it a speed-indicating element which shows when this speed is attained; 900 revolutions being the theoretical speed at which the picture should register upon the scanning disc. Slight adjustments on the speed-control rheostat, however, one way or the other, must be made by the experimenter, to get his speed in agreement with that of the similar disc at the television broadcast station. Considering the picture as accurately framed with the local and distant scanning systems running in perfect consonance, it is evident that, if this keyed-in consonance be lost by even the slightest disturbance occurring at either the sender or the receiver, the picture will "travel" across the field of view, causing a "mis-frame," and in the twinkling of an eye it will disappear unless speed correction be effected by adjusting the rheostat.

Framing the Image

The method in use by many progressive experimenters is to start up the small motor and slowly bring its speed to 900 r.p.m. by watching the indicator circle; at this speed the image should appear at the picture opening (Continued on page 152)
A MULTI-CHANNEL TELEVISION APPARATUS*

By DR. HERBERT E. IVES
Research Department, Bell Telephone Laboratories

This improved system of television provides three times the detail or definition of the image obtained with ordinary scanning, an image of three times the usual number of 4,500 or 13,500 picture elements being employed. Three separate circuits, each of which transmits a 40-kilocycle band, carry the three picture image frequencies. The idea involved is that the ordinary-scanning beam is split up into three parts or subdivisions, giving us the equivalent of 180 lines per inch on the basis of the ordinary 60-hole disc.

Three neon lamps and associated lenses form the individual image at the receiving end.

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Fig. 1-Schematic of three-channel television apparatus. (a) Receiving end disc with "spiral" of holes provided with prism. (b) Sending end disc with "circle" of holes provided with prisms. (c) General arrangement of apparatus.

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A bar to the attainment of television images has a large amount of detail is set by the practical difficulty of generating and transmitting wide frequency bands. An alternative

to a single wide frequency band is to divide it among several narrow bands, separately transmitted. A three-channel apparatus has been constructed in which prisms placed over the holes in a scanning disc direct the incident light into three photodetector cells. The three sets of signals are transmitted over three channels to a triple electrolyte neon lamp placed behind a viewing disc also provided with prisms over its apertures so that each electrode is visible only through every third aperture. An image of 13,500 elements is thus produced. For the successful operation of the multi-channel system, it is imperative to have very accurate matching of the characteristics in the several channels.

If, in a received television image, the individual image elements are, as they should be, of such a size as to be just indistinguishable, or unresolved, at a given observing distance, the number of image elements increases directly with the area of the image. The number of such indistinguishable elements in everyday scenes, in the news photograph, or in the frame of an ordinary basis. This may be compared to the 5,000 cycles in each sideband of the sound radio program. If we are forced to content ourselves with relatively simple types of scenes for television transmission, still the fact must be squarely faced that a very much larger number of image elements must be transmitted than has thus far been found possible; and a far wider frequency band utilized than has ever been used in any communication problem. Now the situation is, simply stated, that all parts of the television system are already having serious difficulty in handling the 4,500-element image. Consequently, a major problem in television progress is to develop means to extend the practical frequency range.

It will be worth while to survey briefly the points in a television system where difficulty is now encountered when the attempt is made to increase the amount of image detail and the accompanying band of transmitted frequencies. Consider in turn the

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Fig. 2—Sending end of three-channel television apparatus, showing film driving arrangements.

Fig. 3—Sending end of three-channel television apparatus, showing sending prism disc and photoelectric cells.

scanning discs at sending and receiving ends, the photoelectric cells, the amplifying systems, the transmission channels, the receiving lamps.

In the scanning disc at the sending end, which we shall assume arranged for direct scanning, increased detail means either less of light or increase in the size of the disc. In either case, the factor of change involved is large. For instance, if the number of scanning holes is doubled in a disc of given size, providing four times the number of image elements, the holes must be spaced at half the angular distance apart, and twice the number of holes, imagined placed end to end, must be included in this half diameter scanning field. The holes will therefore be of one-quarter the diameter or 1/16 the area. The light falling on the photoelectric cell at any instant is the light transmitted by one hole; in this case, 1/16 the amount with the disc of half the number of holes. In general, the light transmitted by the disc to the cell decreases as the square of the number of image elements. If the disc is enlarged so as to hold the transmitted light unchanged, its diameter increases directly as the number of image elements. It is obvious that any considerable increase in the number of image elements—such as ten times—demands either enormously increased sensitiveness in our photo-responsive devices, or quite fabulous sizes of discs. Perhaps the most pertinent conclusion from this survey is that the disc, while quite the simplest means for scanning images of few elements, is entirely impractical when really large numbers of image elements are in question. As yet, however, no practical substitute for the disc of essentially different character has appeared.

It is, however, probable that a very considerable increase in sensitiveness over anything now available must be anticipated, whatever scanning device is adopted. In the matter of frequency range there is definite information. In cells depending on gas amplification (such as argon or neon) a characteristic behavior is a falling off of output with frequency, greater the higher the voltage used, which, becoming noticeable at about 20,000 cycles, may at 100,000 cycles be so considerable as to constitute a practical block to transmission. Vacuum cells are free from this failing, but are much less sensitive. Systematic experiment and development of photoelectric cells with particular reference to extending their range of frequency response is indicated as a necessary step in the attainment of a many-element image.

Taking up next the circuits associated with the photoelectric cell, we find, in general, that the higher frequencies progressively suffer from the electrical capacity of cells and associated wiring and amplifier tubes. This in turn calls for auxiliary equalizing circuits, with attendant problems of phase adjustment, and for increased amplification. Amplifiers capable of handling frequency bands extending from low frequencies up to 100,000 cycles or over offer serious problems.

Communication channels, either wire or radio, are characterized by increasing difficulty of transmission as the frequency band is widened. In radio, fading, different at different frequencies, and various forms of interference stand in the way of securing a wide frequency channel of uniform efficiency. In wire, progressive attenuation at higher frequencies, shift of phase, and cross-induction between circuits offer serious obstacles. Transformers and intermediate amplifiers or repeaters capable of handling the wide frequency bands here in question also present serious problems.

At the receiving end of the television system, conditions are similar to the sending end. The neon glow lamp, commonly used for reception, is already failing to follow the television signals well below 40,000 cycles, and, in the case of the 4,500-element image above referred to, the neon must be assisted by a frequently renewed admixture of hydrogen, which again cannot be expected to increase the
frequency range indefinitely. In the scanning disc, as at the sending end, increasing the number of image elements rapidly reduces the amount of light in the image. With a plate glow lamp of given brightness, the apparent brightness of the image is inversely as the number of image elements.

From this rapid survey, it is clear that at practically every stage in the television system, we encounter serious difficulties when a large increase in image elements is contemplated. It is not claimed that these difficulties are insuperable. One of the chief uses of a tabulation of difficulties is to aid in marshalling the attack upon them. But the existing situation is that if a many-element television image is called for today, it is not available, and one of the chief obstacles is the difficulty of generating, transmitting, and recovering signals extending over wide frequency bands.

One alternative, which prompted the experimental work to be described below, is the use of multiple scanning, and multiple-channel transmission. The general idea, which is obvious from the name given to the method, is to divide the image into groups of elements, the various groups to be simultaneously scanned, and to transmit the signals from the several groups through separate transmission channels. In place of apparatus to generate and transmit a frequency band of \( n \) cycles, we arrange \( m \) scanning processes each to provide frequency bands of \( n/m \) cycles width; \( n/m \) being chosen as within the limits set by the available practical elements of a television system. It will appear that the method which has been developed does provide an image of manifold more image elements than heretofore, and may make easier the problem of transmission over practical transmission lines.

**Description of a Three-Channel Apparatus**

The multi-scanning apparatus which has been constructed and given experimental test uses scanning discs over whose holes are placed prisms of several different angles. At the sending end, the beams of light from successive holes are thereby diverted to different photoelectric cells. At the receiving end, the prisms similarly take beams of light from several lamps and divert them to a common direction. The mode of action of the prisms is illustrated in Fig. 1a, where a three-channel arrangement is shown, which is that actually used in the experimental apparatus. In the figure, the disc holes are shown disposed in a spiral, at such angular distances apart that three holes are always included in the frame \( f \). Over the first hole of a set of three is placed a prism \( P_1 \) which diverts the normally incident light upward; the second hole is left clear; the third is covered by a prism \( P_2 \) turned to divert the light downward. If we imagine the prisms removed and a single channel used instead of the three that are proposed, it is clear that the holes would have to be spaced three times as far apart so that no more than one would be included in the frame \( f \) at one time. The diameter of the holes, and the radial separation of the first and last in the spiral would be unchanged.

One of the important considerations is the division of the light into three sets of beams, it is important to note that the signals transmitted by any one of the three sets of holes are continuous—as one hole of a given prism series passes out of the frame the next of the same series comes in. The signals generated in each photoelectric cell are accordingly exactly like those of a single-channel system.

Before describing the details of the apparatus, the general relationship between the number of image elements, band width, number of channels, and shape of picture may be developed. For this purpose, let the following symbols be used.

- \( B \) = frequency band available in one channel, in cycles per second.
- \( F \) = repetition frequency of images, per second.
- \( C \) = number of communication channels.
n = total number of scanning holes.

\[
\frac{a}{b} = \text{ratio of tangential to radial dimensions of frame.}
\]

\[
\alpha = \text{angular opening of frame.}
\]

We shall assume that the picture elements into which the frame is imagined divided are symmetrical in shape, i.e., either circles or squares. We then have that the number of picture elements in the radial direction = number of holes in the number of picture elements in the tangential direction = \( (a/b) \cdot n \).

Now the number of signal cycles corresponding to this number of elements is \( (1/2) \cdot (a/b) \cdot n \).

The number of cycles per second in one transit along the frame = \( (1/2) \cdot (a/b) \cdot n \cdot F \).

over the whole picture it is \( (1/2) \cdot (a/b) \cdot nF \).

\[
\text{and the number of cycles per second for each channel} = \frac{1}{(e/2)} \cdot (a/b) \cdot F \cdot n = B.
\]

The angular opening of the frame = \( \frac{360n}{C} \).

The number of picture elements = \( n^2 \).

\[
(\frac{a}{b})\frac{n^2}{2} = B.
\]

These formulae may be utilized upon assuming values for any of the variables, to fix the values of the other.

In the present case, it was decided for reasons of simplicity to restrict the number of channels to 3. The band width was chosen as that found feasible in the two-way television system, namely 40,000 cycles. The picture shape chosen was that of the sound motion picture, for which \( a/b = 7/6 \).

The repetition frequency assumed was 18 per second, again following closely that of existing experimental synchronizing apparatus. Substituting these values in the formula rearranged to give \( n \), we get for the number of holes,

\[
\frac{2Bbc}{ab} = 108
\]

and for \( a/b \),

\[
\frac{360}{- \times 3 = 10 \text{ degrees,}}
\]

108

for the number of picture elements,

\[
7 = (108)^2 \times \frac{-}{-} = 13,608.
\]

6

In utilizing the prism disc principle at the sending end, direct scanning, in which the object is imaged on the disc, was chosen, since beam scanning would introduce the problem of separating the light reflected from the object from the several spots simultaneously projected from the disc. Since the light going through the disc must be separated into several beams to be directed into separate photoelectric cells, the full aperture of the image forming lens must be divided by \( C \), the number of channels, with a consequent proportional loss of light to each cell. (This loss balances the decreased size of disc above noted.) It therefore becomes necessary to insure a very high illumination of the object. In the present case, it was decided to use motion picture film to provide the sending end image since this can have a large amount of light concentrated through it by an appropriate lens system.

The use of motion picture film permitted a simplification of the transmitting disc, which is illustrated in Fig. 16. This consists in arranging the scanning holes in a circle instead of a spiral, and producing the longitudinal scanning of the film by giving it a continuous uniform motion at right angles to the motion of the scanning holes. The continuous motion of the film also avoids the loss of transmission time that an intermittent motion demands for the shutter interval.

At the receiving end a spiral of holes is used as shown in Fig. 1a. There again, because of the division of the light into three beams, the angle which can be subtended by the light source (neon lamp) is much restricted. In consequence, the neon lamp cathodes are of small area, and a lens system has been used to focus the images on the pupil of the observer's eye. Other methods of receiving, which promise to be less restricted as to position of observation, are possible, however, as discussed below.

With this survey of certain of the more important features of the system, we may proceed to a more detailed account of the apparatus as constructed. The general arrangement of parts is shown in Fig. 1e and in the photographs Figs. 2, 3, 4 and 5 in all of which the symbols are uniform. Both sending and receiving discs were, for simplicity of operation, mounted on the same axis, driven by the motor M. This means that no question of synchronization entered. Synchronization is in fact a separate problem, having nothing to do with multi-channel operation and has been very completely solved in connection with other television projects.1 If it should be decided to transmit the multi-channel image to a distant point, the apparatus could be cut in two and each end, after separation to the desired distance, operated by synchronous motors controlled in approved fashion. Similarly, no long transmission lines were included.

Starting at the extreme right end of the schematic drawing Fig. 1e, we have an arc lamp A, a cylindrical lens L1, a condensing lens L2, the two lenses together concentrating a line of light on the film F. Between the film and the disc is a lens L3 which images the film on the disc. Directly behind the disc D1, with its circle of prism elements, is a second and cylindrical lens L4 which concentrates the transmitted light laterally, upon the three photoelectric cells St, S2, S3. By virtue of this lens arrangement, the light falls upon the cells in three small practically stationary spots. Additional apparatus not shown in the photographs are gears by means of which the film is driven from the disc axle through a differential, which permits the film to be framed up and down. The light beam is directed through the film to the right angles to the axis of the discs by means of two prisms, whereby certain conveniences in driving and handling the film are attained.

The photoelectric cells are similar to ones previously described. The amplifier system was substantially identical with that used in the two-way television system, and need not be described again. Similarly, the amplifier at the receiving end is of the type used in displaying their use in Television. The Cathode Ray Tube is going to solve our scanning problems. Better be versed in its technique.

Are You Familiar with CATHODE RAY TUBES?

More articles in the next issue explaining their use in Television. The Cathode Ray Tube is going to solve our scanning problems. Better be versed in its technique.

TELEVISION NEWS

May-June, 1931


(Continued on page 147)
Glow Discharge Tubes for Television

By H. W. WEINHART
Special Research Dept., Bell Telephone Laboratories

Here is a very interesting resume of the trend in developments of the glow discharge tube, used in reproducing the image at the receiver. Water-cooled tubes as well as many other interesting types are described, including the latest Beryllium-Neon lamp.

SINCE the historic television demonstration by Bell Telephone Laboratories on April 7, 1927, and the showing of television in color early in 1929 when objects were reproduced with their true color values, many advances in the efficiency of the equipment have been made. Some of these were incorporated in the two-way television apparatus shown this spring. Notable among them are the changes made in the glow discharge lamps used at the receiving end. The lamps used with the present equipment permit much greater power input than those of the earlier demonstrations and their structure has been changed quite radically.

It is essential that glow discharge lamps for television uses contain some of the noble gases, such as argon and neon, which produce a light of high intrinsic brightness that may be modulated with sufficient rapidity to follow the incoming signals. For monochromatic television neon is usually employed. For television in color, which requires the three basic colors, red, green, and blue, the neon tubes may also be used but only for part of the reproduction. Behind a suitable filter, they supply the red component. For the blue and green, however, argon is employed because of its richness in both blue and green lines of the spectrum. Suitable color filters are also used with them. For monochromatic television no color filters are required; the image is reproduced in the pinkish glow of the neon lamp.

All such tubes are constructed with two electrodes, and the glow forms on the cathode. Its quality depends not only on the material of the electrode but on its structure and its treatment during manufacture. The material of the anode requires less care in preparation. For it the chief consideration is position relative to the cathode.

Lamps used for the early television demonstration (Figure 1) had flat plates for electrodes. These are separated by only about 3/32 of an inch and this small separation maintains effective insulation and forces the glow discharge to develop only on the outer surface of the cathode. Radiation is depended upon entirely in cooling, which limits the operating current to about fifty milliamperes. The brightness of the glow is a function of the anode current and is thus limited by the cooling arrangement.

To obtain a greater brightness, water cooling was resorted to and one of the early water-cooled tubes is shown in Figure 2. The cooling of the cathodes of such tubes is not a limiting factor, and currents as high as 500 milliamperes may be used, giving a very bright glow on the cathode surface. A nickel-plated hollow copper cylinder is employed for the cathode and the glow occurs on one end. The other end is sealed to the glass container and has two tubes entering it for water circulation. Surrounding the cathode is a glass shield which restricts the area of glow to the end, and also serves as insulation between anode and cathode.

One of the lamps used with the early demonstrations of television in color is shown in Figure 3. A single piece of tubular nickel-plated copper, closed at one end and flattened along one side, forms the cathode. Its open end is sealed to a glass tube through which water is passed for cooling. The glow forms over a rectangular area of the flattened surface; on the rest of the surface glow formation is pre-
vented by a protective coating of lavite and insulating cement. The anode is a metal strip bent into a rectangle open at one end, and the tube is mounted so that the cathode is viewed nearly end on through the open end of the anode. A rubber stopper, not evident in the illustration, is inserted in the glass cylinder that supports the cathode, and glass tubes passing through the stopper allow the cooling water to enter and leave.

This early lamp possessed many objectionable structural features which have been eliminated in the tube for television in color, shown in Figure 4. The cooling water for this tube is not in direct contact with the cathode but is confined to a glass tube to which the cathode is tightly clamped. A mica shield replaces the lavite and cement insulation and by providing a long insulating path prevents the glow from forming anywhere but on the flat rectangular area. The anode is similar to that of the earlier tube but supported in a slightly different manner.

The bulb shown attached to both of these tubes is used for supplying small quantities of hydrogen which has been found essential for the efficient operation of all television lamps. After the lamp has been in operation over a period of time, the glow discharge develops a sluggishness which causes fuzziness or poor definition of the image produced. If a small amount of hydrogen is allowed to mix with the gas in the tube at this time, the sluggishness immediately disappears and good definition is again obtained. Such hydrogen admission is required periodically during the life of the tube.

The construction of the admission system is shown in Figure 5. Two porous plugs, one sealed in an extension of the lamp and one in the end of the hydrogen supply bulb, are normally sealed with mercury but when pressed together permit the passage of hydrogen into the tube. Lavite is used for the plugs and is heat treated until it is porous enough to pass hydrogen but not mercury. After the supply bulb is formed, the glass tube around the porous plug, with a short piece of rubber tubing attached to its upper end, is filled with mercury to prevent air leaking into the bulb, which is then evacuated, filled with hydrogen, and sealed. After this the upper end of the rubber tube is attached to the lamp, as shown in the illustration, so that the two plugs are about a quarter of an inch apart. When hydrogen is required the supply bulb is raised until the two porous plugs are in contact, when hydrogen may pass into the lamp.

For the more recent work on monochromatic television the type of lamp shown in Figure 2 has been displaced by the one shown in Figure 6. As with the latest lamp for color television, the cathode is clamped in good contact with a glass tube through which the cooling water circulates. The glow discharge is confined to a flat square surface by mica shielding, and the anode is a metal strip fencing off this active area.

The uniformity of the glow of neon tubes and the sputtering from the active surface depends very much on the use of proper technique in preparing the cathode surface. Sputtering is the dislodging of material from the surface by impact of ions from the glowing gas. The matter released leaves the surface with high velocity and deposits on the inside of the bulb directly in front of the glow. This soon renders the lamp useless by reducing the intensity of the light as viewed through the bulb. It has been found that beryllium sputters far less than
View showing one of the Bell Telephone Laboratories in which research on television glow tubes is conducted. The Bell physicists and engineers have the finest facilities imaginable for carrying out experiments based on their newest ideas and theories. Dozens of laboratories such as this one are constantly devoted to the study of new problems in television, radio, telephony, etc.

In preparation the cathode is first baked at 800° centigrade in a vacuum for an hour, which anneals the copper without oxidation. The flat surface is then sand-blasted and nickel-plated but not polished. The rough surface allows the final plating to adhere tightly. Beryllium is not easily worked. It can neither be electroplated nor readily deposited by cathode sputtering so it is necessary to deposit it by the method of vaporization and condensation. This is done in a high vacuum to prevent oxidation and to leave the surface as free from gas as possible.

A special tube shown in Figure 7 is used for the purpose. The cathode is mounted face downward over a tungsten filament to which have been welded a large number of pieces of beryllium. The filament is then raised to a high temperature when the beryllium forms melted globules which slowly vaporize. Some of this vapor condenses on the nickel-plated cathode where it forms a thin and uniform coating. In transferring the cathode to the neon tube, care is exercised to keep the surface free from dust, moisture, or finger marks.

After assembly, the tubes are sealed to a vacuum pumping system and evacuated to a low pressure. During this period the entire bulb is baked at a high temperature and then allowed to cool. Neon or argon is then admitted through a porous plug system similar to that used for admitting hydrogen, and a glow discharge is started. During this operation the current used is always at least 100 milliamperes more than the anticipated operating current so as to provide sufficient local heating to degas parts of the tube and to release any remaining gases from the cathode.

After treatment in this manner, the impure gas is pumped out, water is circulated in the cooling system, and fresh gas is admitted to the pressure that produces the most efficient glow on the cathode surface. The tube is then sealed off from the vacuum system and is ready for use. (Reprinted by courtesy “Bell Laboratories Record,” October, 1930.)

THE editor is anxious to receive letters telling of your experiences in anything pertaining to Television. We want to make TELEVISION NEWS as full as possible of human interest; but we cannot do so without your help and support. Let us have your experiences, so far as they pertain to Television, for the benefit of your co-readers. We will publish all for which space can be found.

Tell us why you are interested in Television—tell us why you like the game—tell us what encourages you—tell us what discourages you—and let us have a general get-together. Only by discussing these things through the columns of TELEVISION NEWS can we make this your very own magazine.
How to Build the New
Jenkins Television Receiver

By H. G. CISIN, M.E., and CHAS. E. HUFFMAN

The article herewith by Mr. Cisin, well-known radio author, and Mr. Huffman, engineer with the Jenkins Company, covers in detail the construction of a thoroughly tested and proven A.C. Television Tuner and Amplifier. This receiver is the very latest development of the Jenkins laboratories and has demonstrated that it is selective and yet thoroughly capable of passing a sufficiently wide band of frequencies to ensure a very faithful image at the scanner, not a weak “black and white” silhouette.

In the last issue of TELEVISION NEWS, an article covered in detail the building of a Home Televisor. Some of the readers of that article appear to have received the false impression that the television receiver, required for use with this televisor, must be necessarily a complicated and expensive piece of apparatus.

Fortunately, just the reverse is true. Instead of being complicated, the television receiver is extremely simple; instead of being expensive, it costs less than most good radio sets. Best of all, the design of the television receiver has been improved and simplified, until a minimum number of parts produce a maximum amount of service and satisfaction.

Television fans and custom set builders will be especially interested in the new television receiver kit, just announced by the Jenkins Television Corporation, which has been designed to co-ordinate with and supplement the televisor kit described by the writer in the last issue of TELEVISION NEWS.* However, it is universally adaptable, also, to all standard televisor outfits.

Receiver Kit Result of Careful Research

The new kit has many points to recommend it to set builders. First of all, it has been produced only after many months of careful study and research. It has been tested carefully under various conditions and will give most excellent results; all the experimenting has been completed at the Jenkins laboratories. When the kit reaches the set builder, it is merely necessary to follow the simple set of instructions and the receiver, when completed, is certain to work and work extremely well.

A second feature of the new kit is the fact that it is composed of the very highest quality components obtainable. There is a definite necessity for using such fine parts; in ordinary radio reception, the ear passes over numerous slight imperfections; but, in television, the eye being more sensitive, will notice very slight deviations from the normal. For this reason, it is almost axiomatic that poor parts

*Article was written by Mr. Cisin, and appeared on page 16, TELEVISION NEWS, No. 1 (March-April).
must never be used in television equipment.

**Kit Easy to Wire**

A third important feature of this kit is the ease with which it can be put together and wired. Hardly any mechanical skill is required, since all the difficult operations have been performed at the factory. For instance, the metal chassis is received by the builder, bent to the proper shape and with all mounting holes drilled. Photographs, diagrams and detailed instructions are furnished with the kit; and these explain each operation so clearly, that even a novice will experience no difficulty whatsoever in successfully completing the receiver.

**Details of the Receiving Circuit**

The circuit of the Jenkins television receiver comprises two impedance-coupled stages of tuned radio frequency using screen-grid tubes; a grid detector, for which a 427 tube is used; and three resistance-coupled audio stages. The first of which utilizes a screen-grid tube, the second a 427 tube, while the output stage employs a 465-type _p_-type tube.

The three R.F. coils are enclosed in aluminum shields. Coil (2) is a specially designed Jenkins television antenna coupler, while coils (11) and (19) are special Jenkins television impedance coils. The three circuits, consisting of the two R.F. stages and the detector, are tuned by a shielded three-gang condenser, having 11 plates in each section. Three small equalizing condensers permit the three tuned circuits to be adjusted and matched accurately, so that only a single dial is needed for tuning. The double grid and plate circuits of the two R.F. screen-grid tubes, (6) and (14), are carefully isolated, to prevent unwanted interaction of circuits, by means of 300-turn R.F. chokes; and the latter are by-passed to ground by small fixed condensers. A convenient feature here, is the use of two condenser blocks (8A, 8B, 8C) and (16A, 16B, 16C), each containing three 0.1-mf. by-pass condensers.

A choke, (30), is interposed between the detector and the first audio stage to keep R.F. currents out of the audio portion of the circuit; it is by-passed by a small mica condenser (29).

For providing the correct grid bias on the three screen-grid tubes, 500-ohm resistors in each case are connected between cathodes and ground. Of course, each cathode resistor is by-passed by a suitable fixed condenser. In order to furnish the required bias for the 427-type second audio tube, a 2,000-ohm resistor is placed in the cathode circuit. The grid bias for the power tube is obtained by means of the voltage drop in the 2,000-ohm resistor (49), connected in series between ground and the center point of the wire-wound 50-ohm resistor (48).

Volume is controlled by means of a 25,000-ohm potentiometer (21), connected in such a way that the voltage on the outer grids of the two R.F. screen-grid tubes may be reduced from normal operating voltage to zero, by turning the knob of the potentiometer. This method is highly efficient and gives very smooth control. The power switch (54), is mounted on the volume control shaft, thus eliminating an extra control.

**Includes Complete Power Pack**

The power supply equipment of the receiver consists of four essential components. The plate voltage for the rectifier tube (and for the receiver), the 5-volt filament supply for the rectifier, 2½ volts for the power tube's filament and a separate 2½-volt source for the other tubes, are all obtainable from the power compact (53); which contains also the two 30-henry chokes which form a part of the filter system. The alternating current is rectified by means of a full-wave 480-type rectifier tube (55). The two heavy-duty filter condensers (56A) and (56B) are contained within a single casing for convenience in assembling. A 1-watt enamelled tapped resistor (57) serves the purpose of a voltage divider. Only two taps are taken from this resistor; one supplying the 180-volt plate supply to the two R.F. screen-grid tubes and the other furnishing the correct outer-grid voltage to the first audio screen-grid tube. The other screen-grid voltages, plate voltages, etc., are obtained by reducing the maximum "B" plus voltage to the desired values by means of the voltage drops in various individual metallized resistors.

Binding posts are provided; for aerial and ground connections at (1) and (3), and for the output connections to the neon lamp terminals of the televisor at (51) and (52).

(Continued on page 145)
Television Image and Voice
Recorded on and Reproduced from Film

By WILLIAM SIRAWATKA

INTRODUCTION
The accompanying article by Mr. William Sirawatka, is published because it seems to contain the essence of a new idea. Briefly, the inventor proposes to record both picture and voice images on film, develop it and later project the magnified picture image on a screen, accompanied by the voice. Both picture and voice are recorded simultaneously. The film is used over and over. In its present form, however, it leaves a number of interesting problems for the student; one of which is represented by the fact that, while the pencil of light at the transmitter is scanning the picture image, it is not scanning the voice-track on the film and, in consequence, there will be gaps in the voice record. This gap can be closed by lagging characteristics in the voice amplifier, possibly; or, also, by optical or mechanical methods which would change the speed of the film at the point where the voice is recorded on it.—EDITOR.

ONE of the limitations of television today is the size of the received images. This is partly so because the scanning disc limits the illumination which can pass through a single one of the tiny holes when revolving at high speed. But, by photographing the image on a motion-picture film, and then passing a bright light through the film, a much greater illumination is passed on to the photo-electric cell, which enables it to respond better.

As you will see from the illustrations I am able to receive and project

Transmitter: Voice and image are recorded on film, then broadcast.
Receiver: Film records image and voice, then reproduces them.
be the image onto a screen of any size. On my receiver the screen is 12"x12". I also intend to transmit and receive sound in conjunction with the image.

Recording Television Image

The person to be televised is photographed by a special motion-picture camera, incorporated in the television apparatus. At the same time, the sound is resolved into electrical vibrations which are changed into light and photographed along the edge of the film. This sound track, ¼-inch wide, runs down one side of the film; it consists of a hollow metal drum studded with 48 separate lines, which are changed into light and dark bands or lines, and the spacing of these lines at each point depends on the pitch of the sound. The greater the contrast between the light and dark lines, the louder the sound. In the diagram you will see how this is done. The film is developed and fixed, and then run through the television apparatus, which consists of a hollow metal drum which is studded with 48 separate little lenses, which concentrate an intense pin-point of light through the film. Behind the film is a sensitive photo-electric cell which receives the light. The drum revolves at 15 revolutions per second; the separation between the lenses is equal to the width of the film.

Scanning

As the drum revolves, the light beam travels horizontally across the film; when it runs off the left edge, the beam of the next lens starts at the right, but at a point a trifle above where the first started. The film is moving down at the same time, while the drum is turning to the right; 48 beams of light travel across each picture in 1/15 of a second. The light beam scanning the film including the sound track falls with varying intensity into the cell, which is connected to an amplifier which is connected to the transmitter.

The film used is phototropic in effect. In other words, it has the property of fading out and regaining its sensitiveness when passed through a dark box. The film is coated with an emulsion of sulphide of zinc and mercury salts. The developing and fixing solution does not spoil the phototropic effect. An 1800-R. P. M. synchronous A.C. motor is used to run the shutter and sprockets that drive the film and also the scanning drum.

The film is then passed through a synchronizing apparatus used in his experiment.

(Continued on page 149)
The Television Constructor Will Find These Charts Very Useful

Here are the full size scanning disc layout charts which television enthusiasts have been looking for.

The four quarter-circle charts here reproduced may be traced or transferred by carbon paper in such a manner that when the similarly labelled sides such as A-A, B-B, etc., are placed together, you will have a complete template or chart for television scanning purposes. While discs have been laid out which contained 24, 36, and other numbers of holes on the same disc, the present design cannot be used in that manner and each spiral of holes should be laid out on a separate piece of disc material. It is only necessary to change discs when you switch to a transmitter using a different hole frequency.

(See page 131 for data on 64x72 element image.)
The four quarter-circle charts, when matched, form a complete template.

It will be apparent, after a little study of the accompanying charts, that one cannot drill all of the holes on one disc of metal, as the various holes corresponding to the different series such as 24, 36, etc., would interfere with one another; a separate disc should be used for laying out each spiral of holes. Aluminum, about 1/32 inch or less thick, has been used and also hide as well as other materials. Be very careful to check up the spacing between the holes where the division line between quarter patterns fit together. This can be done very easily with a strip of paper containing spacing marks.
Complete Instructions for Building the

BAIRD UNIVERSAL TELEVISION
and SHORT WAVE RECEIVER

This article describes in detail the assembly and operation of the Baird Universal Television Kit and Baird Combination Shortwave and Television Receiver which has been especially designed for use with the Television Kit. This kit has been especially designed for the individual who wants television in his home without spending a prohibitive sum of money, and is offered with the assurance that, although lacking in the finer constructive details of higher priced receivers, it nevertheless will receive a television picture with good detail.

We will first go into complete description of the assembly and operation of the Baird Combination Shortwave and Television Receiver. This receiver will tune from 15 to 550 meters for the reception of music, television images or code. It is simple to construct and will operate from 110-115 volts 50-60 cycle current with a minimum of A.C. hum interference, especially below 50 meters, where this would be most evident. The regeneration control is smooth and the quality of music and voice reception will be found excellent, due to resistance coupling in the audio stages. The outfit described here must be built very carefully and instructions must be followed implicitly, as the quality of the picture to be received depends entirely upon the final construction and operation of this receiver.

For television reception this receiver must be non-regenerative and transformers cannot be used for audio amplification. It is necessary to cover a frequency band of about 10 cycles to 30,000 cycles and the average transformer only covers a frequency range of 100 cycles to 5,000 cycles. This receiver is especially useful as it is not limited for use only as a shortwave-television receiver. It has been so designed that by simply changing the plug-in Octocoils it becomes a highly efficient regenerative receiver covering a wave band from 15 to 550 meters. The Baird Combination Shortwave and Television Receiver, therefore, is universal in the full sense of the word, in the fact that not only will it work as a non-regenerative television Receiver but can give you selected programs of voice and music from all parts of the world.

Capacities and other values have been figured out with utmost care and the set-builder's work will be much easier and much less open to eventual trouble if he confines himself entirely to the use of material described herein. Substitution may throw the complete receiver out of balance. If you want to experiment, do it later. Build this receiver exactly as we describe it, using only the parts which we recommend. Then, if you think you can
List of Parts for Baird Short-wave Receiver

All necessary supplies and parts for building the Baird Universal Shortwave and Television Receiver, as well as the Television Unit, are now on sale at local 2, 3, X-Ray, etc., to $1.00 Stores.

The following is a complete list of parts to be used in the construction of the Baird Combination Shortwave and Television Receiver:

1. Baird 8 x 21 Metal Panel
2. Baird Aluminum Chassis, drilled and punched, with static shield plate base—complete
3. Sets Octacol
4. only Broadcast Octacol
5. only Metal Television Octacol
6. Type 1285 Drum Dial with dial light
7. 2 M.V. 150 Hammarnlund Variable Condensers
8. Type J-11 Midget Variable Condenser with knob
9. Type J-23 Midget Variable Condenser with knob
10. Type 609 Toggle Switch
11. Royalty Electrical 50,000 ohm Potentiometer
12. Type 216 Tube Sockets

Mount a type No. 216 socket into No. 1 hole with the two filament holes to your left. Nos. 2, 3, 4, 5 are all type No. 217 sockets and should be mounted with the grid hole, which is the single hole by itself, towards you. Before inserting the screws for the No. 4 socket put one terminal lug under the head of the left hand screw on the top side of the chassis. Put a lug under each mounting nut of the No. 5 socket on the bottom side of the chassis. No. 6 is a type No. 216 socket which should be mounted with the two filament holes toward you and a lug under the left hand mounting nut on the bottom side of the chassis. Nos. 7 and 8 are each type No. 216 sockets which should be mounted with the filament holes furthest from you.

in this receiver numbered 1 to 8. No. 1 is the socket for the BH Raytheon tube which rectifies the current in your power pack. No. 2 is a screen grid R.F. stage ('24 tube). No. 3 is a screen grid detector ('24 tube). Nos. 4, 5, 6 are three stages of resistance coupling with type '27 tubes in sockets 4 and 5 and a '45 power tube in No. 6. Nos. 7 and 8 are for the plug-in Octo coils. In beginning your assembly have the chassis' top side up in front of you with the No. 1 socket furthest from you (Diagram No. 1). This relative position should be maintained whether you have your chassis top side or bottom side up. If this is followed the assembly and wiring of your receiver will be much more simple.

Every effort has been made to make Diagrams Nos. 1 and 2 as clear and concise as possible. If there is any question about the exact location of any particular item in the instructions, you should have no difficulty in clarifying your mind by careful scrutiny of the diagrams.

There are a few small holes in the chassis through which the rubber cover will have to be drawn. In all of these places we suggest using a short piece of spaghetti to draw your wire through so as to prevent the sharp edge of the hole cutting into the wire.

Mount a type No. 1049 grid leak holder between sockets No. 3 and 4, putting a lug under the mounting nut on the bottom side of the chassis. Take a No. 1450 .02 Aerovox condenser, bend one of the lugs at right angles and fasten it to the chassis with a screw and nut through the hole half way between No. 5 socket and the edge of the chassis nearest you. The location of this condenser can be seen in diagram No. 1. Then mount the No. 1285 drum dial in the location as shown in diagram No. 1.

Turn your chassis upside down, still keeping No. 1 socket furthest from you. Take three No. 260 Aerovox 25 condensers and screw them to the No. 1001 bakelite strip. Be sure to use the flat head screws furnished in the No. 1000 assembly package. Mount the bakelite strip with the condensers onto the chassis in the holes provided, using two nuts on each screw between the chassis and the strip so as to separate the strip from the chassis; have the terminals of these condensers pointing towards the row of five sockets.

Next, mount a type 261 2-mf. Aerovox condenser, which is the condenser with only two terminals, between sockets Nos. 5 and 6 and the jacks which you have just mounted with the leads pointing in as shown in diagram No. 2. Then mount a type 261 XX 2-mf. condenser between the jack and No. 1 socket. This is the condenser with three terminals, which terminals will point towards the No. 1 socket. Mount a type 261 XX 2-mf. Aerovox condenser between No. 7 socket and the bakelite strip as shown in diagram No. 2. Mount one No. 260 .25-mf. Aerovox condenser, with the terminals towards you, between Nos. 3 and 4 sockets.

Mount a No. 1450 Aerovox .00015-mf. condenser just to the right of the bakelite strip with the threaded fibre bushing furnished in the No. 1000 assembly package, being sure you use the right length screws so that the screw holding the condenser to the fibre bushing will not strike the other screw coming through from the chassis. Mount a No. 1450 Aerovox .02-mf. condenser on the left hand mounting screw of No. 7 socket and another condenser, type 1450, .02-mf., Aerovox, to the right hand mounting screw of No. 3 socket.

Mount your binding posts so that the two posts marked "Antenna" are...
on the bottom right hand corner. Both must be insulated from the chassis, using the small fibre washers furnished for this purpose in the No. 1000 assembly package. Place one lug under each nut. Mount one plain binding post directly in back of socket No. 1, and two plain binding posts a little to the right, as shown in diagram No. 2. These are all to be mounted with insulating washers and terminal lugs.

Your ground binding post is mounted to the right side of the chassis in the hole nearest the right hand further corner. A No. 996SW Aerovox voltage divider resistance is mounted in the hole near the ground binding post with a 5-inch mounting screw and nuts, keeping the terminals pointing towards the row of five sockets and being sure that the end of the voltage divider marked with the Aerovox name is mounted nearest the frame of the chassis. This is distinctly shown in diagram No. 2. Now in the top left hand corner mount two plain binding posts; the furthest one from you that is the one nearest the corner, must be insulated from the chassis with the fibre washer furnished in the No. 1000 assembly package, and a lug must be put under this nut.

Next, mount the No. 100 Baird television choke as shown in diagram No. 2 between Nos. 3 and 4 sockets so that one of the terminal lugs on this choke will rest against the terminal lug of the first type 260 condenser on the bakelite strip. Attach to the left hand mounting nut of the No. 2 socket a Pyrohm No. 992 400-ohm resistor, so that the other terminal lug of the pyrohm rests on the terminal of the .02 No. 1450 condenser which is connected to the mounting nut of No. 7 socket.

Turn your chassis over again so that you are looking down on the top with the No. 1 socket still furthest from you, and mount the No. 411 power transformer in the further left hand corner, the 9 terminals facing No. 1 socket, putting a lug under the nut of the screw nearest you on the bottom left hand corner of the transformer.

Take two rubber grommets from your assembly package and insert in the half inch holes in the chassis near the terminal lugs of the 411 and 431 units (diagram No. 1). Mount a No. 431 double choke coil in the right hand corner of the chassis with the terminals pointing in towards the No. 1 socket and put a lug under the mounting nut of the bottom left hand screw, which is the one nearest socket No. 5. Then place mounting ring on your Aerovox 3-section ES-888 electrolytic condenser and screw to the chassis between the No. 431 double choke coil and No. 1 socket.

Turn your chassis over again so that it is now bottom side up with No. 1 socket furthest from you and mount an Electrad 4,000-ohm wire grid resistor onto the top right hand mounting nut of the No. 431 double choke coil, this mounting nut being between the non-insulated jack and type 261 XX condenser. Now mount two type 1070 .02 Aerovox condensers on the two mounting nuts of the No. 411 power transformer which are nearest the No. 1 socket, so that the other ends of the 1070 condensers will rest on the filament terminals of the No. 1 socket. Also, put a lug under the mounting nut of the 1070 condenser furthest from you. All this is shown clearly in diagram No. 2.

Again turn your chassis over so that you are looking down on the top of it with the No. 1 socket furthest from you. Mount one Hammarlund No. MLW150 .00015 condenser to the left side of the drum so that the longest parts of the plates are towards you, and insert two 1-inch No. 10/32 screws from the under part of the chassis, placing the two 7/16-inch long fibre spacers found in No. 1000 assembly package between the condenser and chassis frame to hold it rigid, threading the screws into the threaded holes in the bottom of the condenser.

Next, take a No. MLW150 .00015 Hammarlund condenser and remove the brass shaft by releasing the two set screws on the rotor and insert in its place the bakelite rod found in your assembly package. Then mount this condenser into the right side of the drum and support the condenser to the chassis with the two other 7/16-inch spacers, being sure to use the two fibre shoulder washers between the heads of the screws and the chassis for this purpose. This condenser must be mounted with the bakelite rod and

Fig. 2—Showing bottom view of the Baird Universal Television and Short Wave Receiver chassis, assembled and wired.
fibre washers exactly as described, as it has to be insulated from all metal, otherwise it will be short circuited. Connect the loose end of the .02-mf. 1450 Aerovox condenser mounted on the chassis to the Hammarlund condenser with a machine screw.

This completes the mounting of all parts on the chassis before soldering. Now take the 8 x 21 inch metal panel and mount a No. 609 toggle switch on the extreme left. In the next hole to the right mount a J-13 midget condenser. On the extreme right mount an Electrad Royalty 50,000-ohm potentiometer and in the next hole to the left mount a J-23 midget condenser. Attach the drum escutcheon plate over the window in the panel and connect the metal panel to the chassis with screws provided in the assembly package.

Wiring Instructions for Baird Short-wave and Television Receiver

NOTE.—Remember that in running wires always follow the shortest possible lead from one point to another. The diagrams have been drawn so that it will be easy for you to follow in wiring but do not necessarily indicate the length of wire.

The first wiring to be done should be the heater and filament wires. Twist together several feet of connecting wire. The two terminals marked F on sockets Nos. 2, 3, 4, 5 are connected in parallel with the twisted wire. On socket No. 3 solder one pair of twisted leads to the same pair of terminals. Run this pair through the hole with the rubber grommet near No. 3 socket up to terminals 1 and 2 on the 411 transformer, across which a 20-ohm center-tap resistor is also soldered. Now take another pair of twisted wires and solder to terminals 3 and 4 on the 411 transformer; bring through grommet hole and run over to the two F terminals on socket No. 6.

Solder a pair of twisted wires to terminals 5 and 6 on the No. 411 transformer; run these wires through the grommet hole and solder one lead to each binding post (wires No. 5 and 6 on diagram No. 2). Solder a pair of twisted wires to terminals 7 and 9 on 411 transformer; bring through rubber grommet near No. 1 socket and at the same time solder a .5 meg metalized resistor from this G post to the ground lug under mounting screw on No. 5 socket.

Next, connect the right-hand terminal of the middle type 260 condenser to the P terminal on No. 4 socket. A 50,000-ohm metalized resistor is laid across this 260 condenser as shown in the diagram and one end of it is soldered to the same terminal on the condenser. The other terminal of this condenser goes to the G post on No. 5 socket and at the same time solder a 25 meg metalized resistor from this G terminal to the lug under the mounting screw of No. 6 socket. Connect the right-hand terminal lug of the third type 260 condenser to the terminal lug marked F on No. 5 socket and at the same time solder a 50,000-ohm metalized resistor on the same terminal lug of the condenser. Connect the other side of the 260 condenser to the two terminals. Across the F terminals on socket No. 6 solder a 20-ohm center-tap resistor.

We will now proceed to wire the three type 260 condensers on the bakelite strip. First, solder the two lugs that are touching between the first No. 260 condenser and No. 100 choke. The other terminal on the condenser goes to the G post on No. 4 socket. At the same time solder a .5 meg metalized resistor from this G post to the ground lug under mounting screw on No. 5 socket.

Next, connect the right-hand terminal of the middle type 260 condenser to the P terminal on No. 4 socket. A 50,000-ohm metalized resistor is laid across this 260 condenser as shown in the diagram and one end of it is soldered to the same terminal on the condenser. The other terminal of this condenser goes to the G post on No. 5 socket and at the same time solder a 25 meg metalized resistor from this G terminal to the lug under the mounting screw of No. 6 socket. Connect the right-hand terminal lug of the third type 260 condenser to the terminal lug marked F on No. 5 socket and at the same time solder a 50,000-ohm metalized resistor on the same terminal lug of the condenser. Connect the other side of the 260 condenser to the two terminals. Across the F terminals on socket No. 6 solder a 20-ohm center-tap resistor.

We will now proceed to wire the three type 260 condensers on the bakelite strip. First, solder the two lugs that are touching between the first No. 260 condenser and No. 100 choke. The other terminal on the condenser goes to the G post on No. 4 socket. At the same time solder a .5 meg metalized resistor from this G post to the ground lug under mounting screw on No. 5 socket.

Next, connect the right-hand terminal of the middle type 260 condenser to the P terminal on No. 4 socket. A 50,000-ohm metalized resistor is laid across this 260 condenser as shown in the diagram and one end of it is soldered to the same terminal on the condenser. The other terminal of this condenser goes to the G post on No. 5 socket and at the same time solder a 25 meg metalized resistor from this G terminal to the lug under the mounting screw of No. 6 socket. Connect the right-hand terminal lug of the third type 260 condenser to the terminal lug marked F on No. 5 socket and at the same time solder a 50,000-ohm metalized resistor on the same terminal lug of the condenser. Connect the other side of the 260 condenser to the two terminals. Across the F terminals on socket No. 6 solder a 20-ohm center-tap resistor.

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the lug of the right hand midget jack with which the tip of the phone plug makes contact. Now connect the second or middle lug on the same jack to G on socket No. 3 and at the same time connect a .25 metalized resistor to the same terminal on the socket and the other end of the metalized resistor to the left hand mounting nut of socket No. 5.

To the same mounting nut of socket No. 5 solder one end of a 1,500-ohm, 2-watt metalized resistor and the other end of this resistor to the center tap of the filament resistor on socket No. 6. From this same point run a wire to one of the terminal lugs of the type 261 2-mf. condenser. Solder the other terminal lug on this condenser to the lug under the mounting nut right beside it. Connect P on socket No. 6 to the lug on the left hand midget jack, with which the tip of the phone plug makes contact, and continue through the grommet hole to terminal No. 3 on the No. 431 choke coil (No. 22 wire on both diagrams). Connect a wire from the frame lug on the left hand midget jack through the grommet hole to post No. 2 on the No. 431 choke coil (No. 23 wire on both diagrams). Continue this wire back through the same grommet hole and run it over to the end terminal nearest socket No. 1 on the Aerovox voltage divider (No. 24 wire on both diagrams).

Connect the remaining lug on the left hand jack to the insulated binding post in the top left hand corner.

Wires Through Holes

In all cases where a wire goes through a hole in the chassis, the socket number appears on such wire on both diagrams Nos. 1 and 2, and the wire can easily be traced. Where the text refers to a numbered hole, it means the hole with a wire of that number going through.

Connect the plain binding post near socket No. 1 to P on socket No. 1, and continue wire from there through the same grommet hole to terminal No. 1 on the No. 431 choke coil (No. 25 wire on both diagrams), and continue this up to one of the terminal posts on the Aerovox electrolytic condenser. Connect terminal No. 2 on the No. 431 choke coil which already has two wires coming from it to another terminal on the electrolytic condenser. This leaves the terminal open on the electrolytic condenser No. 21, which should have a wire run down through the grommet hole (wire No. 21 on both diagrams), and goes back between sockets 4 and 5 under the bakelite strip and hooks onto the open side of the 50,000-ohm metalized resistor which is laid across and connected to the last Aerovox 260 .25-mf. condenser. Continue this same wire to the 50,000-ohm metalized resistor to the middle terminal 260 condenser. Continue the wire back under the bakelite strip to the second terminal of the voltage divider.

If you are using the Dongan double choke, No. 7512, you will find three leads, two black and one yellow, that correspond to terminals 1, 2 and 3 on the No. 431 double choke. The two black leads are the same as terminals 1 and 3 on the No. 431 choke, and are interchangeable; the yellow lead corresponds to terminal 2 on the No. 431 choke. Connect one end of a 10,000-ohm metalized resistor to the terminal lug marked P on the No. 3 socket. Also to the same terminal connect a piece of wire and continue to the open end of No. 100 choke and from there to P on socket No. 8. Solder a wire to one of the outside leads of type 261 XX condenser near socket No. 1 and run to terminal No. 3 on the voltage divider. Continue to the other end of the 100,000-ohm metalized resistor which you have just connected to socket No. 3 and then continue along to the left hand terminal marked F on socket No. 8. From there continue the same wire, No. 18, through hole to the junction where the .02 condenser is connected to the frame of the .00015-mf. variable condenser.

Connect from G post of No. 8 socket through to the mounted side of the .00015-mf. Aerovox condenser and continue on the P terminal on socket No. 2. Now, cut into this wire at hole No. 14 shown in diagram No. 2 and solder a piece of wire to it, running this wire through hole to the stator post of the variable condenser. Connect a 5 megohm resistor to the left hand mounting nut of No. 2 socket and the other end of this resistor to the other side of the .00015-mf. fixed condenser and then run a wire from this same end of the condenser down through hole No. 11. Fit a remaining grid tube into socket No. 3 and measure your wire so that it reaches just to the top of the tube and then solder a screen grid cap onto the end of this wire. Be sure that this wire is not any longer than you actually need for it to slip over the top of the tube. Connect the open end of the .02-mf. condenser connected to socket No. 3 to the G terminal on socket No. 2 and continue right back through the hole up to the center terminal of the 50,000 ohm potentiometer on the front panel (wire No. 16 on both diagrams).

Now connect a wire (marked No. 17 on both diagrams No. 1 and 2) to the potentiometer; bring through hole and run to the fourth terminal of the voltage divider. Solder a wire to the fifth terminal on the voltage divider and continue to G terminal on No. 3 socket. This wire continues to the remaining outside terminal on Aerovox No. 261 XX condenser located near socket No. 1. The small Pyrohm resistor No. 992 should be soldered to the .02-mf. condenser which is connected to the left hand mounting nut of socket No. 7, and a .02 condenser is soldered to the junction of the Pyrohm and the condenser over to the post marked C on socket No. 2.

Solder a wire to the center terminal.
of the center-tap resistor between posts 1 and 2 on the No. 411 transformer and continue to post No. 8 on the same transformer and from there continue through the grommet hole to the lug under the 1070 condenser, (wire No. 8 on diagram No. 2). Put a 4,000 ohm wire grid resistor under the mounting nut of the 431 choke near the right hand jack and the other end of this resistor solder to terminal marked C on socket No. 4. From this same terminal run a wire across to the outside terminal of the older 261XX2-mf. condenser near the .00015-mf. grid condenser. Connect the other outside terminal of this same condenser to the terminal marked C on socket No. 5 running this wire under the bakelite strip and from this same terminal connect a 4,000-ohm wire grid resistor to the left hand mounting nut of socket No. 8. Connect the antenna binding post nearest socket No. 7 to terminal marked P on socket No. 7. Solder lug under right hand mounting nut of the same socket to right hand terminal marked F (F + on diagram No. 2). Connect a .00005-mf. fixed condenser across the two antenna binding posts.

Now to connect the two terminals on the type 260 25-mf. condenser between sockets 3 and 4. The left hand terminal is connected to the lug under the mounting nut of the grid leak holder. The other terminal is connected to the terminal lug marked C on socket No. 3 and also through the hole No. 12 on diagram No. 2 to the terminal on the grid leak holder near socket No. 3. Connect a wire to terminal marked G on socket No. 7; follow through hole No. 13 on diagrams No. 1 and 2 and connect on terminal lug of the stator plates of the .0015-mf. variable condenser and then onto stator of the J-13 midget condenser. Connect the rotor lug, or the one underneath the plates of the J-13 condenser, to the rotor side of the .0015-mf. condenser and continue through hole No. 10 on diagrams No. 1 and 2 to the remaining F terminal on socket No. 7. Connect the last terminal of the voltage divider to the lug on the mounting nut marked to it. Solder lug under mounting screw of socket No. 4 to grid leak holder diagram No. 1. Attach wire to left hand side of J-13 midget condenser, with a lug, and solder screen grid cap on the other end of the wire, leaving it just the right length so that it will slip over the cap of the 224 tube in socket No. 2. Connect the remaining terminal on the 60,000 ohm potentiometer to the rotor lug on the J-23 condenser.

Run a wire from the stator of the J-23 midget condenser through hole No. 15 on the Diagrams No. 1 and 2 and connect to remaining F (B+ on diagram No. 2) terminal on socket No. 8. Take the cord leading into the 411 power transformer and cut one of the wires about four inches away from the transformer. Now solder an additional piece to each of these ends; run them along the base and up to the AC switch on the panel as shown in diagram No. 1. These two added wires should be twisted together, although they are shown untwisted in the diagram.

Either a dynamic or magnetic speaker may be used with this receiver. If an AC dynamic type is used it must have its own power supply. A No. 66A Utah or No. 410 Magnavox is recommended.

Aerial

If you already have a good aerial for your broadcast receiver it may not be necessary to erect another for your Shortwave Receiver as you may be able to get two different programs off the same aerial at the same time. However, this will not always be the case and in order that you may decide whether or not you can use the same aerial it will be necessary to try out the Shortwave set on all the coils; first with your regular radio receiver still connected and then disconnected with a piece of cloth dipped in alcohol.

Be very, very careful to follow the diagrams when wiring; leaving nothing to chance. The wires that go through holes in the chassis are all carefully numbered so as to give you a better idea of where they go. Wherever there is any doubt, we have repeated that same number on both diagrams to show the junctions.

The Television News Kit consists of the following parts:
1. Type 120 Balloon Variable Speed Vertical Motor 1/25 H.P.
2. Type A1469 Special Oil Impregnated Aerosan 4 mf Condenser
3. Type GR149 Centralia Giant Power Rheostat, with knob
4. Type 121 Magnet Mounting with two washers, one lock ring and bar
5. Type 122 Synchronizing 48 Tooth Wheel
6. Type 123 Television Spindel, without belt
7. Type 124 48-hole Television Belt
8. Plate Neon Lamp
9. Type 216 Socket
10. AC Switch
11. Type JSC 3" Square Magnifying Lens
12. Fixture Cord and Plug
13. Television Cabinet

Remember that in running these wires always follow the shortest possible lead from one point to another. The diagrams have been so drawn to see if it is taking away any volume from the Shortwave Receiver. If there is any appreciable increase in volume when you disconnect your broadcast receiver, it will be necessary to use a separate aerial for best results.

Diagram A—Showing synchronizing amplifier for television unit, assembled and wired.

Diagrams to show the junctions. Wherever there is any doubt, we have carefully numbered so as to give you a better idea of where they go.

Instructions for the Assembly of the Baird Universal Television Kit

The assembly of the Television Kit will now be gone into in detail, and it is surprising how simple the assembly of this kit is. There are very few parts in the construction of the kit, but it must be borne in mind that they must be put together with extreme care, as in the assembly it will be found that the synchronizing tooth wheel (Fig. 8), when assembled onto the magnet mounting (Fig. 6), the distance between the outside edge of the gear tooth and the outside edge of the magnets is only five thousandths of an inch. Although these parts have been made with precise care, you should, nevertheless, be very careful.
in making the assembly, taking pains to see that each item is placed exactly as the instructions are outlined, taking your time doing this.

To assemble the Television Kit remove 7” bar from the No. 121 magnet mounting and lay to one side; take the No. 121 magnet mounting, with the magnets turned up as shown in Fig. 6, and slip over the shaft of the motor so that this holder fits onto the projection on the top of the motor frame with the magnets on the right (see Fig. 5). Now, place the spring washer, which is the thin bent washer, on top of the magnet mounting; over this washer place the ordinary steel washer and then force the lock ring into the groove which can be seen on the motor just above where the washer fits, by putting one open end into the groove and forcing the ring over the edge and into the groove. When this lock ring is placed in position, the magnet holder will revolve but will not move up or down. In fitting this magnet holder onto the motor be very careful that you do not damage the magnets or force the magnet mounting in any way. Now, carefully slip the synchronizing tooth wheel No. 122 over the shaft as far as it will go without forcing. This Synchronizing Tooth Wheel will now be lined up so that the top and bottom edges of the teeth are in direct line with the laminations on the magnet. Attached to the Synchronizing Tooth Wheel by two springs is a brass collar. This brass collar should be fastened to the shaft by the set screw, leaving about the thickness of a sheet of newspaper between the collar and the Synchronizing Tooth Wheel, so that this wheel will move freely on the shaft. Slip the spider onto the shaft but do not tighten, and place the assembly in the cabinet so that the whole assembly will be centered inside the cabinet; then remove the spider and screw the motor securely to the bottom of the cabinet; using the six rubber bushings (found in Assembly Package No. 1000). Place one bushing under and one over each foot of the motor; place an iron washer over each top bushing, and then fasten motor to cabinet with screws, making sure that no part of the screws touch the iron of the motor foot. (This can be done by putting a bit of rubber tubing around each screw.)

Mount a GR150 Centralab Giant Power Rheostat in the bottom right hand corner of the front of the cabinet and a 110-v. A.C. switch in the bottom left hand corner. You should mount a small piece of asbestos between the GR150 Rheostat and the front panel. Take the type No. A1409 Aerovox condenser and place in the further left hand corner of the cabinet near the leads coming out of the motor. There are three leads to this motor and they are colored red, black and green. Splice and solder the red one to either one of the leads of the Aerovox condenser and tape with rubber tape.

Connect the black wire to the other lead of the condenser and at the same time splice and solder to this joint a lead which goes to one terminal of the A.C. switch. Connect the other terminal on the switch to one terminal on the 150-ohm Giant Rheostat. Now take your favorite, carefully slip the synchronizing tooth wheel with the magnets.

In all places where splicing is done, be sure to use rubber tape and not friction tape, so as to come within the Underwriters’ Rules on wiring.

Mount a type No. 216 socket inside the lid of the television cabinet in the place marked for it so that when the neon lamp is placed in this socket and the lid closed the neon lamp will be hanging down into the cabinet. Have the filament terminals on socket pointing towards the front of the cabinet.

**Synchronizing Amplifier**

Before we proceed any further with the Television Kit it will be necessary to assemble the Synchronizing Amplifier, Diagram A. The parts necessary for the construction of this amplifier are as follows:

- 1 Type 992 Aerovox Pyrohm, 4,000 ohms
- 1 Type 200 Baird Television Filter Coil
- 1 Type 1000 - ohm Pyrohm nearest you.
- 1 Type 206s Aerovox condenser
- 1 Type 200s Aerovox condenser
- 1 Type 992 Aerovox Pyrohm, 4,000 ohms

This synchronizing amplifier consists of one stage of power audio frequency amplification, which takes the 720 cycle note out of the neon circuit and amplifies it enough to operate the small synchronous motor on top of the larger motor. This synchronous motor is composed of course, of the magnet holder and synchronizing tooth wheel with the magnets.

The above parts should be mounted on a small baseboard about 4” by 10”, a layout of which can be very clearly seen in diagram A. The wiring should be done as follows:

We assume that you have mounted your parts exactly as shown in the diagram, with the socket in the top right hand corner. First connect a piece of wire from G terminal on the socket to the grid lead on the transformer.

Connect one side of the 2005 Aerovox condenser to the other side of the secondary of the transformer, and to the same connection on the transformer, solder one end of a 50,000-ohm metalized resistor. Connect the other end of this resistor to the end of the 1000-ohm Pyrohm nearest you. Connect the right hand F terminal on the socket to the end of the 2-ohm Electrad resistor nearest the socket. Before screwing the other end of this Electrad 2-ohm resistor to the baseboard, loosen the tap and slide it in toward the center about four or five turns of wire, so as to reduce its actual resistance. Connect the other side of the 2005 Aerovox condenser to the left hand F terminal of the socket, and from there continue to the side of the 1000-ohm Pyrohm furthest from you.
Connect one end of the primary side of the transformer (it does not matter which) to the nearest terminal lug of the type 260 .25-mf. condenser; from there continue up to the nearest terminal lug of the No. 200 Baird Television filter coil, and from there continue to the first terminal lug of the second 260 .25-mf. condenser. Connect the other side of the primary of the transformer to the second terminal lug of the first 260 .25-mf. condenser; continue up to the other terminal lug of the No. 200 filter coil, and from there continue to the end nearest you of the 4,000-ohm Pyrohm. Connect the other side of the same, 4,000-ohm Pyrohm to the terminal lug of the No. 200 filter coil, and from there continue to the end nearest you of the 4,000-ohm Pyrohm. Connect the other side of the same, 4,000-ohm Pyrohm to the terminal lug nearest to it on the second 260 .25-mf. condenser. Solder a piece of wire about 12" long to the P terminal on the socket. Solder a 3-foot length of wire to the other terminal lug of this same magnet mounting; run this wire through the hole in the back of the television cabinet, and attach it to the single plain binding post just in back of the No. 1 socket on the Shortwave Receiver. Solder one end of a piece of wire (about 5 feet long) onto the F- or left hand F terminal lug of the socket in the lid of the television cabinet. Tack this lead inside the lid and down the back of the cabinet so that it will not hit anything. Do not bend or cut any adjustment after it has been set.

In giving you the lengths of the wires which run from your television cabinet to your Shortwave Receiver we have approximated the distance at which you might want to keep the receiver from the kit. There is, of course, no harm in putting both units as close to one another as possible. If this is done, the leads coming from the television cabinet can naturally be made correspondingly shorter.

Now, take this amplifier and place it in the further right hand corner of the television cabinet and screw it securely to the base of the cabinet, with the socket toward the front of the cabinet.

The two plain binding posts in the further right hand corner of your Shortwave Receiver, are the connections for the neon lamp. The one further from you is insulated, and the one nearer to you is grounded to the metal chassis. Take the 3-foot lead "A" on your amplifier, put it through the hole in the back of the television cabinet, and connect it to the grounded plain binding post we have just mentioned. Take the 3-foot twisted leads and continue up your amplifier through the hole in the back of the television cabinet and insert into the two plain binding posts on the back of the chassis near the 411 power transformer.

Connect the other end of the 12" length of wire, which has already been soldered to the P terminal on the socket, to either one of the terminal lugs on the No. 121 magnet mounting. Solder a 3-foot length of wire to the other terminal lug of this same magnet mounting, run this wire through the back of the television cabinet, and attach it to the single plain binding post just in back of the No. 1 socket on the Shortwave Receiver. Solder one end of a piece of wire (about 5 feet long) onto the F- or left hand F terminal lug of the socket in the lid of the television cabinet. Tack this lead inside the lid and down the back of the cabinet so that it will not hit anything. Do not bend or cut any adjustment after it has been set.

In the Baird Universal Television Kit, the different speeds are taken care of by the rheostat which controls the speed of the motor. The 45-hole belt furnished with this kit is the one most commonly used by various stations. A 45 line picture is now being transmitted in Chicago, and one or two stations are transmitting a 60 line picture. These two latter belts and synchronizing tooth wheels are accessories to the Baird Television Kit.

Operating Instructions for Combination Radio and Television Receiver

The operation of the Baird Television and Shortwave Receiver will depend on whether you use it for shortwave, television or broadcast reception. In using green, brown and blue Octocoils, which cover the wave bands from 16 to 100 meters, the grid leak holder on the chassis should have a 201A fixed rheostat inserted in it, as we do not want a power detector for these wave bands. On these wave bands all stations will be tuned in, using regeneration which is controlled by the J-23 midget condenser. The 50,000 ohm Electrad volume control will probably not be varied and should be turned full on to the right on these bands, unless you tune in a particularly strong signal which the regeneration control will not cut down. The J-15 midget condenser is just a trimming condenser and will not require any adjustment after it has been set for each pair of coils.

The jack in the further right hand corner of your chassis is the loud speaker jack and the other is the phone jack. The two binding posts on the right hand side of the chassis near those jacks are, as we have said before, the connections for the neon lamp and which have already been hooked into the television kit when you followed previous instructions.

The red coil covers from 100 to 200 meters. If you want to tune in this band when you are using the television kit you may still leave the 201A fixed rheostat in the grid-leak holder and use the regular red Octocoils in sockets No. 7 and 8.

To tune the broadcast band, remove the fixed rheostat still using the television kit you may still leave the 201A fixed rheostat in the grid-leak holder and use the regular red Octocoils in sockets No. 7 and 8.

To tune in a picture you (Continued on page 147)
New Television Process
of
THE TELEHOR CO.
By DR. FRITZ NOACK
(Berlin-Germany)

Mirrors instead of scanning holes in the revolving disc, form the basis of this newest German system of television. Mirrors, as Dr. Noack points out, possess certain advantages which are herein described.

The Telehoro Company of Germany has quietly worked out a new television process, which is extremely simple. It is interesting to learn in what way the inventors developed this process, and the principle involved will also become clear.

The projection on a screen of television pictures has, as you will at once concede, an extraordinarily great deal in its favor; because it is only projection that a number of persons can look at the pictures. In all processes employing the Nipkow scanning disc, there is invariably the disadvantage that the observer must sit in front of the televizor, in the direction of the optical axis.

The Mirror Wheel

For projection purposes there probably come first for consideration all those processes that use a mirror.

The Telefunken system, which uses the Weiller mirror-wheel, has extraordinary advantages. This process has been described before and those familiar with it will remember that a mirror is necessary for each pictorial line; and that the width of the mirror is determined by the height of the picture projected. It is patent that, if one wants to use a large number of lines, the diameter of the mirror-wheel must assume unusually large dimensions. For the purposes of home television there is therefore a limit to the size of mirror wheels.

In the case of the Weiller mirror-wheel, the little mirrors are fastened on the periphery of a large wheel. Suppose we set up the individual mirrors on a roller, which needs to have only a small diameter; here the length of the axis is dependent on the number of mirrors. In Fig. 1 such a model is represented in diagram.

Now it is not easy to fasten individual mirrors (as in Fig. 1) on a mandrel and at the same time be able to adjust them correctly and accurately. Therefore the inventors of the new Telehoro system conceived the idea of setting several circular glass discs side by side on a shaft (Fig. 2), polishing off a part of the periphery parallel to the axis, and silverying it (as a mirror) and then turning the individual discs a little with relation to one another (Fig. 3).

The Improved Mirror System

The intention was to make a dot-shaped source of light radiate on these individual mirrors, as in the Telefunken process. It became apparent, however, that the arrangement can be used much better in the following manner:

Suppose we arrange the axis of the set of revolving mirrors a little distance from the set of revolving mirrors a filament-type
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Fig. 5—Diagram of the entire television apparatus. a. multi-pack thread glow lamp; d. position of the observer; e. connections of the glow lamp to the receiving set; f. synchronizer with electro-magnets: g. operating motor; c. plane in which the image appears in the mirrors.

Why “Looker-in”? Think Real Hard—Coin a New Word. It may be worth $50.00 to you.

See Page 92

glow-lamp, (Fig. 4), which produces a vertical line of light. Now if one looks at this line in the rotating set of mirrors, there will be observed in the set of mirrors (with sufficiently rapid rotation), a surface of light, exactly as with a luminous-plate glow-lamp. In fact, each individual mirror describes a line of light before our eyes. The little mirrors are so coordinated, and the distance of the revolving set of mirrors from the filament of the glow-lamp is so chosen, that, just as one mirror has produced a line of light, the second mirror at once begins to function. Thus the lines of light are described horizontally and are placed parallel to one another, exactly like the lines of light observed with a Nipkow disc. Of course each mirror forms only a small part of the thread. Assuming that we use 30 mirrors and each mirror has a width of 2 mm. (.08 inch), then the whole set of mirrors would be 60 mm. (2.34 inches) broad; and that is exactly the necessary length of the line of light given by the glow lamp. Then each individual mirror reproduces a part of the filament, and therefore each of the individual mirrors forms a line of light, the second mirror at once begins to function. This gives a 40-fold increase of light over the Nipkow disc process. Yet the new Telehor process has a great advantage over the mirror-wheel, at least so far as home operation is concerned; because with the Weiller mirror-wheel only, a projection is possible, while direct observation is excluded.

For home apparatus in sets with the mirror-wheel, there is the question of projection on a rather small ground-glass screen; because otherwise the output of a radio receiver is insufficient. The projection on a ground-glass screen has, however, certain disadvantages, which are due to the coarse granulation of the ground glass and its strong absorption. With the new Telehor television system one can observe the image directly in the mirrors, and thus these disadvantages vanish. If we take into account the loss of light on the ground-glass screen, then with equal power one will get about the same image brilliancy in the case of the new Telehor apparatus as in that utilizing the Weiller mirror-wheel.

Simplicity of Construction

But, at the same time, the new system devised by the Telehor experts has the great advantage of being extremely simple in construction. The construction and adjusting of the set of mirrors are far simpler than those for the Weiller wheel; and then, too, the slight weight of the set of mirrors is above all of prime importance. By skillful construction it can be so devised that operation is at all times easily possible by means of an ordinary synchronizer (Fig. 5).

The importance of the new invention becomes especially evident, if one foresees the need for more than 30 pictorial lines. One can change to as many pictorial lines as may be desired, without getting abnormally large sets of mirrors; because we can make the individual mirrors suitably thin whereas, with the Weiller mirror-wheel, a reduction in size is not desirable possible.

The height of the attainable picture depends only on the thickness of the individual mirrors and therefore on the total height of the whole pack of mirrors. Filament-type glow-lamps can be obtained today up to almost any desired length. There is the added point, that filament glow-lamps are becoming extremely cheap to manufacture.

In spite of the direct observation of the pictures, it is not necessary to have all the observers look at the picture from the same direction and thus disturb one another. Rather, the pictorial angle amounts to about 50 degrees; at this angle, several persons can sit at the apparatus and look at the picture. Therefore one has the same advantage as with projection of a picture on a screen or other surface, where the angle of observation is also about 50 degrees.

The future construction of the Telehor television apparatus will probably be as follows: In the ordinary television set, only the mirror assembly and synchronizer, the amplifier, and the source of the synchronizing frequency are included, while the glow-lamp and television are set up at a certain distance. In fact, the glow-lamp must be placed at a certain distance from the mirrors, to observe the latter from a proper distance. This separation of the glow-lamp and actual television is, however, no more inconvenient than, for example, the construction of a normal picture-projection set; in which the projector must, of course, always be set up at a certain distance from the screen.

The new process of the Telehor Company undoubtedly represents a great step forward, even if it is perhaps not the ideal solution. To me the ideal solution seems to be a television which with sharp tuning works well on a narrow frequency band.
A DISTORTION-LESS AMPLIFIER for Television

By JOHN WADE*

TELEVISION is today emerging from an extended period of hibernation, resulting from its wintry reception during the past two years. Boomed abortively in the days when its possibilities were circumscribed by the laboratory walls, it quickly subsided to an innocuous desuetude, awaiting the further development and refinement that would definitely establish it as a complement to our sound radio installations—as an entertainment, not a novelty.

The present-day optimism of the National Broadcasting Company and engineers in general seems justified; and the status of the art today would indicate that the required progress is rapidly rounding the last lap of realization. The experimenter who shelved his neon tubes and scanning discs three years ago will find the old system of audio-picture reproduction modified by this progress; and it is the purpose of this article to describe one phase of television in the terms of tubes and principles with which we have become more familiar during the period of television’s reincubation.

The definite details of amplifier construction for a television receiver will necessarily vary with the system of reproduction—the method of integrating the image. However, the principles are consistent; and the amplifiers considered in this article may be superficially modified, in respect to input and output circuits, to meet the requirements of the television ensemble. In recognition of simplicity and general similarity, the amplifiers here diagrammed and discussed are shown outputting to an ionization (glow) tube in a conventional circuit.

Low-Frequency Response—Elimination of Hum and Stability Against Motor-Boating Are Primary Considerations in Modern High-Gain Resistance-Coupled Design.

We are pleased to present the accompanying article, prepared especially for the readers of Television News by an expert who has pioneered, in the design of resistance-coupled amplifiers.

—The Editor.

Fig. 1—A fundamental resistance-coupled amplifying circuit—the starting point for the design of a scientific television amplifier.

Fig. 2—The modified resistance-coupled amplifier employing battery tubes. The principles demonstrated in this diagram may, of course, be applied to any motor-boating amplifier.
TELEVISION NEWS

May-June, 1931

Television purposes. When the image has a vector of motion in the tangential direction of the scanning mechanism (that hole) it is because the distance between the points on the frame in the same direction as the scanning, some frequencies may be lower than the picture-frequency. It is generally conceded that a resistance-coupled amplifier is the only system providing the degree of linearity (fidelity) and low-frequency response essential to good television reproduction. The fundamental circuit, to which we shall refer, is illustrated in Fig. 1.

What Hum Does to Image

The existence of hum in a television output circuit will result in a "hum pattern"; a crazy-quilt design, interesting and pleasing in itself, but having no more place in a televised image, than fog has on a print.

The problem of stability is a fundamental one; for a television amplifier may be described as inherently prone to low-frequency oscillations; known as "motor-boating." This condition results from several causes: the amplifier being of the resistance-coupled type, the resistance-capacity values of the condenser-resistor circuits are often such as to favor a low-frequency periodic disturbance. Such a disturbance could not exist in the average transformer-coupled amplifier, because of its inability to amplify these frequencies effectively. In other words, the excellence of the resistance-coupled amplifier's frequency-characteristic contributes toward its tendency to motor-boating.

The reduction of hum and the stabilization of the amplifier may be considered jointly; because the existence of either or both disturbances postulates the rise and fall of a pulsating voltage in the common coupling circuit—the power supply. The characteristic of the circuit being what it is, the difference between hum and motor-boating frequencies may be neglected; and the design of a humless circuit may be considered as definitely mitigating against the possibility of any low-frequency oscillations.

Calculating the Hum

Assuming that an A.C. hum potential exists across the output of the eliminator, it is necessarily applied to the plate circuits of all amplifying tubes. If the direct effect of this hum potential were the only hum component existing in the output circuit (if all other tubes, for instance, had their plate voltage supplied by batteries), the hum would not be serious; and an ordinary filter would reduce it to a negligible degree. However, the hum current or voltage in any plate circuit in the direct effect and the amplified effect of the hum existing in the preceding circuit.

Referring to Fig. 1, let us represent the direct hum effects in tubes 1, 2, 3 and 4 by \( E_{1u} \), \( E_{2u} \), \( E_{3u} \) and \( E_{4u} \) respectively, and the entire hum voltage in each tube plate circuit by \( E_1 \), \( E_2 \), \( E_3 \) and \( E_4 \). Obviously \( E_{1u} = E_1 \).

If \( \mu \) equals the amplification in each stage (remembering that the phase shift in each stage of a resistance-coupled amplifier is 180 degrees), and all tubes are of the same type, having the identical values of load resistance all supplied from the same plate potentials, the following relationships exist:

\[
E_1 = E_{1u} + \mu E_2 \]
\[
E_2 = E_{2u} + \mu E_3 + \mu^2 E_4 \]
\[
E_3 = E_{3u} + \mu^2 E_4 + \mu^3 E_5 - \mu E_2 \]
\[
E_4 = E_{4u} - \mu E_3 + \mu^2 E_5 \]

If \( E_{4u} = \mu^3 E_5 = -\mu E_2 + \mu^2 E_5 \), \( E_1 = 0 \) and no hum will exist in the output circuit.

Solving the equation, \( E_{4u} = \mu^3 E_5 \)

\[
E_{4u} = \frac{\mu^3 E_5}{\mu^2 - \mu + 1} \]

Let \( E_2 = E_{1u} = E_{3u} = E_4 \)

then \( E_3 = \frac{\mu^3 E_5}{\mu^2 - \mu + 1} \)

Condition for "No Hum" in Output

In other words, when the hum voltage in the plate circuit of the first tube, or \( E_{4u} \), equals the fraction \( \frac{\mu^3 E_5}{\mu^2 - \mu + 1} \) of the hum potential in the last stage, no hum will exist in the output of the amplifier. The hum components have been balanced out. A relationship can be established for an amplifier employing different tubes and plate loads. However, it is arithmetically more involved.

It follows from equation (2) that, in Fig. 1, to the correct fraction of the hum potential in the plate circuit of the first tube, or \( E_{4u} \), equals the fraction \( \frac{\mu^3 E_5}{\mu^2 - \mu + 1} \) of the hum potential in the last stage, no hum will exist in the output of the amplifier.

(Continued on page 149)
Radiovision Equipment Prices Reduced

Radio television is going to make a start at getting public support during 1931, according to the statement of D. E. Replogle, Assistant to the President of the Jenkins Television Corporation. “Coincident with the unusual activity of the press with regard to television developments and possibilities, together with greatly increased production facilities at our new plant in Passaic, N. J., we find it possible to reduce the list prices on our home television equipment,” states Mr. Replogle. “Dealers can now afford to stock television equipment and to demonstrate radio television possibilities to their clientele, thereby expediting the public acceptance of this form of home entertainment.”

The Jenkins 1931 line will definitely appeal to two classes of buyers: first, kits will readily interest home-set builders and tinkerers who wish to handle the radio industry in its early years; secondly, completely manufactured units are priced right for the radio owner who desires television in an immediately usable and living room form.

“We anticipate an immediate reaction on our price reductions. It is our belief that radio television is here. The engineering work has been done to the point where the commercial stage is at hand. The job from now on is one of merchandising as well as engineering,” concludes Mr. Replogle.

A Senator Watches Television Perform

Dr. E. F. W. Alexander, one of the inventors in “The House of Magic” at Schechtday, recently invited Senator C. Dill to foreshore the national capital for a some time to visit that realm in the Mohawk Valley where television images leap into space for transoceanic and transcontinental rallie.

The Western Senator, as a member of the Senate Interlace Committe, has been one of the leaders in drafting radio legislation. He is now convinced the perfection of the thyratron tube will due time to make television commercially practical because it will eliminate the whirling disk and enable the television images and scenes to travel on waves less than one meter in length. This would prevent all interference with sound broadcasts.

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A Non-Mechanical Scanner

By GEORGE WALD

SCANNING DISCS, driven by small motors, while necessary in present television work, are admittedly crude and unsatisfactory. The cathode tube, which has been used with some success in the laboratory, has some special and peculiar requirements. Lieut. Wald, a U. S. army officer, stationed at Selfridge Field, has just patented another method of scanning by electricity, without the use of moving parts which depends on the fact that voltage waves are continually moving up and down an A.C. transformer.

The principal features of the method are here described, with reference to the patent drawings.

No matter how perfect a motor-synchronized scanning disc may be made, in the writer's opinion it will never be a success in the home. The housewife desires an apparatus whereby she can turn on a switch and tune in a station; then "look and listen." Any other manipulation of devices is destined to failure.

The writer, after consideration of the problems, was led to invent a television apparatus for the transmission and reception of images without the use of any mechanical scanning device; and U. S. patent 1,754,491 has been issued for its basic ideas.

As shown in Fig. 1, the receiving tube, when seen end on, presents a screen of anode and cathode wires, crossing at right angles, and establishing the elemental points of the televised image to be reproduced. Each of these wires is connected to one tap of a secondard (12, 16, Fig. 2); and variable frequencies are applied to these secondary coils. As the currents in the secondaries set up a varying voltage at each tap, there is a maximum difference of potential at the intersection of only one pair of wires at any instant; and at this point the discharge between the anode and the cathode produces one bright point on the image screen.

As each variable-frequency train sweeps over the row of cathodes, the bright point on the screen moves and produces a line; and as each train of frequencies passes over the row of anodes, the entire frame of the image is traced. The time relations of the impulses are so synchronized that a systematic scanning of the image, by the bright, glowing point, is effected. The television impulses, which have been superimposed on the cathode current, modulate the brightness of the scanning point and thus reproduce the shades of light and darkness in the image.

The tube shown in Fig. 2 is of a modified type, such that the portions of the secondaries to which the taps are connected are placed inside the envelope. It has six prongs, the connections of four being shown. There are two more, connected to the anode and cathode tuning condensers which are shown at 28 and 29 in Fig. 3. These condensers serve to adjust and center the image on the frame. A slight change in the tube will permit it to receive the image from any station, even though the latter does not use the variable-frequency system described below.

The Transmitting System

The transmitting apparatus invented by the writer works on a similar principle; it contains the light-sensitive elements, similarly arranged in two systems of lines crossing at right angles. The television impulses, as amplified, are superimposed on two varying-frequency currents, corresponding to the scanning. The image-frequency is separated from these and the television current is broadcast together with an actuating carrier wave.

For telephonovision, the voice is transmitted on the same wave as the image, by using a part of each image-line to record sounds. At the transmitter, the voice is converted into

Fig. 2 (above)
The circuit of a television receiver using the Wald tube.

Fig. 1
An end view of the tube, showing the cross wires which tap the secondaries.

Fig. 2 (right)
A cross-section of the new tube, showing the relative positions of its elements.

In Our Next Issue--

"How to Build a Drilling Jig for Television Discs."

TELEVISION NEWS
A Universal Television Receiver

By JOHN J. FETTIG

An excellent design of special television receiver, free from oscillation tendencies, and having a high gain R.F. section, a sturdy detector stage, and a carefully designed audio frequency amplifier having an output stage with two 45 tubes in parallel.

The apathy of the reception that, until now, television as a home entertainment factor has received, is largely attributable to the public's misconception of the possibility of obtaining any such entertainment. Yet, a comparison of the status of television, as it is today, with that of aural radio in the hectic year of 1921 is illuminating; in that it shows television offering a greater entertainment value to the user.

For example, in 1921 there were but a few broadcast stations regularly operating. At the present time there are twenty-seven stations that regularly transmit television impulses and, by the time this article goes to press, there will probably be a few more. The average transmission time in 1921 was five hours per day. Today, the average television transmission time is six hours per day. Whereas, with the crystal receiver of the vintage of 1921, only one or two persons were able to enjoy the program through the medium of headphones, television images may now be viewed by from two to six people. Besides this, television in its present state offers the ardent experimenter, once again, ample opportunity for the employment of his constructional and creative talents.

Since television impulses are transmitted on wavelengths between 100 and 175 meters, it becomes apparent that a special receiver is necessary for the reception of these signals. This article will be devoted to the description of a receiver designed primarily for the efficient reception of television signals, but which is also versatile enough to be used as a high-quality broadcast receiver or for the reception of short waves. It may be mentioned, in passing, that the short-wave bands offer the listener a thrill that has no counterpart in the broadcast spectrum. He can hear police being dispatched to the scene of a crime at the moment of its commission. Trans-Oceanic broadcasts are commonplace, and the chatter of radio amateurs fills the air.

High Television Frequencies

In the design of a television receiver there are several important considerations that are not encountered in broadcast receiver design. A high degree of selectivity is not desirable; since the channels used for picture frequencies are considerably wider than those necessary for aural reception. The reason for this becomes apparent when we calculate the frequency of light-intensity variations possible, during each second of transmission, from a station scanning sixty lines at twenty frames per second.

A picture of elongated aspect would be composed of 4320 elements. Multiplying this by the number of pictures framed per second, we have a total of 86,400 elements viewed in that time, or 43,200 complete changes per second! This means that the television channel required to pass the "A. F." component essential for good quality reproduction must be over eight times as wide as that used for sound broadcast purposes! The audio-frequency amplifier necessary for a flat response from 15 cycles to 43,200 cycles begins to partake of the nature of a radio-frequency amplifier; in other words the maximum frequency is equivalent to a wavelength of about 7,000 meters. These figures will serve to indicate some of the difficulties involved in the design of a good television receiver.

A successful television receiver must be absolutely free from any tendency to oscillate; otherwise the image will be marred by a ripple pattern. This fact, in addition to the necessity for a wide carrier-admittance channel, precludes the utilization of ordinary short-wave receivers or short-wave adapters; since, almost invariably, they employ regenerative
detectors. Consequently, in order to obtain sufficient sensitivity, we are compelled to use a high-gain radio-frequency amplifier.

Arrangement of the Tuner

The radio-frequency circuit consists of one untuned or coupling stage, making the outfit equally efficient on any antenna, and two tuned, transformer-coupled stages. Each section of the ganged tuning condenser has a capacity of .00014-mf. Radio-frequency transformers wound on plug-in coil forms are used; the forms are 11/2 inches in diameter and, for the television band, are wound with a primary consisting of 28 turns of No. 30 wire and a secondary having 29 turns of No. 26 wire. (These windings should not be separated more than 1/8-inch, or too great a degree of selectivity will be obtained.) The impedance of the primary is sufficient to permit the use of screen-grid tubes; one end goes to the 75-volt tap of the voltage divider, and the other to ground.

A '27 tube, employing grid rectification, is used as detector; this type has been found to retain its efficiency as a detector, even at extra high frequencies. A filter in the plate circuit prevents all radio frequencies from passing into the audio system.

With this form of detector, three stages of A.F. are required in order to properly phase the image; i.e., give us a positive image.

Screen Grid “A.F.” Amplification

Details of the audio amplifier circuit can be derived from the circuit diagram. The first two stages employ screen-grid tubes. It will be noted that all plate, screen-grid, and biasing circuits are by-passed. This precaution must be observed in order to secure a satisfactory picture. Filter resistors are inserted in all plate leads to prevent motorboating. The use of screen-grid tubes in the first two stages enables us to secure the gain necessary for good picture intensity.

The third stage consists of two '45's in parallel; the plate current of the output stage governs the amount of light in the neon glow-tube, and these two power tubes will cause approximately 68 milliamperes to flow through the glow-tube, thereby insuring a brilliant light.

The power supply is quite conventional, comprising an '80 rectifier tube, feeding into a two-section filter circuit, using capacitative input. A three-section dry electrolytic condenser is used in the filter.

If all the specified values are carefully observed, no difficulty should be encountered in the construction of the receiver. Compactness and simplicity of construction has been given considerable thought in its design; the over-all size is 18 1/2 x 11 x 7 inches.

If the chassis is obtained in the finished form, a screwdriver, a pair of pliers, and a soldering iron, will be the only tools necessary. One need not be an engineer in order to assemble the set; for any reasonably handy person can do this easily.

No output device has been incorporated in the receiver, because most dynamics have a built-in output transformer. A single-pole, double-throw switch enables one to switch from speaker to neon glow-tube.

Exhaustive tests, over a long period of time, have proven this set to be a consistent and efficient receiver for television impulses.
A SHORT COURSE in TELEVISION

The editors feel sure that the reader will greatly appreciate this short course in Television, which has been specially prepared by Mr. Nason, an electrical engineer who has been closely associated with the growth of American television. This second lesson discusses how to lay out scanning discs; punching holes; Sanabria triple spiral scanner.

By C. H. W. NASON

Lesson 2.

Laying-Out Scanning Discs

There are but three systems of scanning, existent in America today, which employ the simple scanning disc. They are the 48-line system of Jenkins and Radio Pictures; the 60-line image employed by R.C.A. and N.B.C.; and the 45-line multiple arrangement of Sanabria employed by Western Television. The scanning apparatus required by the first two is simply described by the picture specifications. For an example, we will take the 60- by 72-element image, as broadcast by the R.C.A., N.B.C. and forthcoming C.B.S. stations. These images are scanned at a rate of twenty pictures per second, corresponding to a shaft speed of 1200 R.P.M.

The reference to the picture dimensions, as 60 by 72 elements, shows that the picture is not square, but oblong, with an aspect ratio of 1.2. The physical dimensions are determined, in the case of simple equipment by the dimensions of the neon-tube's plate, which is on the average 1.55 inches square.

Round or Square Apertures?

It might be well to digress for a moment to discuss the relative merits of the round and square holes. There has been much said on this subject and the writer will not pause to review the arguments. A simple statement of the matter should make things quite clear.

With our present systems, the whole problem of the amateur lies in the small amount of available light. The light available to the eye at any instant is that passing through a single aperture. A physiological effect (too complex to describe here in detail) further reduces the apparent light, because of the rapidity with which the aperture is traversing the field of vision. Inasmuch as the percentage of the light available through the round aperture is 78.54 of that available through the square opening, there remains but little choice in the writer's opinion. On top of this the square aperture is much simpler to cut accurately than the round.

Calculation of Dimensions

We start our design with several factors known. The dimension "W" (width of the image) is determined by the size of the picture desired and the size of the neon-tube's plate. We know "N," the number of apertures, and we know that the circumference of the circle represents an arc of 360 degrees. Assuming a dimension "W" of 1.44 inches we may proceed as follows:

Given:

N = 60
C = 360 degrees

Then:

h = 60 elements; the height of the image
W = 72 elements, or 1.44 inches

The angle of displacement = 6 degrees = (360/60)
The aperture size = 1.44/72 = .02-inch square.

h = .02 x 60 = 1.20 inches
c = the circumference of the circle through the first aperture = 1.44 x 60 = 86.4 inches

r = the radius through the first aperture = 86.4 + .02 = 86.42 inches

r' = the radius through the inner aperture = 13.75 - 1.2 = 12.51 inches.

We can readily see that the diameter of our disc must be greater than 27.5 inches. Allowing a bit extra for a light-shield (to keep the light of the neon tube from direct vision) obtain a circular blank of aluminum 30 inches in diameter; about 20 gauge stock will suffice. With a sharp punch or scriber, mark the center carefully; and draw a line from this center mark to the edge with a sharp scriber. These lines should be as thin and light as possible. Using a protractor, draw further radii at intervals of six degrees until sixty in all have been drawn.

These sixty radii locate the relative positions of the apertures, in one sense. Selecting any one radius, lay off the distance 13.75 inches from the center and draw a partial circumference through this point with a pair of dividers. This portion of this circumference need only cut the next radius line. This concludes our work until the first and second apertures have been punched.

A Tool for Punching Apertures

If the reader is handy with tools, he may readily construct a punch for cutting the apertures. If he is unable to do this work himself any machinist
May-June, 1931

can do the work at a slight cost. An ordinary drift, nail set or center punch should be ground down to a flat surface, .02-inch square. For best results, the tool should be cut back slightly, and directly behind the cutting edge, as shown in Fig. 1. A block of some soft wood should be cut and carefully leveled on the end grain. The larger this block, the better it will serve as an anvil on which to perform the punching operation. Lay the disc on the block, and carefully align the punch so that its edges coincide with the sides of the angle "a" formed by the first radius line and the partial circumference drawn through it. (See Fig. 2.) Now hit the punch a sharp blow.

Punching into the end grain of the wood should allow the metal to cut cleanly without leaving a burr. If burrs are left, they may be removed by careful work with a small file. The diagram shows clearly the location of the tool for punching the second aperture, at b.

With the dividers carefully located in the center mark of the disc, draw another partial circumference, running from the inner edge of the second aperture to the third radius line. Locate the punch in the correct angle and punch the third aperture at c.

The remaining apertures are cut by following the same method of locating —namely, by drawing a partial circumference through the lower edge of the preceding aperture.

When the sixty apertures have been cut, we must decide whether to lay out a 48-line spiral on the same disc, or use a separate disc for that type of signal. Once the hub has been fitted to the disc it will be difficult to locate the center in order to lay out another spiral.

**TELEVISION NEWS**

The 48- by 60-Element Spiral

It is possible to take as our initial dimension either a given aperture size or one picture dimension. With a .020-inch aperture, a 48- by 60-element image would have a dimension "W" of 7.5 inches. The radius at the outer aperture would be 9.16 inches. The "h" side of the image would be 0.96-inch; the angle between successive radii would be 7.5 degrees (7 degrees, 30 minutes).

The image size is almost as great as the neon tube will stand; but it would be possible to obtain a larger image on a separate disc, or on the same disc were we to come closer to the outer apertures. In each scanning operation, the field is divided into 45 lines as shown in Fig. 3. The scanning sequence, instead of running from 1 to 45 by units, is as follows: 1-4-7-10-13-16-19-22-25-28-31-34-37-40-43.

The second operation includes the following lines: 2-5-8-11-14-17-20-23-26-29-32-35-38-41-44. The third and completing operation comprises lines: 3-6-9-12-15-18-21-24-27-30-33-36-39-42-45.

The manner in which the apertures are laid out is shown in Fig. 4.

The whole thing is really much simpler than it seems if we remember that the apertures scanning adjacent lines are 120 degrees apart. A little care enables one to lay out the disc with no more trouble than in the first instance. N is of course 45. Assuming a square image and an aperture of .034-inch we find that the "h" and "w" dimensions will be 1.53 inches. The angle of displacement is 8 degrees. The circumference through the outer aperture is 69.1 inches, and the radius at the outer aperture is 11 inches. Notice that the radii at the inner and outer apertures lie between the 48- and 60-line spirals already laid out and we may therefore—with proper care—construct a disc containing all three modes of scanning. Of course it will be necessary to provide for a shift of the neon tube to the required points and a method of changing the speed of rotation.

**The Sanabria System**

In a later lesson we will discuss the theory of this and other scanning systems; but today our main problem is getting "on the air." Those readers who reside in the middle west will be interested in the type of disc required in the reception of signals from WVOX, Chicago. This system scans the scene three times for each rotation of the disc; this scanning is not complete in each instance, the lines being separated by twice their width in each scanning operation. The field is divided into 45 lines as shown in Fig. 3. The scanning sequence, instead of running from 1 to 45 by units, is as follows: 1-4-7-10-13-16-19-22-25-28-31-34-37-40-43.

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**Laying Out the Sanabria Disc**

In order to avoid conflict with lines previously drawn, it would be well to reverse the blank if a combination disc is being made. If not, a 24-inch disc should be obtained and 45 radii, separated by 8 degrees, drawn. Mark off the 11-inch radius and draw a segment of a circumference with the dividers so as to cut the 16th radius (120 degrees). With an .034-inch punch, stamp out the first and the 16th aperture—one above and the other below the line—just as in the first disc punched. Draw another circumference through the lower edge of the 16th aperture to the 31st radius, and punch that aperture. Continue in this manner until all apertures are punched; make sure in each instance, that the arc you have drawn traverses 120 degrees, by checking with the protractor before punching.

If you intend to make a combination disc it might be well to cut the apertures for the Sanabria system first, to avoid any possibility of losing the previous labor by slipping up on the last step.
HINTS for the BEGINNER

Action of Scanning Discs; Framing the Image; Laying Out Holes

By H. W. SECOR

THOSE who have had little or no experience with television will probably find the following hints of value and interest. Referring to the first illustration (Fig. 1) we see how the subject before the television transmitter (such as that used in the Bell Telephone Laboratories' demonstrations) is posed for scanning by the "flying-spot" method. A synchronous motor drives the disc containing the spiral of scanning holes, behind which is a diaphragm, against which the light beam is focused. In some cases a lens is placed in front of the scanning disc; in any event, the small pencil of light scans across the face, one line after the other, until it has described the whole image. The continually-changing light beams reflected from the face or other object, fall on the photoelectric cells "P"; and the continually fluctuating current from these cells, (which are connected in parallel with a compensating or regulating resistance in series with each cell) are passed into a vacuum-tube amplifier of from eight to nine or more stages. In the present Bell Laboratories' television apparatus, the arc lamp at the transmitter has been replaced by an incandescent lamp of special design.

Amplifier Should Cover 20 to 40,000 Cycles

In the next diagram (Fig. 2) the "direct-vision" method of illuminating and scanning the subject's face at the transmitter is portrayed. Here a number of strong lights are focused on the face of the subject; and the reflected light rays pass through a lens, through the holes of the revolving disc, and fall on the photoelectric cells "P." The reflected light rays pass through the holes of the revolving disc, and fall on the photoelectric cells "P." The reflected light rays pass through the holes of the revolving disc, and fall on the photoelectric cells "P." The reflected light rays pass through the holes of the revolving disc, and fall on the photoelectric cells "P."
disc (4) then through a diaphragm (2—shown above in front view) and then onto a photoelectric cell (3). The photo-cell's currents are passed through a coupling tube and then into a V.T. amplifier of the resistance-coupled type, employing six to eight stages or more. For the best results the amplifier has to pass a very wide band of frequencies; from, say, twenty cycles up to 40,000 cycles per second. Fair results will be obtained with an amplifier not designed to pass such a wide band of frequencies as this; but the picture will, of course, be not so wide band of frequencies as this; but the amplifier has to pass a very wide band of frequencies; from, say, twenty cycles up to 40,000 cycles per second. Some experimenters have obtained a passable image with an ordinary audio-frequency amplifier, utilizing transformers; but a resistance-coupled amplifier is the only one to be considered if you are going to experiment with television in earnest. The output of the multi-stage amplifier is connected to the neon glow-tube, which is placed behind a second revolving scanning disc at the receiver.

At the right of Fig. 2, we may see how a subject may be illuminated at the television transmitter by invisible or "dark" light. Powerful incandescent lamps are employed behind a hard-rubber sheet in the upper diagram; while that at the lower right utilizes an arc lamp and a hard-rubber window, which passes the invisible infra-red rays. John L. Baird, the well-known British television expert, has demonstrated many times that a subject can sit in total darkness, illuminated by invisible infra-red rays in the manner just made clear, and be televised, by utilizing a special photo-electric cell designed to be particularly sensitive to the infra-red part of the spectrum.

Laying Out the Holes of the Scanning Disc

In the next diagram (Fig. 3) we see how a scanning disc (with only four holes shown for simplicity's sake) is laid out; the holes being arranged to overlap slightly. It will be clear from this diagram how the holes, 1, 2, 3, and 4 each scan along orbits of their own and that, after all four holes have passed by a given point, the whole picture or image will have been completely covered or scanned.

Referring to Fig. 4, we see how the scanning holes are arranged in relation to the size of the diaphragm opening, or image. Note that the 47th hole and the 48th hole have been repeated at the left of the diaphragm opening; merely to show how, as the 47th hole is just about to leave the picture opening, the 48th hole is just ready to enter the frame.

Several hints on laying out scanning discs are illustrated in Fig. 5; this diagram corresponds to the method followed in the earlier Bell Laboratory design of scanning discs, which contained 50 holes instead of the present 72. If you will note the size of the image as indicated by the dotted line, it becomes apparent that the diameter of one hole will be the height of the picture (P) divided by the number of holes; and that the radial angle (at the center) is ascertained by dividing 360 degrees by the number of holes. Also, it will be evident that the holes are caused to overlap slightly by making, for example, the distance between two successive layout lines (circles described by the centers of the holes) equal to the diameter of a hole, less .002-inch.

One method of mounting the metal (Continued on page 156)
HOW SHALL WE AMPLIFY THE TELEVISION SIGNAL?

By C. H. W. Nason

The author, one of the foremost television engineers in America, discusses the principles of design essential in the construction of a television amplifier, capable of amplifying all frequencies from 15 to 30,000 cycles.

The inherent stray capacities of transformer windings make it impossible to design a transformer-coupled amplifier capable of reaching both the low and the high frequencies. The same disadvantage is present in impedance-coupled circuits. Hence, we are limited to resistance coupling in one form or another; not because of the effects of stray capacities, but because of the variation in phase displacement apparent in transformer-coupled circuits, with variation of the signal frequency. The human ear is incapable of recognizing phase differences; but phase distortion of the television signal is quite apparent in the received image, and quite apart from discrimination against the higher frequencies. The transformer-coupled amplifier is therefore unsuited for television use.

In a resistance-capacity-coupled amplifier (shown schematically in Fig. 1) the basic gain per stage is a "function" of the "mu" (\( \mu \)) of the tube \( V_1 \) which, in turn, is a function of the plate resistance \( R_p \), and the load resistance \( R_3 \). This is, at a mid-range frequency where the reactance of \( C \) is negligible and with the effective load resistance taken as the paralleled grid- and plate-resistance values,

\[
E_3 = \frac{E_2 \times 100}{R_3 + R_p}
\]

This we may consider as a constant from which all deviations from the normal gain are to be measured; taking it as 100%, the percentage of reproduction attained at other frequencies is

\[
E_3 / E_2 \times 100
\]

Inspection of the equation shows that the gain is primarily dependent upon the magnitude of \( R_3 \); and that the condition

\[
E_2 / E_1 = \mu
\]

obtains when the factor

\[
R_3 + R_p
\]

approaches unity, through the plate resistance's becoming negligibly small in comparison with the load resistance.

It is possible that, at some low frequency, the reactance of \( C \) will become large in comparison with \( R_2 \); and an attendant rise in \( R_3 \) will increase the gain at the low-frequency end. This is usually overcome, through the fact that \( E_3 \) is taken across \( R_2 \) in series with the reactance.

In computing the response at the low frequencies we have

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Resistance Coupling Essential

The high-frequency response of any amplifier is dependent upon the admittances due to shunt or stray capacities remaining negligibly low in comparison with those of the other circuit elements. The inherent stray capacities of transformer windings make it impossible to design a transformer-coupled amplifier capable of reaching both the low and the high frequencies. The same disadvantage is present in impedance-coupled circuits. Hence, we are limited to resistance coupling in one form or another; not because of the effects of stray capacities, but because of the variation in phase displacement apparent in transformer-coupled circuits, with variation of the signal frequency. The human ear is incapable of recognizing phase differences; but phase distortion of the television signal is quite apparent in the received image, and quite apart from discrimination against the higher frequencies. The transformer-coupled amplifier is therefore unsuited for television use.

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The evaluation of the quantity is dependent upon the factor C R2 and, with a predetermined value of R2, the low-frequency response is dependent upon the value of C. Likewise, with a fixed value of C, raising the value of R2 will improve the amplification at the low end. C R is the "time constant"; numerically equivalent whether C and R are taken in farads and ohms, or in meg-ohms and microfarads. Its values for a reproduction factor of 95% at various low frequencies, are as follows:

<table>
<thead>
<tr>
<th>Frequency (cycles)</th>
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<tbody>
<tr>
<td>10</td>
<td>0.05</td>
</tr>
<tr>
<td>20</td>
<td>0.25</td>
</tr>
<tr>
<td>50</td>
<td>0.61</td>
</tr>
<tr>
<td>100</td>
<td>0.68</td>
</tr>
<tr>
<td>150</td>
<td>0.64</td>
</tr>
</tbody>
</table>

The reproduction factor must be held high in the individual stage; as the percentage of amplification at a given frequency decreases geometrically with the number of stages. Thus the reproduction factor of 95 in the single stage becomes 88.7% when cubed by three successive stages.

Effect of Tube Capacities

The high-frequency response is less dependent upon the factor C R2 and, since low frequencies are as follows: a reproduction factor of 95.The characteristic of the amplifier is practically straight between 100 and 10,000 cycles; between 15 and 30,000, it does not fall off enough to destroy the televised image.

The high-frequency response is less dependent upon the factor C R2 and, since low frequencies are as follows: a reproduction factor of 95.

Assuming the first case and taking the required output R.M.S. voltage as 60, we decide upon a '45 type tube for the output stage; since this is the most economical tube capable of supplying this voltage under the power output conditions encountered—that is, 60 volts across 10,000 ohms (the approximate impedance of the neon tube).

The design of each stage (as indicated in Fig. 2) is shown in the data of Table II. The values of R2 and C are chosen to give a reproduction factor of 95 at 10 cycles, with a fairly low-resistance leak, to avoid the shunting effects of the grid-filament capacity.

The bias is chosen so that it cannot swing positive at any signal voltage which is probable; i.e., each individual stage is so proportioned that there is but slight danger of overload.

A frequency-characteristic taken with one of these amplifiers is shown in Fig. 4. It can be seen that the curve is superior to that obtained with even the best transformer-coupled amplifiers, and that it holds closely to the limits set in the opening paragraphs.

In the schematic drawing (Fig. 3) the D.C. voltages given are not the effective terminal voltages, but include excess voltage to compensate for the IR drop in the plate circuits.

**Table II**

<table>
<thead>
<tr>
<th>Stage</th>
<th>R2 (ohms)</th>
<th>C (muF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd</td>
<td>60</td>
<td>0.005</td>
</tr>
<tr>
<td>2nd</td>
<td>30</td>
<td>0.010</td>
</tr>
<tr>
<td>1st</td>
<td>15</td>
<td>0.015</td>
</tr>
</tbody>
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**Table I**

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</table>

**Fig. 4**

The standard, 100%, is the reproduction of a 400-cycle note. The characteristic of the amplifier is practically straight between 100 and 10,000 cycles; between 15 and 30,000, it does not fall off enough to destroy the televised image.

The high-frequency response is less dependent than 95% at 10 cycles, with a fairly low-resistance leak, to avoid the shunting effects of the grid-filament capacity.

The bias is chosen so that it cannot swing positive at any signal voltage which is probable; i.e., each individual stage is so proportioned that there is but slight danger of overload.

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In the schematic drawing (Fig. 3) the D.C. voltages given are not the effective terminal voltages, but include excess voltage to compensate for the IR drop in the plate circuits.
Television Projected in Three Dimensions

WHILE all television images hitherto reproduced have been extremely limited in the angle of vision of the scanning apparatus (if only because the detail of the image was limited for electrical reasons) it will ultimately be desirable to present moving scenes of considerable size. An interesting system of viewing localized action from all sides has been worked out by Leslie Gould, the Bridgeport, Conn., inventor, whose system of colored television was described in the July, 1930, issue of Radio-Craft (page 24). The ingenious method proposed is illustrated here as it would be applied to the televising of a boxing match, to which it seems especially suited.

Above the principals is shown a cone C, containing a synchronous motor which rotates a horizontal rod, on each end of which is mounted a scanning device E. This “electric eye,” as shown in the detail sketch (A) at the upper right, contains a photo-electric cell, surrounded by a scanning drum, which passes the light rays from the scene below, point by point in a vertical line, to the sensitive surface of the cell. The result, it will be seen, is that the moving figures within the range of the photoelectric cells are scanned spirally, from every direction, in the course of one rotation of the rod. It is possible, of course, to use more than two electric eyes; but a separate channel or waveband is required for each transmission.

At the receiving end, the reproducer used will be composed of a radio receiver and a rotating vertical drum, inside which are mounted two neon tubes, as shown at (B) in the upper right corner. One of the tubes gives out red light, and the other green, corresponding to the two pickups at the transmitter. The combination of the two colors approaches the natural light-values of the scene.

Since the neon tubes revolve in one direction, and the diagonal slots in the other, the reproduced image is also scanned spirally; and the result is that we have, as shown at the lower right, a television image which may be seen from several angles; standing out, as it were, in the round. The effect described by the inventor is that of viewing the ring from any desired angle, just as if it were reduced to the compass of the outer scanning drum of the television reproducer.

BRITISH TELEVISION WORK

Stage effects in television, as shown by the experiments of the General Electric laboratories a couple of years ago, present novel problems; since the photoelectric cell does not see as the eye does. Because of the limited size of the image, when the first television play, “The Queen’s Messenger,” was produced at Schenectady, faces and hands could not be shown together; and one pair of actors presented the former, and another player the latter features.

The British Broadcasting Co., which is semi-governmental, is now carrying on television work on the regular broadcast band, from Brookmains Park station near London; and on July 14 it staged Pirandello’s “The Man With a Flower in His Mouth.” For this, an account stated, “scenery” was used. The scenes were painted in bold black on white boards, about three feet by two; and it was not considered practicable to show the actor and the background at once. The looker-in, therefore, had to commit the scene to memory while watching the actor. The British transmissions, it will be noted, are but 30-line images, instead of the 48- to 72-line transmissions available here on the shorter waves only.

Changes of scene were effected, not with a mixing panel of the type used in the American television play, which blended the electrical impulses in a fade-over; but by the simple method of raising and lowering a blackboard which served as a curtain.

Experiments with blue-and-white, green-and-black, and yellow-and-red facial make-ups for the actors finally brought out the fact that white faces, with contrasting lines blackened, give the best results. The work described, of course, represents only a beginning in television technique. The public interest is thus being allowed to grow up with the progress of the art of television in England; contrasting with the policy in the United States, where it has been decided to keep general broadcast listeners “in the dark” until the development of television to a commercial basis shall force its recognition.
CONE PULLEYS Provide Sensitive Speed Adjustment

By C. HERLING GLEASON

Use of the cone pulley in regulating the speed of television scanning disks is advocated by Mr. Gilbert I. Lee, of Los Angeles, California. That such a coupling is sufficiently accurate for television purposes is proved by its use in many industries requiring minute and flexible control. In the paper mills, for example, this type of regulator has been found to meet the very stringent requirements of that industry. The rollers through which paper is passed must run at slightly different speeds because of the stretching of the paper: yet all speeds must be exactly correct and must be maintained constant, since a misadjustment may mean breaking the paper.

The problem of synchronism in television has been very successfully solved by Gilbert I. Lee, a Los Angeles engineer and experimenter, who has devised a mechanical speed control that overcomes the principal difficulties which heretofore existed.

Mr. Lee's device embodies a steel frame in which are set two conical pulleys, faced in opposite directions and connected with a leather belt. A metal guide clasped about the belt can be shifted from side to side by a lever, thus guiding the belt to any desired position on the pulley. It will be seen that when the belt is toward the small end of one pulley, it will encircle the larger circumference of the other; but when it is shifted to the opposite side, the relationship is reversed. When the belt is in the middle, the diameters of the pulleys at that point are equal, providing a 1:1 ratio. Thus the speed ratio may be varied at will from 3:1 down to 1:3. If the driving motor turns 900 r.p.m., the scanning disk may be adjusted to any speed within the range of 300 to 2700 revolutions.

As used by Mr. Lee, the two pulleys, each five inches wide and tapering from three inches in diameter at the base to one inch at the apex, are mounted 12 inches apart (on centers) in a steel frame. The belt is of leather and is one-half inch wide. Special ball-bearing mountings were originally used, but proved too noisy, and phosphor-bronze bushings were substituted.

Practically every known type of speed control was tried before the present method was hit upon. Control through a synchronous motor regulated externally by impulses transmitted simultaneously with the picture frequencies, as employed by the Bell Telephone Laboratories in their famous test of 1927, proved unsatisfactory for transmission over long distances; for, if the synchronizing signal fades, the receiver is thrown out of gear and must be regulated all over again. Friction drives were discarded as too unstable and tricky; gears, as too noisy and not sufficiently flexible. Control by field resistances, Mr. Lee regards as inherently unsatisfactory, as it not only upsets the electrical operating conditions of the motor, but is also slow and inaccurate because sufficient time must be allowed after adjustment for the motor to settle down to a constant speed.

Eventually, he came to the conclusion that mechanical means were the only solution. A control was needed that could be adjusted, preferably continuously, or by very slight steps, over a wide range of speeds, in order to meet the varying requirements of different transmitting stations; one that could be brought up to any desired speed instantly and without hunting; and one independent of external transmission conditions. The result was a drive that is more flexible and stable than any ever tried.

If You Are Getting Good Image Reproduction from home-made Television apparatus write a description of it, with photos and diagrams, and send to the Editor. All articles accepted and published will be paid for at regular rates.
A POWER SUPPLY for The Television Receiver

By C. H. W. Nason

In the last issue of this magazine, the author described his idea of the very latest type of television receiver, including the tuner, detector, and audio amplifier. Here he describes a power supply for a receiver of that type.

In its essentials, the power supply required for television service differs in no great degree from that used for broadcasting. New developments in the art of rectifier-output filtration cannot be readily adapted to the needs of the amateur; because of the fact that special equipment is required for each individual case. The gods have been good in recent years, and there is no lack of material well suited to the use of the home constructor. The particular design here shown is the result of a brief series of experiments carried out through the courtesy of the De Forest Radio Co.; the problem being the possibility of achieving a sufficiently high output voltage with standard apparatus.

Method of Coupling Filter
Rectifier filter circuits may be connected to the rectifying tube either through a condenser (condenser input) or through a choke (inductance input). The condenser input permits of a higher terminal voltage with a given A.C. transformer voltage; while the inductance input has a more kindly effect upon the operating life of the tube and the filter condensers and gives better regulation. The Amertran "type 245" power block, which we will employ as our power source, has a total secondary high potential of 730 volts (R.M.S.), 365 on each side of center tap. The chokes contained within the power block have ratings of 15 and 40 henries, with D.C. resistances of 120 and 625 ohms respectively. They are, in the order named, the same as the Amertran "709" and "854" chokes obtainable as units.

Two rectifier systems, employing these inductances but differing in the fact that one had a 2-mf. condenser across the input, while the other was fed through the 15-henry choke (with no input condenser), were connected up and output voltage readings were taken over a wide range of current drain. The regulation curves for these two filter systems are shown in Fig. 1.

Effect of Load on Voltage
A reference to the article on page 25 of the first issue of TELEVISION NEWS will show that a terminal voltage at the filter output of at least 400 D.C. was required. While it was hoped that the rectifier, with an inductive input to the filter, would be capable of this output voltage, the curves show quite plainly that, in spite of the marked improvement in regulation obtained with this type of filter, the maximum voltage required cannot be secured. Our receiver demands a high voltage of 400, with an average current drain of 40 milliamperes. This current drain is not fixed, as we will have to accept a variation in load when varying the brilliancy of the neon tube; an additional drain of ten milliamperes, due to the voltage-divider resistance shunting the rectifier output, gives us a total drain of 50 milliamperes (ma.). Reference to the curves in Fig. 1, yields the information that the D.C. voltage at the rectifier input is about 430, at 50 ma. drain.

We have also taken into account the IR (current times resistance) drop through the filter chokes. At 50 ma,
What Does YOUR FACE Sound Like?

Perhaps you do not know that the television signals which carry the image of your face through space, may be recorded on a phonograph record and then reproduced at any future time—A novel and interesting idea to experiment with.

The curves above represent typical pulsations in the television image current for a minute fraction of time and give some idea of the nature of the fluctuating sound waves recorded on a phonograph record for future reproduction purposes.

At the present time, once your “face” has been televisioned over the air, it is lost forever, but if some recording means (such as a film or wax record) were used as here shown, the image of your face could be reproduced at will for any purpose whatsoever. In the future, if we wish to record the faces of our favorite musical stars, as well as their voices when they are giving an unusually fine performance, we can do so by the same means or similar ones, as above outlined. We can then reproduce the faces and voice to perform exactly as it did in the original reception, whenever we desire to do so.—H. W. S.

IN OUR NEXT ISSUE

WHAT’S THIS THING—SYNCHRONIZATION?

THE PRINCIPLES OF TELEVISION SCANNING, by A. C. Kalbfleisch, Television Consultant, National Radio Institute

INERTIA—FREE LIGHT SOURCES FOR TELEVISION SETS, by Frederick Winckel, Well-Known German Television Expert

SOME OF THE PROBLEMS OF TELEVISION, by D. E. Replogle

THE GLOW-TUBE PROBLEM IN THE TELEVISOR

AN IMPROVED HOLE LAYOUT SCHEME FOR DRILLING TELEVISION DISCS

NEW TYPES OF PHOTOELECTRIC CELLS, by A. R. Olpin, of the Bell Telephone Laboratories

COLOR TELEVISION, by Dr. Fritz Noack (Berlin)
A PERFECT SCANNING DISC

By DR. HANS VATTER

The principles described by the author in the accompanying article apply specifically to German 30-hole scanning, but the ideas set forth are, of course, applicable to any scanning disc.

Fig. 1—Shows how square holes can be laid out by the use of graph paper, ruled in divisions of about one millimeter (.039 inch).

Fig. 2—Above, shows how the metal strips, with the scanning holes in them, are fastened to the disc. The dimensions shown are for 30 holes or lines, each one millimeter apart.

Fig. 3—At right, shows how scanning disc can be made lighter by cutting four large holes in the central portion.

Fig. 1—Shows how square holes can be laid out by the use of graph paper, ruled in divisions of about one millimeter (.039 inch).

The Best Disc Design

The simplest method for the amateur, to build an excellent scanning disc, is to make the hole cut-outs separately, in order to fasten them later on the disk over larger holes, in such a way that they can be moved a fraction of an inch in all directions. This adjustment easily makes it possible to

(Continued on page 153)
LATEST GIANT TELEVISION SCREEN

Large television image is built up of spots of light from 2,100 small lamps, each lamp's brilliancy varying with the image signal strength.

The accompanying photograph shows a new, large-size television screen which consists of a ground-glass sheet, behind which are 2,100 small tungsten filament lamps. The size of this public television screen is 2 by 5 feet, and the images produced on it are declared to be of extraordinary brilliance and definition. One writer in Television, London) states that the brightness of the screen was quite comparable to that of the usual theatre motion picture, and that the various parts of the image varied from intense white, through various shades of sepia, to dead black.

At the demonstration in London of this newest form of public television screen, an entertaining program which lasted for about thirty minutes was staged. Mr. Sydney A. Moseley, introduced the demonstration with a short speech; and the audience present were then treated to a visual as well as aural entertainment. Several well-known television artists presented songs as well as dialogue. Mr. John L. Baird, well-known British television expert, discussed the point that what the spectators were seeing was simply the nucleus of a very much larger television screen, one which would have at least ten times the scope of the present 2 by 5 ft. one.

At the close of the demonstration, the members of the audience were allowed to inspect the apparatus, which was described in detail by Mr. Baird. The screen on which the image appeared, comprises a sheet of ground glass; and behind it there is placed a closely nested series of 2,100 small compartments, in each of which there is placed a small tungsten-filament lamp. Each one of these lamps is connected by means of a wire to one segment of a rotary switch, or commutator, containing 2,100 insulated segments.

As the selector brush of the commutator revolves, each lamp is lit up in turn; so that the whole of the screen (Continued on page 144)
Synchronizing With a Tuning Fork

Did you know that the speed at which any revolving object is rotating, can be quickly and easily checked with an ordinary tuning fork and prearranged pattern of black lines?

BY looking through the prongs of a vibrating tuning fork at a revolving pattern of pre-determined design (such as a series of white or black marks), which is arranged to revolve on a television scanning disc, we can determine quickly whether the disc is rotating at the proper speed or not. In one of the accompanying illustrations, several different designs of stroboscope discs are shown. In Fig. 2-A, we see one of the usual type of tuning forks used for the purpose of viewing the revolving design, the sighting being done through the slits in a pair of vanes secured to the legs of the fork. The fork is set in vibration simply by striking one of the prongs against a piece of wood or a table top. The method of viewing the revolving stroboscope pattern is shown at B and in this case straight black and white lines are painted or otherwise marked upon the edge of a drum. As becomes apparent, there is a mathematical relation between the speed in revolutions per minute of the revolving pattern, (and the disc or shaft to which it is attached), as well as the number of vibrations of the fork, and the number of lines forming the pattern. The formulas expressing these mathematical relations are given below; as well as a table showing the

(Continued on page 154)
FOR MORE THAN 25 YEARS

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Today, we still supply the needs of experimenters throughout the world. In radio, talking motion pictures and in television, whether their needs are a phonograph pick-up, a honey-comb coil or a super-powerful amplifying system, the experimenter comes to PACENT, knowing that its products are the best to be had.

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The No. 3350-M, three-stage amplifier comes equipped with a built-in gain control. It does not have an input transformer, which makes it available for microphone input. List Price $180.00.

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How to Get Large Television Images

Frank Minturn, Buffalo, New York, would like to know:

Q1. Describe two methods whereby large television images can and have been produced.

A1. Accompanying diagrams show two ways in which large television images have been successfully produced. The first involves the use of the Moore neon crater tube which was invented by Dr. D. MacFarlan Moore, one of the research engineers of the General Electric Company. This neon crater tube supplies a high-powered neon light beam from a small crater in one of the electrodes mounted within the tube; and this brilliant neon beam may be passed through lenses arranged in a spiral on the revolving scanning disc on the receiver (or else it may pass through ordinary holes in the disc and then through a lens), and so on to a screen as shown. This was the method followed in the large television demonstrations presented at the New York and other Radio Shows of the last few years. The power supplied to the neon crater tube is not as great as might be imagined; a couple of 250-type amplifier tubes, with about 300 volts on the plates, suffice to excite the crater tube sufficiently to project a bright image, about 12 x 14 inches, on the screen.

A second method, which was used about twelve months ago, by Dr. E. F. W. Alexanderson of the General Electric Company in demonstrating 6 x 8-foot television images in a theatre, involved the use of the Karolus cell. One of the diagrams shows the arrangement of the electrodes, Nicol prisms and the Karolus cell. The amplified television signal at the receiving station is impressed across the two metal plates immersed in a solution of nitrobenzol in the Karolus cell. The prisms are adjusted until the powerful light beam from an arc (or high-power incandescent lamp) just fails to pass through the optical system on to the screen. Now, when the television signal currents come into the Karolus cell, they cause a polarizing or twisting of the light beam and, with proper adjustment, we obtain a large television image on the screen as shown.

A variation of this cell comprises a tube containing a solution of carbon disulphide, and around this tube is wound a coil of fine wire. In the experiment mentioned above, the electrostatic reaction between the two metal plates is utilized to twist the light beam; while in the second scheme the changing magnetic field within the coil winding is utilized to twist or rotate the light beam. In any case the Nicol prisms are essential, and also a couple of lenses.

It may interest our readers to know that at least one company has found it possible to operate the Karolus cell with voltages as low as 600 to 1500 volts; this cell usually requiring very high potentials such as 10,000 to 20,000 volts. The Karolus cell holds the secret for at least one form of "large-image" home television receiver, when used in conjunction with a high-candlepower incandescent lamp (say 250 to 400 e.p.) with concentrated filament.

What Shape Hole?

Frank Galworthy, Batavia, New York, asks:

Q1. What is the best form of hole and the best disc material to use for television reception?

A1. The drawing herewith shows a variety of television scanning disc holes. First we have the thin metal disc, which may be made from aluminum, duralumin or even brass. Some of the commercial discs being sold are made of metal.020-inch thick. The holes, after they are laid out, may be drilled or punched through the metal. Where a piece of metal is not handy, a plywood disc may be employed, counter-sinking each hole in the manner shown. Where a very accurate job is desired, another trick which has been commercially employed, is to drill the holes around the spiral of considerably larger size than desired; then, over each of these holes, a small plate is screwed. The sight hole has previously been drilled through the center of the patch plate. This permits trying out a number of different shapes of holes on the same disc.

Still another form of television scanning disc is that having a series of lenses, one for each hole, arranged as shown. This method has been used by Jenkins, Alexanderson and other experimenters in some of their television apparatus.

Synchronization

John M. Wiley, Camden, New Jersey, asks:

Q1. Please describe briefly a few simple methods for synchronizing a television motor and scanning disc.

A1. In the accompanying illustration three schemes for establishing synchronization between the television transmitter and receiving discs are shown. The first arrangement, which has been used to a

(Continued on page 142)
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VICTOR ABC
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As used in Victor Sets.
For use with 6Z-4T, 6L6 or pec amplifiers, can be used for any power amplifiers using 245 tubes.

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QUAM
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Improved in every respect. Insulated in beautiful and finished metal cabinet; 11.1/2" resonance. Excellent in performance.

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K-267314B Resistor, 2500 ohms, tapped at 1250 ohms; used in RPA 4 and 4A; Part 988.
K-267315B Resistor, 3000 ohms, tapped at 1500 ohms; used in RPA 4 and 4A; Part 988.
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TELEVISION NEWS

(Continued from page 140)

considerable extent, involves the use of a coarsely-adjustable resistance R2, and also a finely adjustable resistance of low ohmic value at R1; a push-button is connected across the lower resistance R1. A rheostat R1, of the wire-wound type provided with a slider or switch arm (or one of the graphite-disc type) having a maximum value of about 12 to 15 ohms, permits fine graduation of the motor speed. Coarser variations of the motor speed are established by the high resistance R2 of the wire-and-slider type or this may be also of the graphite disc variety. The two rheostats are adjusted until the disc is rotating just under the desired speed, and the operator periodically pushes the button, short-circuiting the low-value resistance R1, to be opened and closed as the motor speed rises and falls. A variation of this idea is shown in Fig. 3, where a governor causes the grooved sleeve to exert less pressure on the microphone button (or a pile of graphite discs) causing an increase in the resistance of the button, with a consequent reduction of the current passing through the motor and a decrease in its speed. As the speed of the disc's motor falls, the governor sleeve moves toward the right, exerting more pressure on the microphone button, which lowers its resistance, and the motor speeds up; this action repeating itself ad infinitum.

You need two receivers (tuners and detectors) to pick up the television image and voice, each being transmitted on a different wave length. A small loud speaker is here used as monitor for image signals.

One form of "ball-governor" speed regulator for television motors. As the speed rises the resistance R1 is "cut in".

A coarsely adjustable resistance is used at R2, and a finely adjustable one at R1, in this speed regulation scheme.

The two rheostats A and B, and a finely adjustable resistance are combined in this question and answer scheme.

Q1. What sort of monitor is recommended for use with the Jenkins Home Television Receiver?

A1. The usual practice, with this particular home "Radiovisor," is to use a loud speaker of any type which may be available; and this is cut into or out of the neon tube's circuit by means of a wave receiver (or even a broadcast receiver which tunes down to about 175 meters); this receiver being connected to either a separate aerial, or (in some instances) to the same antenna on which the television image signals are being picked up. If the two receivers are to be connected to the same antenna, the primary coils should be of fairly high impedance, or have about 50 turns in the primary winding.

Q2. How is the voice picked up simultaneously when "looking in" on the Jenkins television images, now being transmitted daily?

A2. The diagram shows how the "voice" is picked up on a second short-

The low-value resistance R1, to be opened and closed as the motor speed rises and falls. A variation of this idea is shown in Fig. 3, where a governor causes the grooved sleeve to exert less pressure on the microphone button (or a pile of graphite discs) causing an increase in the resistance of the button, with a consequent reduction of the current passing through the motor and a decrease in its speed. As the speed of the disc's motor falls, the governor sleeve moves toward the right, exerting more pressure on the microphone button, which lowers its resistance, and the motor speeds up; this action repeating itself ad infinitum.

TELEVISION NEWS

May-June, 1931

An Open Letter from a Radio Pioneer

Mr. Hugo Gernsback, Editor, "Television News," 96 Park Place, New York, N. Y.

Dear Mr. Gernsback:

Permit me to congratulate you on the manner in which you have handled the Editorial content of your new publication, "Television News." As I have expressed, both personally to you and publicly in the Editorial columns of your magazine, it is my frank belief that any medium, effort or enterprise which sets for its purpose the aim of interesting the amateur experimenter in television, will be doing more toward furthering the development of that art and will bring nearer to realization the day when television will be part of our scheme of home entertainment, than any single organization can possibly hope to accomplish.

"Television News" has disclosed through its Editorial content that it is published with the purpose of interesting the amateur experimenter, and through the admirable treatment you have given the subject at hand, both in Editorial content and in the selection of authors with an outstanding background in the radio and electrical fields, you have demonstrated your knowledge of the problem confronting those desiring to further the development of electrical transmission of sight.

It would be superfluous for me to add to the opinion I have already expressed in the columns of this publication since they are now, as they were then, a true indication of my attitude in television. Yet I feel that one slight change in what I have previously stated is necessary; that instead of concentrated activity as that now being waged through the medium of your publication, I see the day considerably advanced when television will form a very common part of home entertainment apparatus.

May I express once more my appreciation for your efforts in publishing this magazine since I believe it is not only of great benefit to those interested directly in television, but also is of considerable import to the radio industry in general.

Cordially yours,

PACENT ELECTRIC CO., Inc.,
L. G. Pacent, President.

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<tr>
<td>1.35 mill. rectifying tube (111 type)</td>
<td>$0.25</td>
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<tr>
<td>2 amp. old and new type charger bulbs (list $4.00), our price</td>
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<td>5 and 6 amp. old type charger bulbs (list $6.00), our price</td>
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<tr>
<td>UX-201 - Used as rectifier, half-wave rectifier, 250 ma. rectifier, special with filament for special circuits</td>
<td>$0.45</td>
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<tr>
<td>UX-202 - Characteristic similar to the UX-201, but used as well as rectifier in circuits</td>
<td>$0.45</td>
</tr>
<tr>
<td>UX-203 - Special A.C. rectifier, limited quantity</td>
<td>$0.45</td>
</tr>
<tr>
<td>UX-204 - Special A.C. rectifier, limited quantity</td>
<td>$0.45</td>
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<td>UX-205 - Special A.C. rectifier, limited quantity</td>
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<td>UX-206 - Special A.C. rectifier, limited quantity</td>
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<tr>
<td>UX-207 - Special A.C. rectifier, limited quantity</td>
<td>$0.45</td>
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<tr>
<td>UX-208 - Special A.C. rectifier, limited quantity</td>
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RADIO TRADING CO., 25T West Broadway, NEW YORK
How the Germans Televise
By DR. FRITZ NOACK

The Mihaly Methods

The Telehor Company also uses a scanning device, a scanninglamp, a driving motor and synchronizing wheel; the motor is connected by a belt to the axle of the synchronizing motor and, consequently, to that of the scanning disc also. Phasing is effected by turning the frame of the synchronizing motor around its axis while it is in operation. To produce the necessary voltage for the glow lamp, a special battery or power unit will be required.

In a larger type, to be used as a universal television receiver, there is also a small vacuum tube oscillator generating a local synchronizing frequency of 375 cycles which it is tuned by a small rotary condenser; an ordinary receiving tube will serve. This current is amplified and conducted to the synchronizing motor which operates on 375 cycles; unlike that in the simpler model, which is designed for 50 cycles. The synchronizing motor and scanning disc are so delicately balanced that the output of the oscillator and its amplifier are sufficient to keep the apparatus operating at the proper speed. To maintain perfect synchronism between the transmitted image frequency and the locally-generated 375-cycle current, the Telehor circuit conducts the A.C. plate potential of the receiver's tube to the oscillator. The oscillator-frequency is thus restored to the normal value if it should vary; a very slight amplitude of the image frequency will suffice. Only when the received image-frequency is completely lost, through fading, can the receiver get out of synchronism; and this cannot last.

If the image is improperly framed in the "window" receiver—say with the bottom half at the top—this can be corrected by turning the mounting of the synchronizing motor, as already explained.

The possibility of using a tuning-fork, instead of the tube oscillator to obtain the local synchronizing frequency, has been considered; but the tuning fork, although it has been satisfactorily employed in transmitting photographs by radio, must be carefully protected against changes of temperature, or its note will vary. So the use of the tube is simpler and cheaper; however, its construction entails some practical difficulties if exact frequency-regulation is to be required. As the frequency-constant of the lamp will cause a lessened peak of the curve of frequency-response.

With the Telehor, the television receiver is connected to the loud-speaker terminals of the radio receiver, and the speaker across the terminals provides on the television apparatus; a switch permits immediate change over from sound to images, and vice-versa. To meet the practical need for voltages, a power unit will probably be built into the receivers; the television will then have only two cords, one to the receiver output and one to the house socket, with terminals for the speaker, as stated.

The designs so far made are only for alternating-current operation; direct-current house supply does not give a voltage sufficiently high. It is not impossible that a battery-operated model may be provided for those who have D.C. receivers.

The German Reichspost (post office department, with control of wire and radio communications) is making test broadcasts for the benefit of experimenters in Germany, from which others will also benefit. The Berlin transmitters are used, and perhaps others, such as Stuttgart, will be used later. This will permit of determining the practical value of the television apparatus, and the suitability of different radio receivers for operating them, before official programs are regularly undertaken.

Latest Giant Television Screen

(Continued from page 137)

is "scanned" in one revolution of the selector. As the selector revolves at 750 R.P.M., it will be seen that over 25,000 contacts are made every second.

The standard television signal is amplified, and the output from a nine stage amplifier is fed to each lamp in turn; since each lamp will light up to a brilliance determined by the amount of current flowing at that moment, a picture is built up on the screen when the selector brush is in synchronism with the disc at the transmitting end. Synchronism is obtained with a synchronizing gear differing from the standard Baird toothed-wheel synchronizer in size only.

This new system of screen television has two great advantages over any previous efforts—that by choice of lamps any brilliancy can be obtained; and that flicker is greatly reduced because the lamps are not instantaneous in their action, but continue to glow for a short time after the selector brush has passed the respective segments.

This prospect opens up a new field for the movie. In the movie theatre of the future we shall see events of the day at the instant they are occurring. In addition, it will be possible to feed a number of theatres from one master studio.

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TELEVISION NEWS
May-June, 1931

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How to Build the New Jenkins Television Receiver
By H. G. CISIN and CHAS. E. HUFFMAN

(Continued from page 105)

The Jenkins television receiver gives excellent fidelity over a wide band of modulated frequencies. A splendid picture signal is attainable, even when the received wave has a field strength as low as 20 microvolts per meter, and is due to the amplification provided by the two R.F. screen-grid tubes. Additional sensitivity is inadvisable, since signals weaker than 20 microvolts per meter, are subject to static distortion and will also show numerous traces of other electrical disturbances.

The R.F. amplifier is selective enough to separate all stations readily, but it nevertheless amplifies the side-bands as well as the carrier frequency, thus assuring superfine picture detail. The detector rectifies the R.F. signal, thus assuring superfine picture detail. The various pairs of filament wires should be twisted. The power switch (54) should be wired in at this time. Then wire in the grid circuits. Note that the connections from the stators of condensers (4) and (12) go to the caps of the screen grid tubes (6) and (14) respectively, and also that the connection from the fixed condenser (32) is to the cap of the screen-grid tube (36). The screen-grid connections are made at the sockets. The volume control is wired in next.

The plate circuits should then be completed, next the cathode circuits, and then the necessary negative returns. The “Ground” binding post should be grounded directly to the chassis, while the “Antenna” post should be carefully insulated from it. The antenna post should be connected to the antenna coupler (2). The various by-pass condensers should be wired in and also the filter condensers. The rectifier filament and plates are con-

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A Multi-Channel Television Apparatus
By DR. HERBERT E. IVES

(Continued from page 100)

Differences of this sort in the three signals are of course caused in general by differences in the characteristics of the three circuits. Such differences can arise from overloading of amplifier tubes, whereby one or more may be working on a non-linear portion; by rectifying action of different amounts in the tubes immediately associated with the neon lamps, or in the neon lamp electrodes themselves. A remedy is the careful design and test of all parts of the system to insure the greatest possible uniformity of performance. When this is carefully done, the behavior of the three signals is reasonably satisfactory.

Conclusion

We are, as a consequence of this work, in a position to make a general comparison of the two chief theoretical means for achieving a television image of extreme fineness of grain, which are (1) extension of the frequency band, and (2) the use of several relatively narrow frequency bands. Both, because of the diminished amount of light which finer image structure entails, demand enhanced sensitiveness of the photo-sensitive elements at the sending end, and increased efficiency of the light sources at the receiving end. The multi-channel scheme described has some advantage in compactness over the equivalent single-channel apparatus, but since it is restricted to narrow angles of illumination of the discs the overall efficiency of light utilization is not essentially different. Comparing now the demands made upon the electrical systems the differences between the two methods are clear cut. Method (1) demands an extension of the frequency range of all parts of the apparatus, the attainment of which depends upon physical properties and technical devices whose mastery lies in the indefinite future. Method (2) demands a multiplication of apparatus parts, and careful design and construction of these parts so as to insure accurately similar operation of a considerable number of electrical circuits and terminal elements. The attainment of the necessary uniformity of performance of the several electrical circuits and terminal elements, while involving no fundamental problems, must present increasing difficulty with the number of channels used.

The Baird Universal Television and S-W Receiver

(Continued from page 117)

No. 8 socket plug in the television Octocoil which has only one winding, leaving the regular red Octocoil in

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Mr. Gernsback has agreed to autograph each copy sold.

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May-June, 1931

50,000 times per second.)

If the picture is out of frame horizontally, snap the AC switch to the left hand side of the television cabinet is turned on full to the right and then plug your motor into the AC line. Now start your television motor by turning on the switch on the left hand side of the television cabinet; then, turn the rheostat on the television cabinet very slowly and as you turn it the picture will come into frame. Remember that you must turn the rheostat very slowly or you will go by the point where you can see a picture. As soon as the picture comes into frame the synchronizing amplifier will hold the picture in that position as long as the signal is tuned in strong. Moving the magnet holder back slowly forward or backward will help to bring the picture into the exact center of your lens. If the picture is out of frame horizontally, throw the AC switch on the television motor off and on quickly once or twice. Unless the motor is running very near the proper speed, the picture will appear as a lot of black lines which are leaning either to the right or left, depending on whether your motor is running slowly or rapidly. When those lines straighten up and become vertical they resolve into a picture which is held there by the synchronizing amplifier and the No. 122 tooth wheel.

There are two probable causes for distortion in the picture. One is the position of the lens, which can be slid forward or backward in the chute until the proper focal point is arrived at, and the other is that the picture has not been properly tuned in on the shortwave receiver. A slight adjustment of the shortwave receiver will give you a sufficient variation of the picture so that you will readily learn how to tune the picture, which is exactly the same as you would employ when tuning in a radio signal on your loud speaker.

If, due to local conditions, there is any possibility of the line voltage in your home going above or below 110 to 120 volts we recommend the use of a 75-watt Lin-A-Trol. This is a very simple connection and can be placed in your television cabinet.
TELEVISION NEWS

Television Image and Voice Recorded On and Reproduced From Film
By WILLIAM SIRAWATKA
(Continued from page 107)

How the Receiver Works
My television receiver is somewhat similar to the transmitter. The received impulses are impressed on a neon lamp. The light is concentrated, emitted from a point about (1/12th inch) 2 mms. in diameter. The intense light of this tube shines. The varying light is photographed on a photo-electric cell, the impulses are amplified and passed through a loud speaker. The film is then passed through a dark box.

The film (in my proposed apparatus) is one continuous piece, which is re-used until through wear and tear it becomes necessary to install a new one.

Simple Synchronizer
The system I have developed will keep the receiver synchronized with the transmitter automatically. There is a simple contact arranged on the edge of the drum which touches a light metal spring at each revolution. The contact closes a circuit that acts to impress a small voltage on one of the grids of the tube in the amplifier. Thus, for each revolution, a strong impulse will be transmitted. The light-spot produced by this impulse will not intrude upon the picture, except in the extreme corner, and then but slightly.

A Distortion-less Amplifier for Television
By JOHN WADE
(Continued from page 121)

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A Power Supply for the Television Receiver

By C. H. W. Nason

(Continued from page 134)

the drop through a total of 745 ohms is a bit above 37 volts; leaving us a rectifier output voltage of 393 volts.

There is bound to be a variable factor arising here, due to the variation in the plate current of the 445 output tube when the brilliancy of the neon tube is changed.

Reference to the curve will indicate that the regulation over the range above 50 ma. is passably fair and that a change in plate current over a range of 10 ma. will shift the plate voltage over a range of but 3 or 4 per cent.

The bleeder resistance, or voltage divider, is an Electrad "D-400" 40,000-ohm watt unit with three extra adjustable sliding clips; these clips allow one to adjust the voltages at the intermediate taps quite accurately, if a reasonably good high-resistance voltmeter is available. As the receiver was designed to employ a battery and potentiometer in obtaining a variable bias for the neon tube, no biasing means is shown.

Fig. 2, shows the complete power-supply unit, with the output posts labelled to correspond with the voltage designations appearing in the receiver diagram on page 25 of the March-April issue. Note that the heaters are lit, not from a single 2-5-volt secondary, as shown in the receiver diagram, but from three separate secondary windings; these are labelled to indicate their proper connections. The heater center-taps are shown connected to ground in each case. It might be well to note here that in certain obstinate cases of hum, a cure might be well to note here that, in television experimentation; for little and will provide a basis for future television experimentation; for little improvement can be made in it in so far as freedom from hum is concerned. In the field of a 900-R.P.M. scanning disc, the 120-cycle filter-ripple of a full-wave rectifier, working from 60-cycle A.C., will appear as a series of

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Over 500 Illustrations, Hookups, Charts, Circuit Diagrams, Dozens of Actual Photographs of Receivers, Transmitters, and a Wealth of Practical Stuff.

This Disc Indicates Its Speed Automatically

By PAUL L. CLARK (Continued from page 96)

of the receiving set. The chances are 2,908 to 1, that the picture will not be framed, but a small portion of the picture will have been in inverted order; so that the outer portions of the sent image are apt to appear in the body of the received image. To overcome this irregularity, the disc must be braked by applying a momentary pressure on the motor spindle, or perhaps—for a slight misframe—by blowing the breath against the disc; the feeble mechanical energy so applied being ample to decelerate the speed momentarily without disturbing the normal speed which prevails by virtue of the rhesot's adjustment. After a little practice, the experimenter can successfully hold his picture rock-steady and practically "nailed to the screen."

Trying to tune in a picture in silhouette without a speed indicator is a hit-and-miss proposition, with the chances of success far outweighed by those of uncertainty; since the technician's sole clue is derived from observation of the blending shadows at the picture opening. A brief analysis reveals that even the slightest over-speed or under-speed, at the moment when the synchronous speed is being passed over, will cause the picture to pass out of view without being recognized. The speed of the disc should be absolutely determinable. With a 45-hole disc, at 900 r.p.m., 15 complete pictures are coming over each second, and the neon-tube flashes are instantaneously produced; but each flash—occurring in 1/34,560th of a second—must be located by a scanning disc hole and, if this hole is ahead or behind that of the corresponding hole of the distant scanning disc at the transmitter, the picture is going to be distorted.

If the receiver disc is going too fast; it will have a speed of 999 r.p.m., which means

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that successive pictures are progressively farther and farther misframed. A single picture which occurs in 1/15th of a second is recognizable; but, if this has superimposed upon it, 1/15th second later, another picture substantially identical with the first, but overlapping it by one per cent, it is apparent that the sharpness of outline is destroyed.

The speed indicator is of the familiar centrifugal type. A spring is opposed to a sliding speed-pointer which, being a dull black, contrasts with the buffed background of the whirling disc; so that, as the disc speeds up, and the pointer moves farther and farther away from the axis of rotation—because of centrifugal force—a black circle of constantly-increasing size appears on the face of the disc. Through the persistence of vision, just as when a spark is twirled around at the end of a string, the circle appears stationary at any fixed speed. On the face of the disc is scribed a circle, which must be bounded by the same arc of a circle.

Producing the holes, to which one sticks exactly to the divisions of the paper. The projecting ends and edges of the gummed strips are cut one粘exactly one sq. mm. remains open. These paper cut-outs are inserted in proper moving about of the newly-inserted pictorial point. After attaining continuous scanning, by repeated moving of the pictorial point just added, then the next pictorial point is put in; proceed in the same way, until finally the whole disc is fitted out and affords a streak-less pictorial field.

The disc itself, of aluminum or copper 0.2-mm. (0.08 inch) thick, is built according to the standard of the RPZ (Reichsepostzentralamt or German Central Post Office); but with the difference that the holes have a diameter of 5 to 6 mm. (0.2 to 0.24 inch). The above-mentioned paper cut-outs are now fastened over these holes, in such a way that the four-cornered hole comes approximately at the right place. The fastening is done with two small bolts and nuts (Fig. 2). By slight adjustments of the cut-outs under these fasteners, one can find the proper positions for the disc holes.

This is done after securing the disc in the usual way on an axle or shaft, and preferably before a ground-glass half-watt lamp with reduced brilliancy.

The paper cut-outs are inserted in turn; care being taken each time to see that, during the quick turning of the disc, the streaks between the lines of light (at first formed between every two holes) disappear, after proper moving about of the newly-inserted pictorial point. After attaining continuous scanning, by repeated moving of the pictorial point just added, then the next pictorial point is put in; proceed in the same way, until finally the whole disc is fitted out and affords a streak-less pictorial field.

The weight may be still further reduced by cutting out four large circular spaces (as in Fig. 3), these being at least 0.8 inch from the pictorial field. —(Rafael 1939. H11.)
Television Receiving Lamps for Practical and Experimental Use—

Recency developments in the laboratory of a well-known company have opened this field for experimentation to advanced radio enthusiasts. The ARGO Television Receiving Lamps have been manufactured expressly for the purpose of facilitating the demonstrations of experimenters and laboratory experts. The ARGO Television Receiving Tubes have been designed to supply high vacuum charge, and at the same time, direct the light to the most useful portion of the observer. Brilliant light spots usually found on the cathode and caused by high frequency current vibrations have been entirely eliminated in ARGO Tubes by a special process utilizing minute “apertures” under the influence of the voltage tube, has a filament consuming 3.5 amperes at 300-450 volts; the operating transformer and stand may be supplied for the purpose of facilitating the demonstrations of experimenters and laboratory experts.

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Synchronizing With a Tuning Fork

(Continued from page 138)

How Stroboscope chart can be viewed through fork. Fig. 1.

The more complicated design can also be used with a 206-pitch fork to check a shaft or disc speed of 900 R.P.M. If the design appears stationary, then the disc is running low: than the desired speed; if the design appears to rotate clockwise, then the disc is rotating faster than the normal speed.

The stroboscope charts can be made on a piece of white paper or cardboard, and they can be attached to the scanning disc with glue or otherwise. The design should be made with India drawing ink or dull black paint.

The formula for calculating the number of marks with a fork of any given pitch is as follows:

(Continued on page 155)

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portant and you should turn to it now—it tells you how you can read TELEVISION NEWS at a big saving.
Television—A Challenge to the Inventor

By C. P. MASON

(Continued from page 95)

which was demonstrated by E. J. Muybridge of San Francisco on May 5 of that year, and which reproduced the first photographic, life-size moving pictures (of a running horse) ; as well as the new "electrical railway" which Edison was then testing—and of which the editor observed: "Perhaps it is not entirely visionary to expect that our street and elevated railways may at no very distant day be operated by electricity."

Television, the movies, and the electric railway—all new inventions in 1880. But television has been a long time in getting its growth.

Various other comments soon followed.

The editor of La Lumiere Electrique, of Paris, laid aside gibing of Mr. Sawyer's idea had attracted a brief attention abroad. Various other comments soon followed.

The editor of La Lumiere Electrique, of Paris, laid aside gibing of the "Japanese mirrors." Kerr in 1880 developed his cell, used today in television. Muybridge of San Francisco on May 5 of that year, and which reproduced the picture of a gas flame. Lights and lamps were not made for his time; selenium is too slow and sensitive for the method described; radio had not been discovered, and wire lines were far from their present state of utility; synchronizing devices were limited; there were no vacuum-tube amplifiers; and no lamps responsive with sufficient quickness to high-frequency current fluctuations. The television worker of 1880 had an abundance of theories, but a great lack of suitable tools.

Other work was done. Kerr in 1880 developed his cell, used today in television. Ayrton and Perry also worked on a multiple-cell unit, in which each sensitive point should control a shutter, like the diaphragm of a camera, to regulate the intake of light. Middleton worked with thermo-couples at each end of the line; the heat of the couples distorted the light at the receiving end, on the principle of the "Japanese mirrors."

Shelford Brookwell, an English experimenter, gave an account of the successful telephotography of a gas flame—perhaps the first in history to have its picture sent over a wire by its own light—on Jan. 5, 1881. The principle was fundamentally that of the light-recording device, now used with photoelectric cells (Fig. 2). As the transmitting cylinder revolved and vibrated on its spindle, it scanned the image focused upon it; and the contact registered the action of light or darkness upon sensitized paper stretched on a receiving cylinder. The pictures thus made, however, were not equalled in efficiency to those of the selenium cells, and few people cared for the picture of a gas flame. Lights and solid shadows could be recorded, but not half-tone values.

Synchronizing With a Tuning Fork

(Continued from page 154)

R.P.M.

ShafT R.P. Sec. Frequency on chart

40.9 sec. per sec.

N.N., Marks.

M N

Stroboscopic Table

Tuning No. Marks

Fork or divisions

Fork Free

120 8 128 64

128 128 64

240 128 32

480 128 16

960 64 8

1920 64 16

2400 64 8

Forked table.

N N

M N

R.P.M.

ShafT R.P. Sec. Frequency on chart

60 1 128 128

120 2 128 64

240 128 48

480 128 16

960 64 8

1920 64 16

2400 64 8

Forked table.

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And RADIO-CRAFT, also edited by Hugo Gernsback, is the radio magazine selected by the greatest number of service men, dealers and radio technicians. Of course, thousands of amateurs read RADIO-CRAFT too. Each month, men of outstanding prominence in the radio field contribute articles of real interest to all. Here is a summary of articles usually found in each issue: Service Men’s Department—Radio Construction and Theory—Kinks and Information Bureau—Tubes and Their New Design—etc.

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Hints for the Beginner

By H. W. SECOR

(Continued from page 129)

This scheme is, of course, that the image will be seen either sideways, upside-down or at some intermediate and undesirable angle.

The method used by many televisionists today, including the Bell Laboratories and other concerns, comprises a worm gear or circular rack mounted on either the motor or the shaft as shown in Fig. 9. After the picture is picked up, but is seen to be out of frame, the operator then moves a lever, which swings a mirror to an angle of 45 degrees between the disc and the hood; so that he can view the image from the side of the cabinet. He then turns the worm-gear’s handle slowly, thus rotating the motor’s frame, until the picture is framed squarely and he does not see, for example, two half-faces—one above the other.

How Chicago Puts Over Television

(Continued from page 87)

contains three spirals of scanning holes, each spiral occupying 120 degrees or one-third of the circumference. Synchronized motors are employed to revolve the disc at nine hundred revolutions per minute and each disc contains 45 holes.

Television signals are susceptible to skip distances, but reports have been received from numerous distant points that indicate excellent receptions of television signals from the Chicago stations.

Leo Hruska, an amateur operating station W9BBH at Cedar Rapids, Iowa, reports that he is picking up the television programs from W9XAP regularly. He states that he recognizes the cartoons and the half-tone pictures equally well. The world’s first musi-comedy, “Their Television Honeymoon,” was recently broadcast with both sight and sound signals.
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Be sure to read the announcement on page 152 if you are interested in the Short Wave field.

Television Digest (Continued from page 122)

Television's First Play

The simultaneous sight and sound broadcast of a playlet, "The Maker of Dreams," by Oliphant Downs, through the Chicago stations W5XAP and W5XAM, quite recently is seen as another step forward in the advancement of the art of television. The presentation represented the first attempt to put on such a program in the mid-West and demonstrated that television drama was not only feasible but practical, according to reports gathered from owners of television receivers in the Chicago area.

The studio arrangement at W5XAP is such that immediate changes can be made from the long shots or full-length shots to semi-close-ups or close-ups. The fact is accomplished through the use of a double installation of scanning mechanisms, one of which takes care of the close-up, the other the long shots and the semi-closeups. The change from the long shots to the semi-close-ups is made through a system of lenses installed on one of the scanners, by which the size of the lighted area in the studio is changed and the amount of light reflected upon the photocells is intensified.

Remote control devices that permitted the changing of the light fields from three different positions were installed in the W5XAP studies last week. At one time during the enacting of the play the switching was controlled by one of the participants seated before the close-up position, while that artist carried on a conversation with another located in a distant portion of the room within the semi-close-up area.

Experiments had been conducted to determine the importance of the materials and colors for scenes so that the participants in "The Maker of Dreams" were costumed and made up in accordance with the findings during the last few months. Especially prepared makeup developed by Max Factor for television purposes was used.

Not a single report of a catch in the listening public has been accumulated. However, for it fully convinced the owners and operators of W5XAP and W5XAM that television is a reality, ready for the public.

Black and White Television

Radio television has been cured of its pink eye, according to statements and demonstrations made by the engineers of the deForest Radio Company. Instead of pink and white pictures, which have been held objectionable from the standpoint of entertainment value, the latest deForest television development is a new type of gas-filled, highly responsive white light source which provides black and white pictures on the screen. According to deForest engineers, not only are the black and white pictures more realistic, but, due to the greater contrast between shadows and high-lights, far better detail is obtained than in the pink pictures. They claim the increased detail is immediately apparent when working with the same signals and apparatus.—Radio Industries.

Send Us PHOTOS of "Your" Television Receiver

Include a brief description and tell the Editor what stations you receive. We will pay well for good photos of the Television image! Get out your camera and try it.

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WITH high-gain radio frequency amplifiers characterizing experimenters' broadcast receivers today, and audio amplification remarkably faithful, it is convenient, economical and easy to tune in television with a short-wave converter. In that way you use your entire broadcast receiver just as it is, and besides the television band, tune in other short waves. The range is 25 to 200 meters, when the broadcast set is worked at a high frequency, around 1,500 kc.

The converter illustrated is model PR-3FS and has a filament transformer built in. There are only four external connections to make, and one of these is to a positive B voltage, 50 to 180 volts, taken from the receiver. If you have a screen grid set you may take this voltage from the screen of a radio frequency tube, by looping the bared end of the B plus lead and slipping the screen prong of the tube through the loop before reinserting the tube in the set.

The converter uses three 227 tubes and plug-in coils of the tube base type. There is an AC switch built in, but there is only one tuning dial (at right). The condenser is the new Hammarlund Junior Midline of .0002 mfd. capacity.

This short-wave converter has proved highly satisfactory, developing great sensitivity and enabling the penetration of great distances. There is no body capacity, no squealing, no squawking and no tricky tuning.

By all means provide yourself with the complete parts for this dandy converter, as specified by Herman Bernard, the designer.

THE newest condenser to come from the laboratories of the Hammarlund Manufacturing Co. is the Junior Midline, made especially for us, and designed for highest grade short-wave performance. The capacity is .0002 mfd. and the Midline tuning characteristic prevails. Single hole panel mount, in a 3/4-inch hole (with option of sub-panel mounting by built-in brackets); end stop provision at both extremes; rigid plate assembly and the fine workmanship of Hammarlund mark this compact condenser. The overall depth of the frame is 1 1/4 inches while the rotor plates turn in a diameter of only two inches. This condenser, our Model PR-H-20, is a superb product, in line with the modern vogue of compact parts.

PRECISION short-wave plug-in coils, three coils to a kit, not counting as a coil the movable tickler. Used with .0002 mfd. for tuning, this kit of coils affords coverage of from 15 to 150 meters. These coils are wound on 97% air dielectric and are precision, de luxe products. A receptacle base, on which the adjustable tickler is mounted, is supplied with each coil kit. This kit is our Model No. PR-AK-1 and represents the pinnacle of short-wave plug-in coil achievement.

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