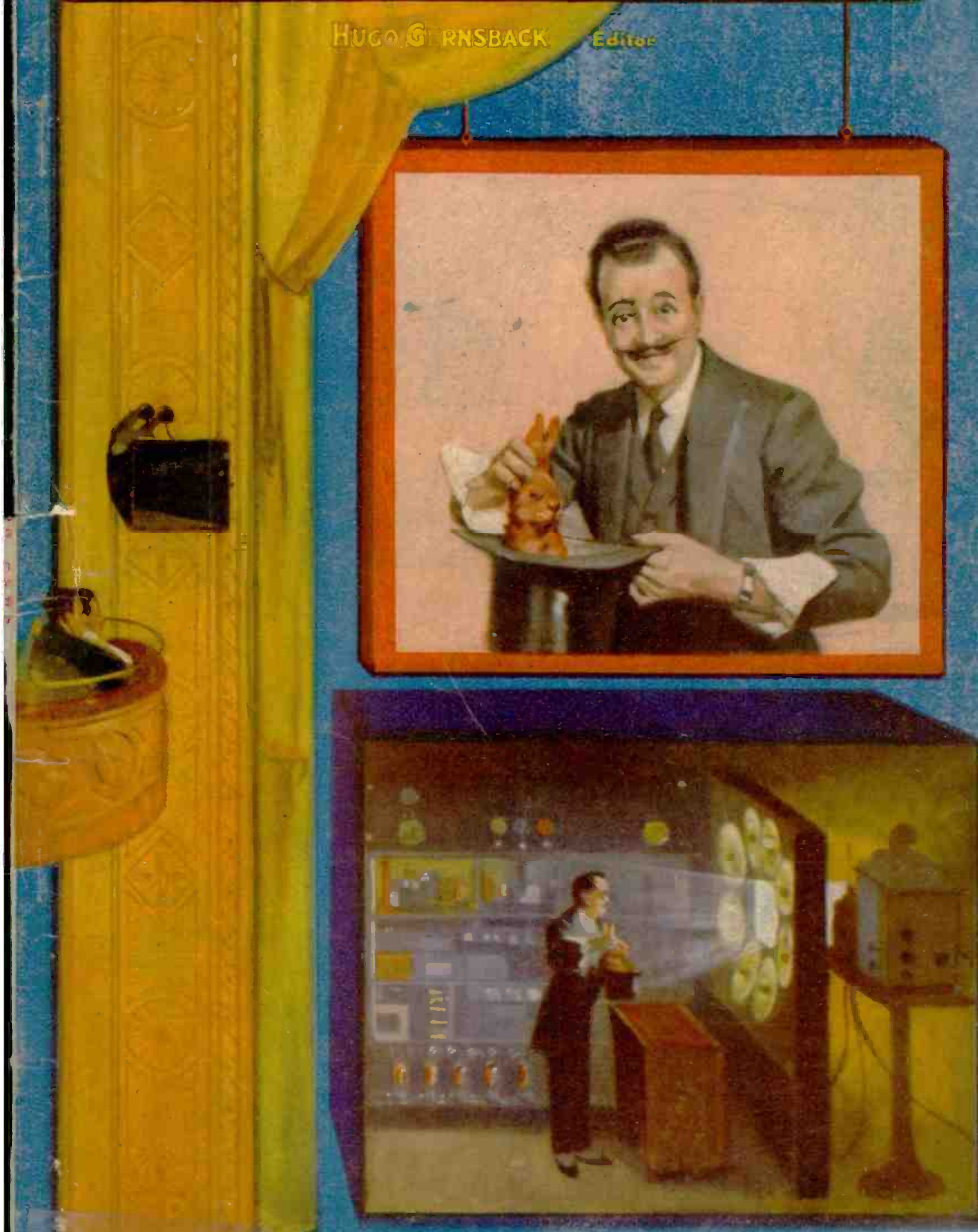
TELEVISION News

NOW 25¢

HUGO GERNSBACK Editor



FEATURES

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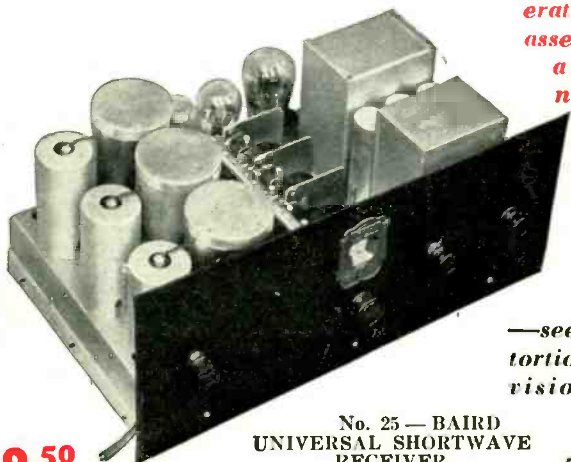

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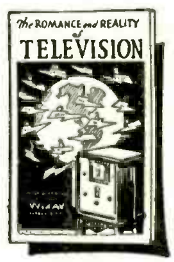

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Gentlemen—Please send me .... Television Kit complete at $39.50 exactly as described in this advertisement. I enclose $................ as deposit.

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I enclose Fifty Cents for which please send me your latest copy of the ROMANCE OF SHORTWAVES AND TELEVISION, together with blue prints and diagrams.

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I Will Show You Too

How to Start a Spare Time or Full Time

Radio Business of Your Own Without Capital

J. E. SMITH, *President*
National Radio Institute

The man who has directed the Home-Study Training of more men for the Radio industry than any other man in America.

Here are a few examples of the kind of money I train "*my boys*" to make

Started with $5 Now has Own Business

"I started in Radio with $5, purchased a few necessary tools, circulated the business cards you gave me and business picked up to the point where my spare time earnings were my largest income. Now I am in business for myself. I have made a very profitable living in work that is play."—Howard Houston, Route No. 2, Box 454E, Tucson, Arizona.

$700 in 5 Months Spare Time

"Although I have had little time to devote to Radio my spare time earnings for five months after graduation were approximately $700 on Radio, sales, service and repairs. I owe this extra money to your help during the time I studied and since graduation."—Charles W. Linsey, 537 Elati St., Denver, Colo.

$7396 Business in 2½ Months

"I have opened an exclusive Radio sales and repair shop. My receipts for September were $2,332.16, for October $2,887.77 and for the first half of November, $2,176.32. My gross receipts for the two and one-half months I have been in business have been $7,396.25. If I can net about 20% this will mean a profit of about $1,500 to me."—John F. Kirk, Kirk Sales and Service, Union Block, Spencer, Iowa.

My Free book gives you many more letters of N. R. I. men who are making good in spare time or full time businesses of their own

THE world-wide use of receiving sets for home entertainment, and the lack of well-trained men to sell, install and service them have opened many splendid chances for spare time and full time businesses. You have already seen how the men and young men who got into the automobile, motion picture and other industries when they were young had the first chance at the key jobs—and are now the $5,000, $10,000 and $15,000 a year men. Radio offers you the same chance that made men rich in those businesses. Its growth is opening hundreds of fine jobs every year, also opportunities almost everywhere for a profitable spare time or full time Radio business. "Rich Rewards in Radio" gives detailed information on these opportunities. It's FREE.

So many opportunities many make $10 to $25 a week extra while learning

Many of the ten million sets now in use are only 25% to 40% efficient. The day you enroll I will show you how to do 28 jobs common in most every neighborhood for extra money in your spare time. I will show you the plans and ideas that are making as high as $200 to $1,000 for others while taking my course. G. W. Page, 2210 Eighth Avenue, S., Nashville, Tenn., writes: "I made $935 in my spare time while taking your course."

Many $50, $60 and $75 a week jobs opening in Radio every year

Broadcasting stations use engineers, operators, station managers, and pay $1,200 to $5,000 a year. Radio manufacturers use testers, inspectors, foremen, engineers, service men and buyers for jobs paying up to $7,500 a year. Radio Operators on Ships enjoy life, see the world, with board and lodging free, and get good pay besides. Radio dealers and jobbers are continually on the lookout for good service men, salesmen, buyers, managers, and pay $30 to $100 a week. Talking Movies pay as much as $75 to $200 a week to the right men with Radio training. My book tells you of other opportunities in Television, Aircraft Radio and other fields.

I will train you at home in your spare time

Hold your job until you are ready for another. Give me only part of your spare time. You don't have to be a high school or college graduate. Hundreds have won bigger success. J. A. Vaughn jumped from $35 to $100 a week. E. E. Winborne seldom makes under $100 a week now. The National Radio Institute is the Pioneer and World's Largest organization devoted exclusively to training men and young men, by correspondence for good jobs in the Radio industry.

You Must Be Satisfied

I will give you an agreement to refund every penny of your money if you are not satisfied with my Lessons and Instruction Service when you complete my course. And I'll not only give you thorough training in Radio principles, practical experience in building and servicing sets, but also Advanced Training in any one of five leading branches of Radio opportunities.

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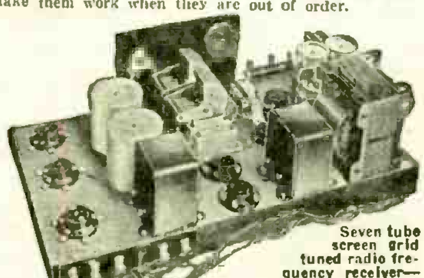
Clip and mail the coupon now for "Rich Rewards in Radio." It points out the money-making opportunities the growth of Radio has made for you. It tells of the opportunities for a spare time or full time Radio business of your own, the special training I give you that has made hundreds of other men successful; and also explains the many fine jobs for which my course trains you. Send the coupon to me today. You won't be obligated in the least.

Get my new book It points out what Radio Offers You

J. E. SMITH, President
Dept. 2AC4
National Radio Institute
Washington, D. C.

I give you 8 Outfits of Radio Parts for Practical Home Experiments

My course is not all theory. You use the 8 Outfits I'll give you, in working out the principles, diagrams and circuits used in modern sets. You can build over 100 circuits with these outfits. You experiment with and build the fundamental circuits used in such sets as Crosley, Atwater-Kent, Eveready, Majestic, Zenith, and many others sold today. You learn how these circuits work, why they work, how they should work, how to make them work when they are out of order.



Seven tube screen grid tuned radio frequency receiver—only one of many circuits you can build.

SPECIAL FREE OFFER

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For the first time this authoritative book on Television is made available to the general public. Until now only my students could have it. Act promptly, and I'll send you a copy FREE, in addition to my big free book, "Rich Rewards in Radio." This book on Television gives you the fundamental steps of Television. Get the facts about this coming field of great opportunity. Mail the coupon now.

Get the facts on my Lifetime Employment Service to all Graduates

THIS COUPON IS GOOD FOR ONE *FREE* COPY OF MY NEW BOOK — mail it TODAY

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National Radio Institute, Dept. 2AC4,
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Dear Mr. Smith:—I want to take advantage of your special offer. Send me your two booklets, "The Principles of Television" and "Rich Rewards in Radio." This request does not obligate me and no salesman will call.

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Vol. I TELEVISION News No. 6

HUGO GERNSBACK, Editor H. WINFIELD SECOR, Managing Editor

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TELEVISION NEWS is for sale at all principal newsstands in the United States and Canada. European agents: Brentano's, London and Paris. Printed in U. S. A. Make all subscription checks payable to Popular Book Corporation.

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Published by POPULAR BOOK CORPORATION

HUGO GERNSBACK, President - - - H. W. SECOR, Vice-President
EMIL GROSSMAN - - - Director of Advertising
Chicago Adv. Office - - - L. F. McCLURE, 737 No. Michigan Blvd.

Publication Office, 404 N. Wesley Avenue, Mount Morris, Ill.
Editorial and General Offices, 96-98 Park Place, New York, N. Y.

London Agent: HACHETTE & CIE., 16-17 King William St., Charing Cross, W.C.2

Paris Agent: HACHETTE & CIE., 111 Rue Reaumur

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AND
TALKING PICTURES

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Here at Coyne you don't need advanced education or experience and many of my student Earn while learning. After graduation I give them lifetime employment service. Here at Coyne too you get individual instruction and you can start anytime.

Radio offers jobs as Designer, inspector and Tester, salesman, and in installation work, operator of a broadcasting station, wireless operator on a ship, with Talking Pictures theatres—with Television Laboratories and studios. Television alone will soon be calling for thousands of trained men.

Come to Coyne here in Chicago and prepare for one of these jobs the quick and practical way BY ACTUAL SHOP WORK.

It's a shame for any fellow to go thru life as an untrained man working at small pay, and never even sure of a steady job, and when he does work working at any old price they want to pay him.

You can avoid this. You can be a trained man and have a real future. Mail the coupon today and I'll send you my big Free book and tell you how you can be a success just as hundreds of my graduates are. H.C. Lewis

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Send me your Big Free Radio and Television Book, and tell me how I too can make a success in Radio.

Name ....

Address ....

City .... *State* ....

WANTED

$20 to $35 a week men who want to earn $50 to $75 a week and more

TODAY—more than any time before in the history of the great Radio Industry—Manufacturers, Broadcasting Stations, Sound Picture and Television concerns, and others—are on the lookout for men capable of being promoted to their more responsible jobs.

They can get all the men they want for their ordinary work—jobs that pay $20 to $35 a week or less. Which, of course, is one reason why these jobs don't pay better wages—almost any man can do the work.

But for their better-paying jobs—those jobs that pay $50 to $75 a week and up—well, it's different. Here brains, not muscle, are required. Here knowledge, not guess work, is necessary. Here men capable of some day being promoted to still better-paying jobs are needed.

This big demand for men of this type has been brought about by the amazingly rapid expansion of the Radio field. Because of dozens and dozens of new, and almost revolutionary, developments, hundreds and hundreds of big-pay jobs have been created almost over-night.

Radio work is no longer limited to the building and servicing of Radio sets.

It now includes such other things as Sound Pictures, Public Address Systems, Radio in Industry, Radio in Aviation, Radio aboard ship (for operating mechanisms of different kinds, and even for running the ship itself), telephotography, Television, etc.—everything, in fact, that makes use of the vacuum tube or photo-electric cell.

Radio devices, today, are operating great machines formerly operated by man—are grading by color or size such manufactured articles as cigars, paper, silks, etc.—are counting people or automobiles as they go by any given point—are turning on and off lights in our big factories or on our city streets—are operating airplanes in the air—directing ships at sea from stations on land—creating music more perfect than played by our best masters—and doing a thousand other things not dreamed of a few years ago.

To know Radio is to know the principles of all of these things.

And to such men the great Radio Industry offers many wonderful opportunities—steady work at good pay, NOW—and an early advancement to still better-paying jobs, as a future.

But no ordinary knowledge of Radio will do. To qualify for these better-paying jobs—men must know the theory and practical application of all Radio devices—old and new, and they should be able to teach other men some of the things they know.

That means they must be "trained".

As few men can afford to get this training at some College or University, the Radio and Television Institute, of Chicago, was organized to train men at home—no matter where they live—in their spare time—easily and quickly—and at a cost of only a few cents a day.

The Radio and Television Institute is the ONLY Institution of its kind whose Course of home-training is actually supervised by an Advisory Board of outside business men,—all highly paid engineers and executives,—each actively connected with some large Radio concern. It is, too, the ONLY Radio School to be endorsed by some fifteen of our largest and most progressive manufacturers of Radio and Television equipment. These public endorsements were given to guide ambitious men who seek a future in Radio. These manufacturers want all such men to know that the Radio and Television Institute has their unqualified approval, and their hearty support, in its work of training men, through spare-time home-study, for the many better-paying jobs that exist today in Radio . . . Sound Pictures . . . and Television work.

Radio and Television Institute home-training prepares men, easily and quickly, for these better-paying jobs. It is the ONE recognized connecting link between ambitious men and a splendid future in Radio.

To the man, then, who is earning $20 to $35 a week NOW—and who would like to earn $50 to $75 a week or more—regardless of whether or not he is doing Radio work today—we say in all honestness—"we think we can help you." Just mail the coupon below for full particulars of our plan and a free copy of the new Opportunity Book.

Radio—first an experiment—then a plaything—now a giant Industry—the fastest growing industry the world has ever known—offering thousands of wonderful opportunities to ambitious men.

RADIO AND TELEVISION INSTITUTE

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JAN.-FEB., 1932

TELEVISION News

VOLUME I NUMBER 6

HUGO GERNSBACK, EDITOR
H. WINFIELD SECOR, MANAGING EDITOR

THE TELE-THEATRE

By HUGO GERNSBACK

IT IS pretty well conceded, by most authorities on the subject, that the "legitimate" theatre is doomed to extinction in the not-too-distant future.

The great inroads which the motion picture has made on the legitimate stage, are becoming more serious right along and, if something is not done soon, we may have nothing but motion pictures left; because, from year to year, it becomes more unprofitable for producers to put on legitimate performances. The reason for this is, of course, that it is impossible to give a "legitimate" performance for 50c.—which would then be competing with the motion-picture houses. The prices for the drama in New York, for a good orchestra seat, are from $3.50 up; and for musical comedy shows from $6.60 up. Plainly, these prices are too high. Hence, the decline of the legitimate theatre.

What, then, is the solution? I propose the following remedy, which I believe is sound; and I am certain that it will have come to pass in the not too distant future. *Television is the key to the situation.*

Audience and Distant Stage Joined by Television

Recently, when the Sanabria Giant Television Screen was about to be exhibited at the Broadway Theatre in New York City, I was asked by the management to supply some new ideas, to attract the public at large and secure favorable publicity for television.

I suggested, at the time, that an attempt be made to connect the stage of another theatre to the one at the Broadway Theatre, and televise a distant performance on the Broadway screen. This suggestion was adopted, and the Broadway Theatre, by means of a television transmitter, picked up the images of the actors on the stage of the Theatre Guild, and showed this performance on the television screen of the Broadway Theatre. *This, then, was the first time in the history that two theatres were connected together by means of television.* The results were quite satisfactory. What has been done on a small scale here, will be done on a tremendous scale in the very near future by the instrumentality, which I now term the "Tele-Theatre".

Imagine a special building, erected in the City of New York, for the sole purpose of supplying the entire country with its daily theatre program—not, mind you, motion pictures, which are a "canned" product, but an *actual* theatrical performance just as it is being produced at the exact time on the New York stage.

A Great Central Television Stage

In order to do so, I visualize a building which will have a series of stages, grouped around a central shaft or pit. There will be stage 1, stage 2, and as many stages as required. The idea of the multiplicity of stages is that I propose to move the actors rather than move the scenery. At the present time it is necessary for the actors to go behind or before the curtain, when scenes are shifted; which is awkward and always takes up an amount of time for which the public in the future will not stand.

In the central pit we have the stage director at the top of a skeleton steel structure with his assistant technical directors. Stage No. 1 is lit up and the orchestra located immediately beneath the director starts to play. Below the orchestra are a "battery" of television transmitters. Microphones are located in the wings in strategic positions. Television transmitters are connected to a wire network radiating to all parts of the country, just as the wire network transmits radio broadcast programs to the different radio stations in the country now.

Television Will Present "Follies" to Millions

In Boston, Chicago, Atlanta, San Francisco, and hundreds of other points, we will have local theatres where, for 50c, audiences are assembled nightly to see the latest Broadway production. Instead of 1,500 or 1,600 people seeing the "Follies," five or ten million people will view them nightly, for one week, or for as long a time as the show is put on by the producers. Immediately the undertaking becomes tremendously lucrative, because millions now support a production; whereas before only hundreds did so, at prices which only the rich can afford.

In the Tele-Theatre, we will, of course, have *both sight and sound*, and the audience will actually see and hear their favorite actors at the exact time when the production is being performed in New York. And, of course, it will even be possible to have the actors enjoy the applause, because microphones in the Tele-Theatre will pick up the sounds of the applauding audiences and convey the sounds back to New York; so the actors will have the satisfaction of the applause which is now missing, so much to their detriment, in motion pictures.

Diversity of Television Programs to Be Available

Naturally, there will be a number of Tele-Theatres in the larger cities, all supplied by the central theatre in New York; so that, if you wish to go out in the evening, you need not see a musical show if you do not wish to do so. You may, instead, see a "comedy" or "straight drama" in another Tele-Theatre in your own town, because New York City will telecast a multiplicity of productions for the same evening.

I need not mention that the productions of the future will be on an unparalleled and prodigious scale, never approached before; for the simple reason that, when millions are to view the same performance, naturally it can be ever so much more elaborate.

And, to satisfy remote points such as the West Coast, duplicate performances must be put on later in New York, on account of the difference of time. Thus, for instance, a man in San Francisco will be seated at 8 o'clock (his time), which is 11 P.M. in New York, when the second performance for Western points starts.

TELEVISION NEWS IS PUBLISHED ON THE 15th OF EVERY OTHER MONTH

THE NEXT ISSUE COMES OUT FEBRUARY 15TH

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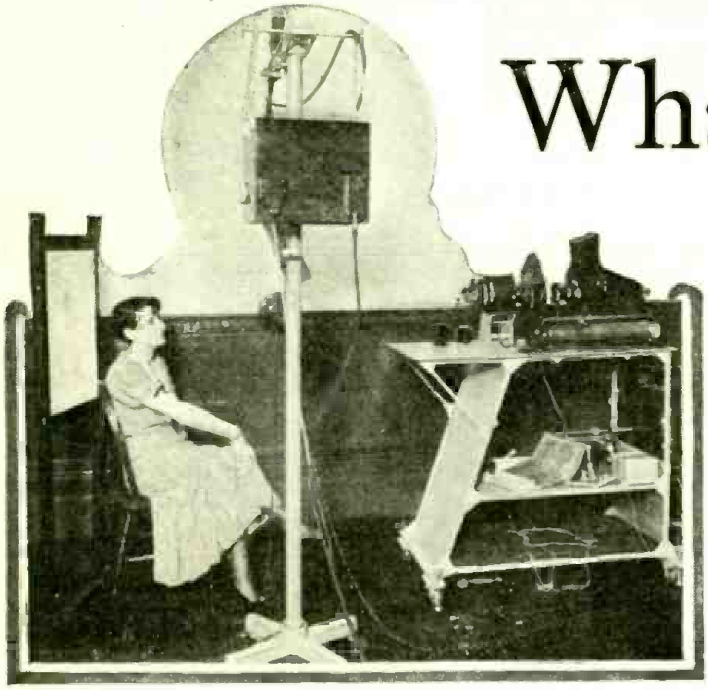


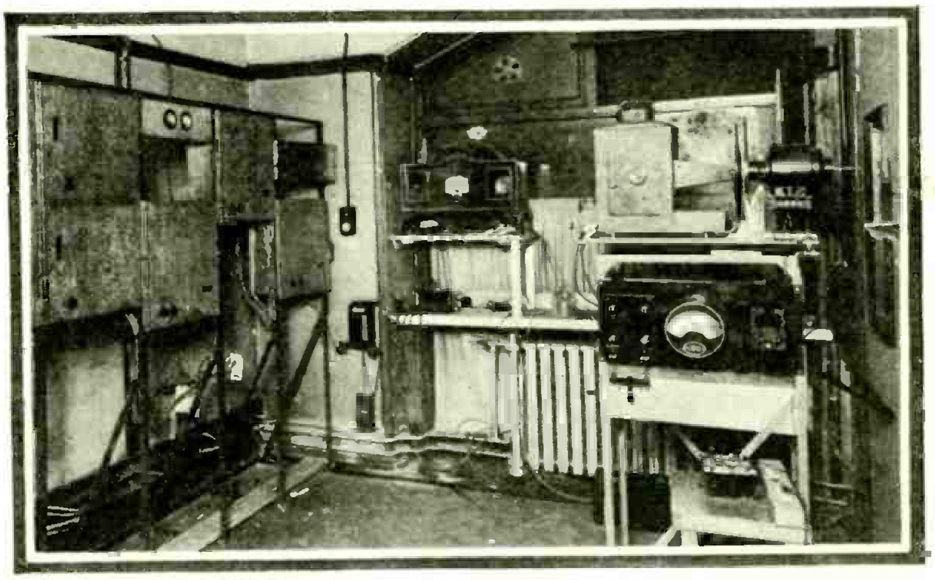
What ENGLAND With

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

This article by Mr. Chapple comes at a very opportune time when Mr. John L. Baird is visiting America. Mr. Baird has made a great name for himself in England; at the present time his company's television programs are being broadcast daily in conjunction with the British Broadcasting

Left: In the Baird experimental television laboratory in England; the subject is being scanned by flying spot. Below: New television control room of the Baird Company.

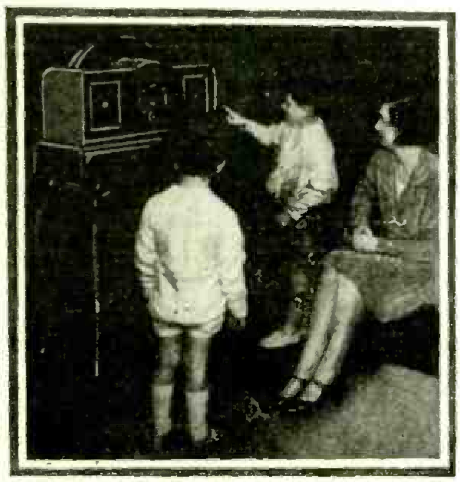
ordinary broadcast service channel used for speech being employed. This established, once and for all, that television could be broadcast under commercial conditions and the demonstration was hailed by the Postmaster General and his committee as a "noteworthy scientific achievement."



ANY attempt to keep pace with television developments is fraught with difficulties because, month by month, new ideas, or advanced developments of old ideas, make their appearance.

As far as England is concerned, television has in no way been standing still and the time is most opportune to deal with some of the most outstanding achievements. We have become accustomed, by means of radio, to hear voices and music which come from hundreds or even thousands of miles away. In this case, however, we are only hearing and are in the position of a blind man. Television is, therefore, of the utmost importance because it is going to complete the business of the ear by adding *sight*.

Many and intricate are the methods which have been applied to bring television to fruition, and the first man to achieve demonstrable results was Mr. John Logie Baird. Fortunately, I have been in constant touch with this inventor for some years, and have watched the progress made; so let me explain some of the outstanding achievements of the past two years.



The little boy in the center is pointing to the window on the English Baird Television receiver where he sees the image.

Prior to 1929

Let me deal first of all with the present *television broadcast service*. Prior to 1929 the Baird Company broadcast experimental television transmissions from their own transmitter of low power, situated on the roof of their laboratories in Long Acre. These were very successful but, obviously, the service area served by these broadcasts was of a very narrow compass. Negotiations were, therefore, undertaken between the Baird Company and the B. B. C. (British Broadcasting Company) to see whether television could be broadcast inside the normal broadcast band, alloted to public-service stations.

Early in 1929, the Baird Company gave a demonstration of television through the old "2LO" station before a representative committee of the engineers of the British Post Office and the B. B. C., and members of parliament. Television was received on portable "televisors" both at the Post Office and at Savoy Hill; no separate synchronizing signal being transmitted and only the

This led up to the successful conclusion of the lengthy negotiations between the B. B. C. and the Baird Company for an experimental television service through 2LO, which was inaugurated on September 30, 1929. This was for vision only; as on that date the present Brookman's Park (London) transmitter was unfinished and during the inaugural ceremony it was necessary to transmit, first of all, speech and afterwards the vision of each individual speaker and artist. The single service of vision alone ran for seven months and on March 30, 1930, "dual" *sound and vision* made its bow to the public from the completed Brookman's Park twin transmitting stations.

Originally the "control room" and "studio," situated at the Baird Company's premises at Long Acre, were of rather small dimensions and it soon became apparent that, if the service of television was to be maintained at a high standard, it would be necessary to increase both the size of the studio and the control room. This was done and

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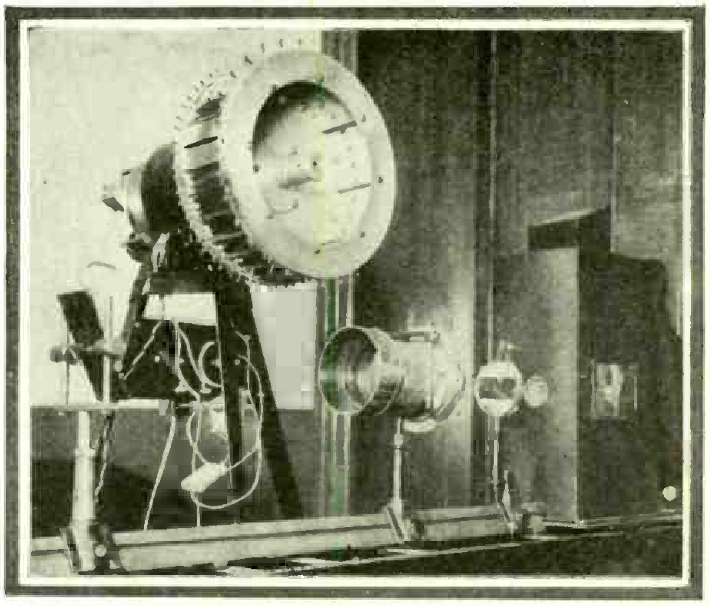
HAS DONE *TELEVISION*

Co. The Baird television system made it possible recently, for Englishmen to see their famous "Derby" right in their own homes—sounds, voices, and all. Thousands of Englishmen have either purchased or built from kits, television receivers for receiving the daily programs.

has been in use for several months now. One of the accompanying pictures shows the new control room with monitor, switch and amplifier panels, scanning light, etc.

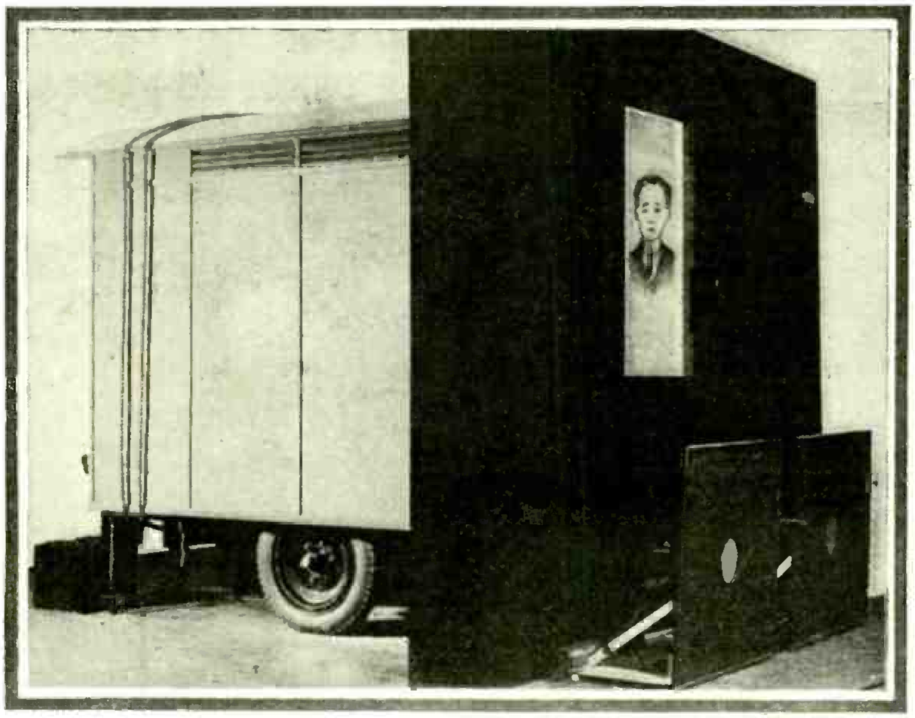
How Television is Broadcast in England

It will be interesting at this juncture



Above: The newest mirror drum and lens system used with the Baird modulated arc.

Below: Large Baird television "lamp" screen, mounted on a portable truck; note loudspeaker for voice.



to digress for a moment and explain the manner of conducting a normal television broadcast. The transmitting apparatus is sectionalized into two parts, that of the studio and that of the control room; these two rooms being divided by a special partition which is noiseproof—that is to say the sounds from the studio cannot pass through into the control room. There are three windows in this partition, two for use in conjunction with the television transmitter and a center one for use as an inspection aperture. High quality plate glass has to be employed, and this must be thinner than is really advantageous for deadening the sound otherwise light would be absorbed. Furthermore, the quality of the glass must be above suspicion otherwise curious image effects will result. In the studio, which has the usual drapery on the walls, are arranged banks of photoelectric cells on suitable movable stands, and also the signalling lights which function between the studio and the control room.

Two Transmitters Employed

There are two transmitters employed. One is a light-spot disc model, somewhat similar to the early pattern of "transmitting table" used by the Baird Company; except that it is now possible to "swing the light beam" vertically and horizontally, as required, in order to follow the movement of the artists. This particular transmitter is utilized for "close-ups," that is the head-and-shoulder images. In the early days of television broadcasting it was possible to broadcast only the head-and-shoulder images and, although these came over with remarkable quality of detail, it was felt that, from the entertainment point of view a great deal was missing, owing to the inability to transmit full length images. Intensive research work has, however, enabled the Baird Company to develop this side of their service and there is now in the control room a mirror-drum transmitter which is employed for semi-extended and extended scenes. It is also possible, as in the case of the light-spot disc model, to follow the movement of the artists when such a course is necessary.

Amplifying Photo Cell Signals

Leaving for a moment the nature of the program broadcast, let me turn to the scheme employed for transmitting these signals through to the B. B. C.'s headquarters at Savoy Hill. The television signals are translated from light and shade to an electrical replica by means of the photoelectric cells, and passed through three separate amplifiers and a *corrector*, before being passed on to the land-line, linking Long Acre with Savoy Hill. More than one bank of cells is utilized, so that it is necessary to "mix the signals"; and this is carried

(*Continued on page* 458)

Receiving Baird television images on small scanner.

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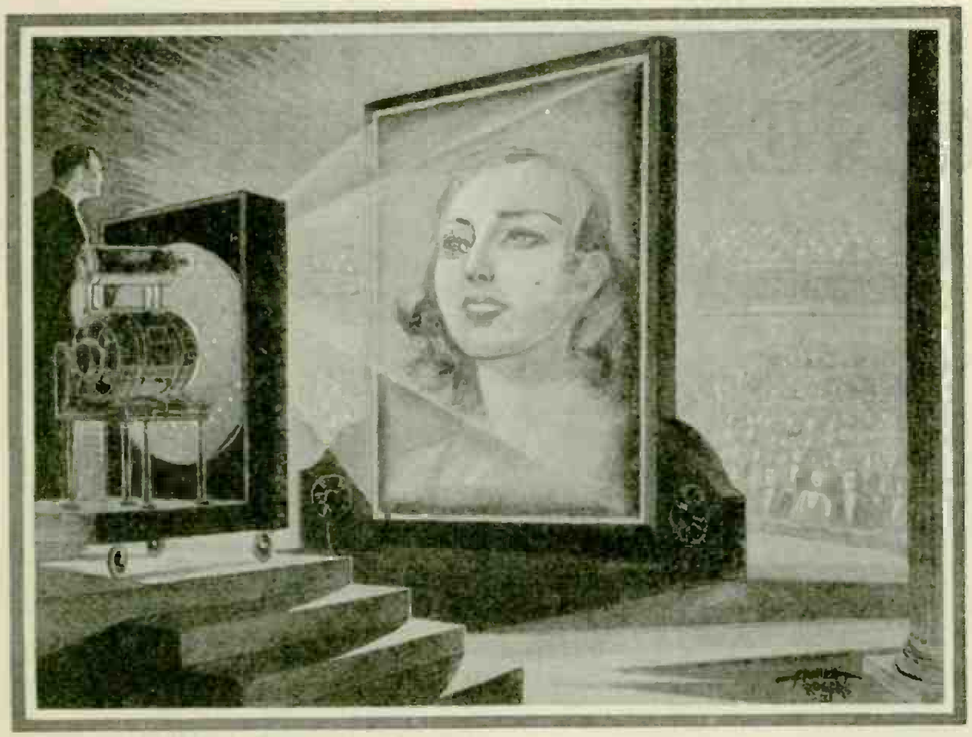
TELEVISION in the *THEATRE* A REALITY!

Sanabria's 10x10 ft. images shown to the audience as part of the regular show in the Broadway Theatre, New York City.

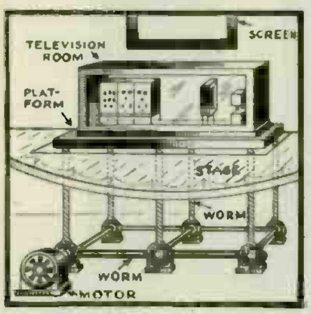


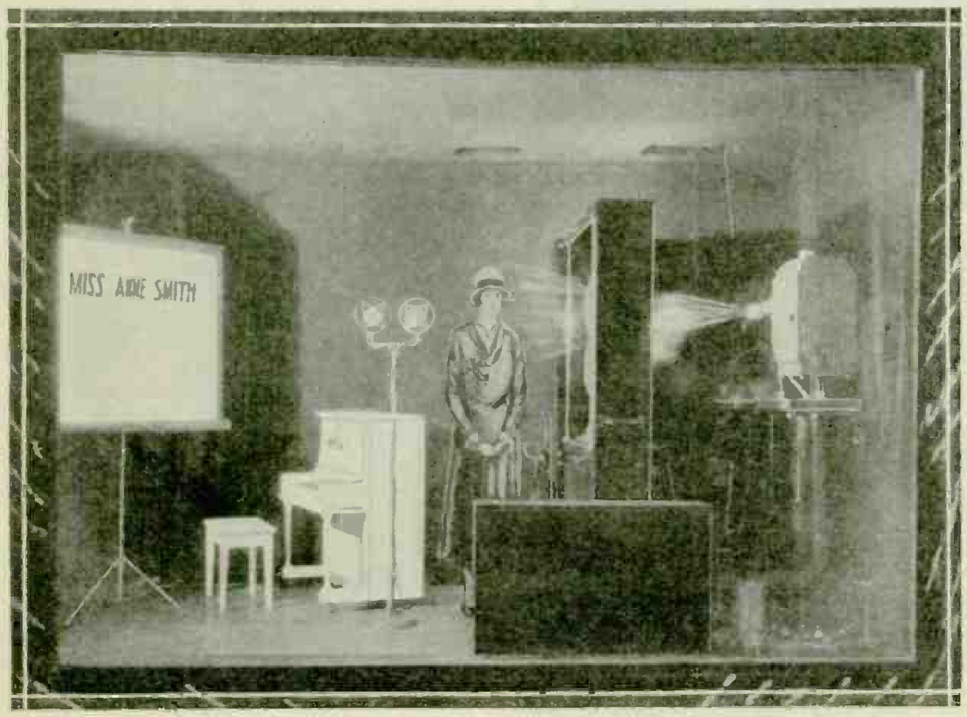
THE first regular presentation of television as a part of a regular theatre show, was given in New York City from Oct. 24 to Nov. 6th, at the Broadway Theatre. Mr. B. S. Moss, proprietor and manager, of the theatre, is to be congratulated on his foresight in billing television as one of the regular acts at his theatre. The public showed its interest in this very latest of scientific advances, by filling the theatre to capacity at every performance. The system of amplification and the form of the special, high-power projecting tube used, was described and illustrated at length in the Sept.-Oct. issue of TELEVISION NEWS.

As the photographs herewith show, the television image pick-up studio was built in the form of a room with a glass front, this studio being placed on a rising and falling platform. At first the platform elevated the television studio to the stage level and after the audience had had a good look at it for a few minutes, the studio was lowered about half-way. The actor then took his place before the photo-cell

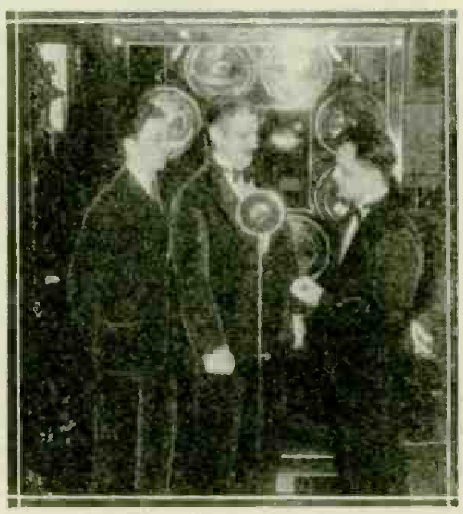
(*Continued on page* 454)

Television on the stage will be "regular and usual" tomorrow. The giant image screen is seen at top of photo, at right, while below it is the studio with glass front. The "studio" was raised and lowered on a platform as shown below.





Another view of the television pick-up apparatus in the theatre stage studio.



Left to right—George Gruskin, Pres. of Sanabria Television Corp., Carveth Wells, noted explorer, and Ulysses Sanabria.

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The FUTURE *of* TELEVISION *as* I See It

By WILLIAM S. PALEY
President, the Columbia Broadcasting System

Mr. William S. Paley, President, Columbia Broadcasting System.

We have asked Mr. Paley for his opinion on the future trend of television, because his company has had actual experience in operating one of the first television broadcasting stations (W2XAB) on a regular daily schedule.

THERE are few questions more frequently asked by us who are in any way identified with radio than: "What is the future of television?" And there are few questions more difficult to answer. It is probably best to let television speak for itself.

On the one hand it is already in practical application, instrucing and entertaining increasing thousands. On the other hand it is still a laboratory product receiving the attention of skilled men of science. From this dual process the technique of visual broadcasting advances almost daily. New problems arise, are faced, are often solved. Whether in time all of the problems will be solved is, of course, unknown to anyone. The television prophet has a dangerous role; it is far better to speak with caution and reserve.

Regular Programs Daily Since July

At Columbia we have given television what may be regarded as its most thorough test since its inception. Dating from July of this year when we inaugurated the experimental station W2XAB in the Columbia building in New York, we have been on the air seven hours a day, seven days a week.

The operation of that station is proof conclusive that television is not "just around the corner." It is actually here, although admittedly in an experimental stage. Within only a few months the images of speakers and singers have gained increasing clarity and accuracy. Our programs have been planned not only from the standpoint of entertainment, but with the goal of intensive and progressive experiments into television's possibilities.

Many Attractive Features Telecasted

Among the program novelties scheduled for W2XAB have been fashion expositions, pantomime performances, bird and dog shows; piano lessons stressing finger movements; dancing lessons featuring close-ups of foot movements; tests in make-up; instruction in several sports; and scores of interesting and instructive events.

HIGH SPOTS IN MR. PALEY'S ARTICLE:

¶ We have been on the air, seven hours a day, seven days a week.

¶ The operation of this station (W2XAB) is proof conclusive that television is not "just around the corner"; it is actually here!

¶ The "boxing bouts" have become a "regular weekly feature".

¶ Amazing developments may also be looked for in television drama presentations.

¶ Television tomorrow will exceed our most optimistic imaginings.

It is not enough, of course, to introduce novelty for novelty's sake alone. To examine one type of performance let us consider the *boxing bouts* that have become a "regular weekly feature." The first of these bouts gained attention primarily because of the newness of the idea. In subsequent weeks, however, they became interesting in themselves. The engineers and program officials studied ways and means of presenting them in more detail. Already such progress has been made that it seems safe to predict the regular televising of all types of sports events. Just as now the sports fan can remain at home and hear a thrilling description of a game given by an announcer, so does it appear likely that in the future he may actually see the contest as it is fought out on a distant field.

New Ideas in Presenting Drama.

Amazing developments may also be looked for in drama. A series of experiments in the production of television dramas will be conducted during the months to come. Especially written scenarios with especially designed backgrounds are required, and it is entirely possible that playwriting technique will be revolutionized.

And so it goes in all phases of visual broadcasting. By the time that commercial television is authorized, a development expected by many before the end of 1932, it is certain that there will be many scientific improvements over the television of today. In looking forward and attempting to foresee the television of tomorrow, one is hampered only by the limits of his imagination.

In the present experimental era, television somewhat resembles the child, in that its steps are frequently awkward and hesitant. But just as we know that in the child's tentative stumblings is contained the certain promise of the confident strides of the adult, so also do we feel that adult television will equal and quite likely exceed our most optimistic imaginings.

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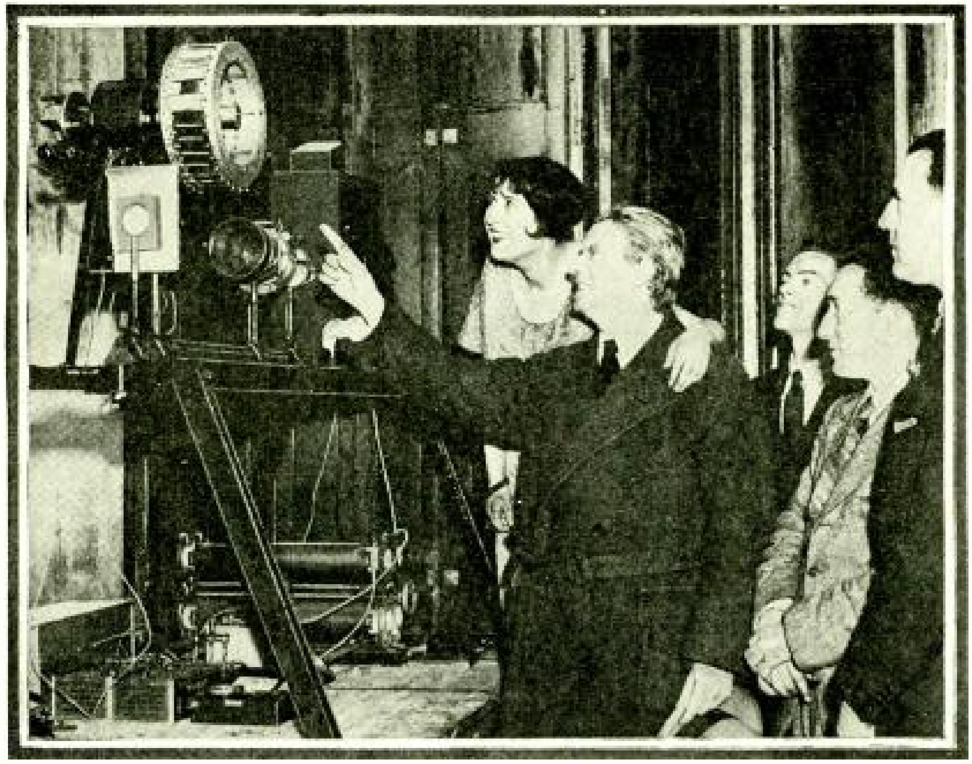
JOHN LOGIE BAIRD *Speaks His Mind*

As Told to H. W. SECOR

Undoubtedly the best-known European television expert is John L. Baird, whose system, in connection with the B.B.C., is supplying English television fans with daily programs. His newest invention is the "modulated arc" for giant image reproduction.



John L. Baird pointing to the mirror drum, which is used in conjunction with his "modulated arc," for producing large television images.

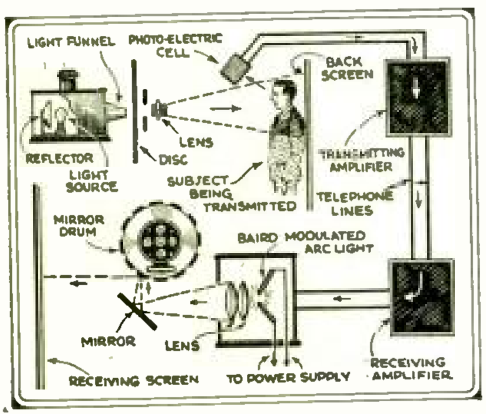
JOHN LOGIE BAIRD, the Scotsman who has demonstrated television in all its various phases and who is now Managing Director of the Baird Television Company—the leading television company in Europe, with a capital of four million dollars, and with affiliated companies in Germany, France and the United States of America—is in New York visiting the American branch of his company.

He has some interesting ideas on the future of television. He believes that tomorrow we shall have stage plays and movie productions at our beck and call, by simply turning a dial and tuning in the desired television feature.

He does not believe that the television sets will be taxed and that for portable and other uses we shall have a small "peep-hole" machine fitted with a magnifying lens; and a de luxe type which will be fitted with a screen which will show an image at least two feet square.

The Baird Modulated Arc

When it comes to cathode ray tubes as a panacea for scanning problems, Mr. Baird, does not believe in it for the immediate future; he inclines to the idea that the scanning disc will be with us for some time to come. Mr. Baird has devised a mirror scanning drum, which he uses either in conjunction with a neon tube such as a crater lamp, or in conjunction with his latest invention, the "modulated arc". Mr. Baird stated that this modulated arc and mirror drum, which are shown in the accompanying photograph, produces an image of surprising brilliance. Compared to other types of light source available for television receivers, his modulated arc is about one hundred times brighter. The television signal is caused to modulate, the current flowing through the arc and special carbons are used which enable the arc to follow the rapid variations of the television signal current. There are about 8,000 television receivers in England, Mr. Baird estimated, a great part of these being built from kits, while a considerable number are home-made receivers, built from plans furnished by the Baird Company in England.



Television transmitting and receiving apparatus in the latest Baird system, using the modulated arc and mirror drum to project images on a large screen.

—J. L. BAIRD SAYS:

¶ Television sets of tomorrow will not be taxed.

¶ Cathode Ray tubes will not prove the panacea for all our scanning problems.

¶ His new modulated arc and mirror drum is giving a more brilliant picture than any yet obtained on a large screen.

¶ Television broadcasts will be carried on waves from 200 to 550 meters; and we do not need ultra-short waves for the purpose, which only cover a limited area from each station.

Ultra Short Waves Not Needed

At the present time there is considerable activity on the part of engineers who are developing the television field, towards utilizing "ultra-short" waves, which, with their extremely high frequencies, would seem to provide the broad television channels, which many experts think we must have in order to produce a good detailed image.

Mr. Baird's opinion is that the necessity for broad television bands has been greatly exaggerated, and from his extensive experience in transmitting and receiving television images, it is his belief that we can and will obtain much better reception of television images, over narrower bands than the theory based on cinematography seems to require.

As Mr. Baird pointed out, one of the undesirable factors in utilizing "ultra-short" waves for television, is that waves of say 3 to 7 meters, only cover a small territorial area; furthermore the receiving station must, ordinarily, be within optical sight of the transmitting station.

Mr. Baird, on his visit to America, has been in consultation with the American branch of his company, who have entered into a working agreement with station WMCA of New York City, so that the Baird television images can be broadcast with "voice," in conjunction with that station. The American Baird Company is making plans to place a reasonably-priced, home television receiver on the market.

English Television Broadcasting

Among other interesting factors connected with the British television broadcasting, the following information was gleaned. A "positive" television image

(*Continued on page* 455)

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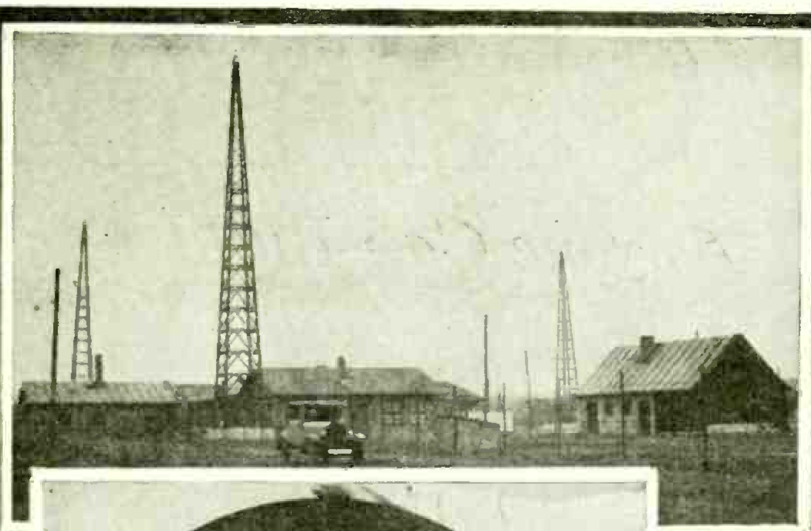
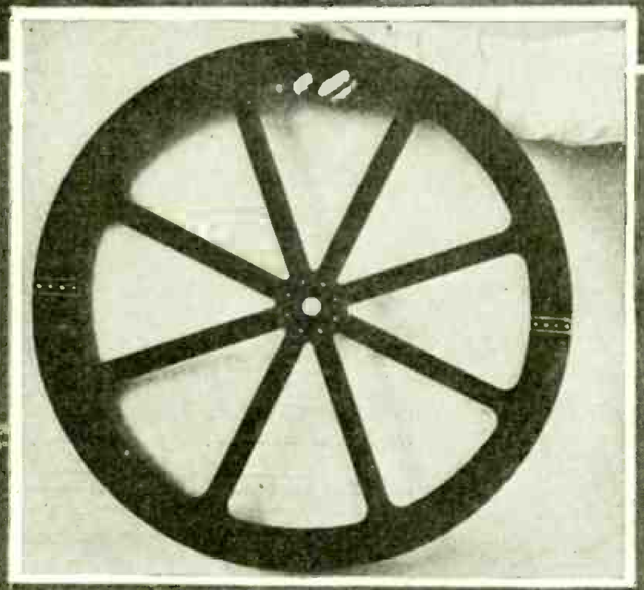


The antenna masts of the Doberitz short-wave television station.



Above: One of the scanning "wheels" used at Doberitz station; it is made in two sections.

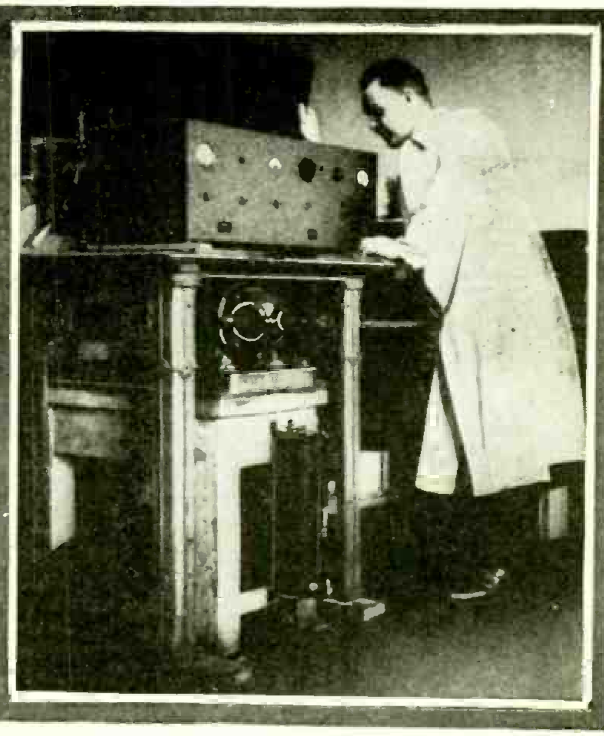


Photo-cell amplifier and scanning disc motor.

SHORT WAVE *TELEVISION* at Döberitz

By HERBERT ROSEN, Berlin

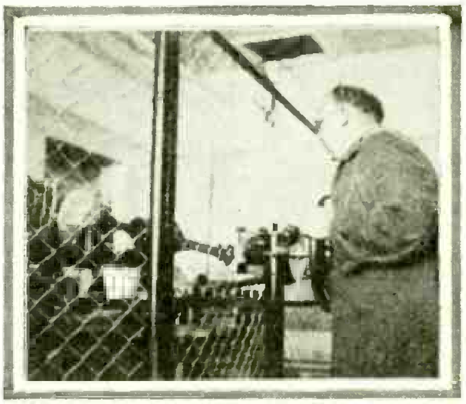
The new German television station at Doberitz, broadcast on 142.9 meters, with 48 lines and 25 frames per second.

ABOUT halfway between Berlin and Nauen, almost directly behind the airship hangars in Staaken, rise five or six antenna towers, hardly noticeable to those speeding by in autos. Here in Döberitz, this "little" station is none other than the experimental transmitter of the Reichspost Central Office, using short waves! Here work has been done on the further development and perfection of short-wave broadcasts, and now the plant is serving for the purpose of *television* experiments on short waves, which have very recently been instituted along with the broadcasts (of television on longer waves) via Berlin-Witzleben and Königswusterhausen.

The station is a small building built in the form of a cross, right on the ground and not divided into stories.

Film Used at Transmitter

After removing hat and coat, we enter the first room, and at once find ourselves in the "transmitting room." A huge *film-projection* apparatus, somewhat altered for television purposes and provided with a Nipkow disc, occupies the place of honor. The technicians are busy putting in a strip of film and getting it running, so that we have sufficient time to look about in the room a little more. Giant amplifiers and heater resistors, dynamos and batteries are to be seen, as well as the usual workbench with files, tongs, hammers, wire, coils, etc. A window in the back wall affords a glance into the actual transmitter, right at hand in a position which, for one thing, permits immediate determination of any disturbances which may arise during its operation; and, for another, makes it easy to communicate with the personnel there. We look around for the "receiver" (monitor), and our glance falls on the rear part of the room, which is cut off by a huge black curtain running the entire width of the room. Curiously we step behind it and see in the corner only a very large box, with a small quadrangular window and a magnifying glass in front of it. At the right in front of it is a set, which on closer examination proves to be a *short-wave receiver*, and now we see the Nipkow disc, the neon tube, etc. So here we have the receiver right before us.

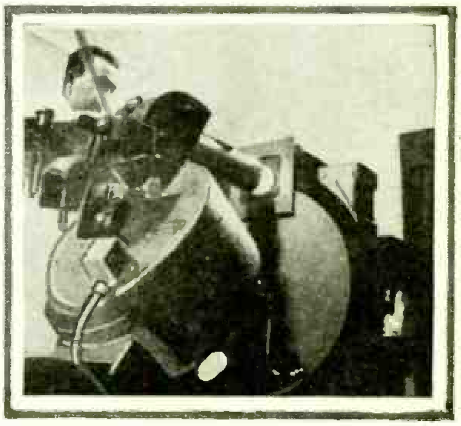


Adjusting one of the short-wave transmitting condensers.

Excellent Quality of Received Images

In the meanwhile the technicians have finished inserting and regulating the film. Signals pass back and forth, and suddenly a light shines before our eyes; the little quadrangular opening is lighted

(*Continued on page* 452)



Television transmitter for film, used at the Doberitz television station.

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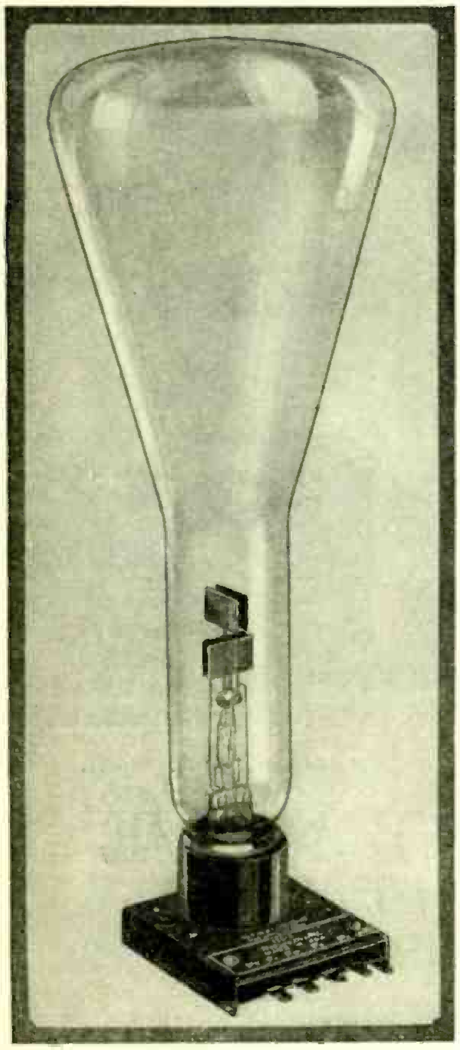
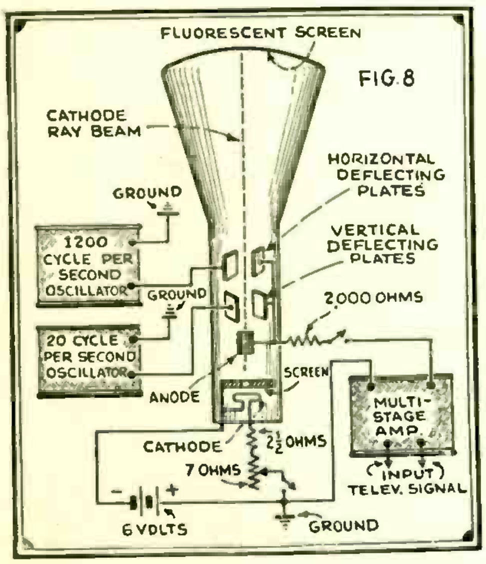
A CATHODE

Anyone Can Build



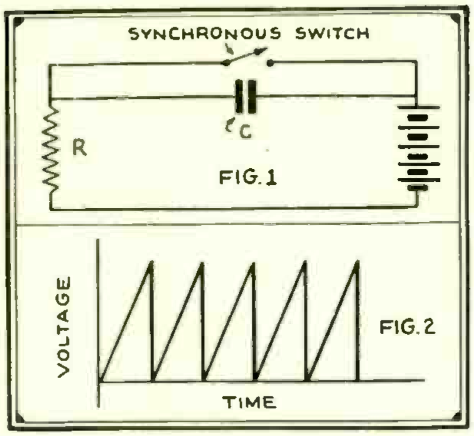
The Western Electric Co., cathode ray oscillograph tube, which has been used for television scanning.

UNDOUBTEDLY, many television experimenters interested in cathode-ray television, are anxious to know of a reliable as well as simple method of producing the "right-triangle" or "saw-tooth" wave oscillator for scanning purposes. In my experimentation with various types of cathode-ray oscillographs and their allied apparatus, I have developed an oscillator which is absolutely fool-proof as well as extremely flexible. This instrument may be used as an audio oscillator for purposes other than television scanning, thereby making it a device adaptable for many purposes.



Connections of the two saw-tooth oscillators to the deflecting plates of the cathode ray tube scanner.

Many ingenious methods have been proposed for the production of a right-triangular wave with but limited application. Mechanical devices are limited in their frequency range; electrical devices, although not limited in this manner, may be unstable, and stability is absolutely essential for proper results. Indeed, with electrical devices, unless the utmost care is taken, distortion may be introduced.



How saw-tooth oscillations may be obtained with a suitable "switch" or "valve," a condenser, a resistance and a source of direct current potential.

Simplest "Saw-Tooth" Generator

The right-triangle wave may be obtained if we have available a synchronous mechanical switch or electric valve, a condenser, a resistance and a source of direct current potential as may be seen in Fig. 1. Thus if the condenser is charged through the resistance and discharged by the synchronous switch, the potential difference across the condenser will increase linearly with time while the switch is open, and instantly drop to zero when the switch is closed.

The use of a mechanical switch has been found to be extremely cumbersome and may be used only at the lower frequencies. Evidently, an electric valve operating automatically at the desired synchronous speed would be the ideal device to be used. Such a valve is nothing more than an ordinary neon lamp. Now, let us consider the circuit in Fig. 3.

Neon Tube as a Synchronous Valve

If the neon lamp were subjected to an increasing voltage, there would be no current flowing until the "ignition" or "ionization" voltage is reached. This increasing voltage occurs while the condenser C in the circuit is being charged through the resistance R. Current will then flow through the neon lamp in a manner similar to the closing of the switch in figure 1, and will continue to flow until the "extinction" voltage is reached. The current flow will now stop, as in the opening of the switch in figure 1.

The frequency of oscillation may be controlled by the adjustment of the resistance R and the capacity C in the circuit. Let us consider the circuit in Fig. 4, which is the equivalent of Fig. 3.

R=resistance in circuit
e=voltage across condenser C
E=applied voltage
i=current flow in circuit
Ri=voltage across resistance R
t=Time

$$E = Ri + e \qquad (1)$$

$$i = C\frac{de}{dt} \qquad (2)$$

SUBSTITUTING EQUATION (2) INTO (1) WE GET:

$$E = RC\frac{de}{dt} + e$$

OR

$$\frac{dt}{CR} = \frac{de}{E-e}$$

THEREFORE

$$\frac{t}{RC} = -\log_\epsilon (E-e) + G$$

WHERE G IS A CONSTANT OF INTEGRATION

LET $t = 0$ WHEN $e = 0$

THEN $G = \log_\epsilon E$

OR

$$\frac{t}{RC} = -\log_\epsilon (E-e) + \log_\epsilon E$$

$$\epsilon^{-\frac{t}{RC}} = \frac{E-e}{E}$$

$$e = E\left(1 - \epsilon^{-\frac{t}{RC}}\right) \qquad (3)$$

Equation (3) represents an exponential curve, showing how the frequency may be varied by varying either the capacity C or the resistance R.

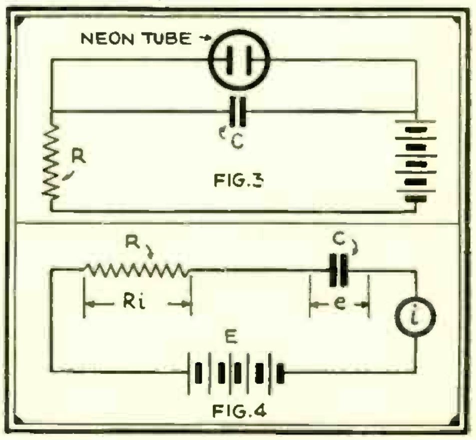


Fig. 3, above, shows connection of neon tube "valve" in saw-tooth oscillator; Fig. 4 is the electrical equivalent of Fig. 3.

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RAY *Scanner*

By M. RAPPAPORT, E.E.
Associate Member, A.I.E.E.

Mr. Rappaport is an electrical engineer, an Associate of the American Institute of Electrical Engineers, and he is one of the few men who have actually built and experimented with a cathode ray scanner, together with the necessary saw-tooth oscillators. The author carried on several years of research work on cathode ray tubes.

The editors feel that they were fortunate indeed, in obtaining this up-to-the-minute article which explains the theory as well as the construction of the saw-tooth oscillators required in the operation of the cathode ray scanner. This is the first time to our knowledge, that all of the details for this newest scanner have been given. It will work on present-day signals, as well as any future scanning line patterns, without any changes in the present design.

The oscillating current may be adjusted for frequencies ranging from the upper audio down to the extremely low values of say, one per hour. There is absolutely no reason why, with sufficient capacity and a great deal of patience, the lower limit cannot be reduced indefinitely. On the other hand, frequencies much higher than audio frequencies are limited by the capacity of the neon tube itself.

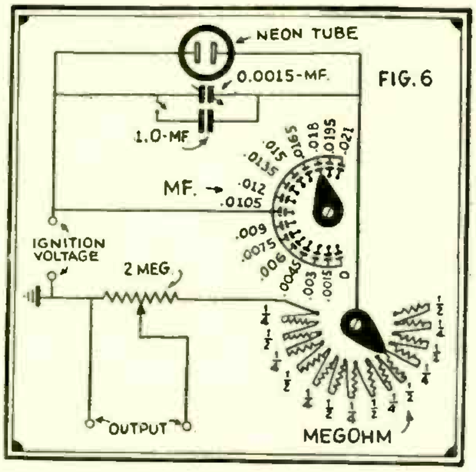
The exponential curve obtained by the charging of a condenser through a resistance has the shape represented by (*a*) in Fig. 5. By using a rather small element of this curve, the rising portion of the right-triangular wave may be considered straight for all practical purposes. The falling portion of the saw-tooth wave, which represents the extremely short period in which current is flowing through the neon tube, is so extremely rapid that the spot of light on the fluorescent screen of the cathode ray tube, shows only a negligible trace as it sweeps back to commence a new cycle.

The Neon Tube Oscillator

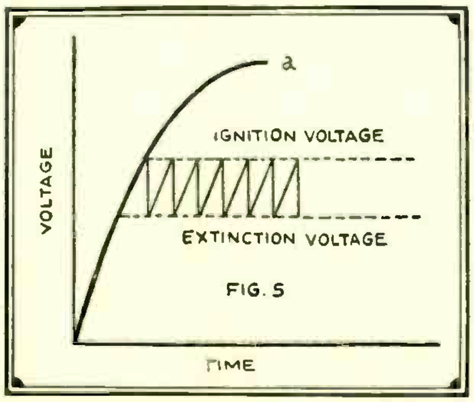
Now that we understand the fundamental theory of the neon-tube oscillator, we may proceed with the design. Fig. 6 represents a neon oscillator with sufficient variables to give a frequency range of from one cycle every fifteen seconds to the upper audio frequencies. The neon tube employed in this circuit is of the ordinary small-plate type used in television. It does not necessarily follow that other types of neon tubes cannot be used, although it is advisable to use tubes having an ionization voltage of not more than about 200 volts (or in that vicinity) for convenience sake.

The 0.0015-microfarad variable condenser is employed for the purpose of making very close adjustments of frequency. A vernier dial controlling this condenser is desirable, although not essential. Another 1-microfarad condenser is connected in parallel with the 0.0015-microfarad condenser through a toggle switch. When the switch is closed, the extremely low frequencies will be obtained and when it is open, the higher frequencies will be produced. A third set of condensers having a range from zero to 0.021-microfarad in steps of 0.0015-microfarad, are attached to a tap-switch, having fifteen taps. By this tap-switch-condenser arrangement, a wide frequency range is obtainable. Another fifteen-tap switch, having resistors of one-quarter megohm and one-half megohm in alternate steps, is inserted as shown. This completes the frequency controls of the oscillator.

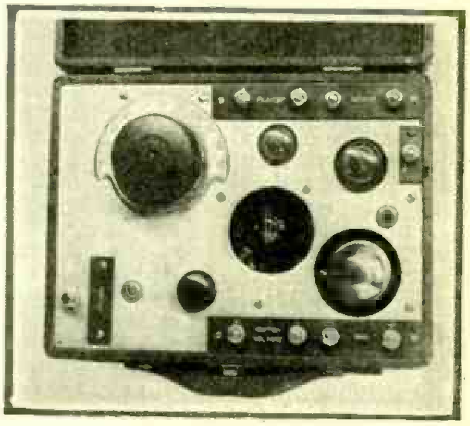
A two-megohm potentiometer is used for controlling the output voltage to the deflecting plates of the cathode-ray tube. The arrangement shown in Fig. 6 may only be used in connection with a very high-impedance load, as may readily be seen from the figure. If a rather low impedance load is used, there will be a change in the resistance of the oscillator circuit and, as a result, there will be a change in the frequency. When the circuit shown in Fig. 6 is used with a cathode-ray tube, it will operate very satisfactorily, because the impedance of the cathode-ray tube and its allied circuit is extremely high.



The saw-tooth oscillator shown in Fig. 6 above is especially suited to a very high impedance load.



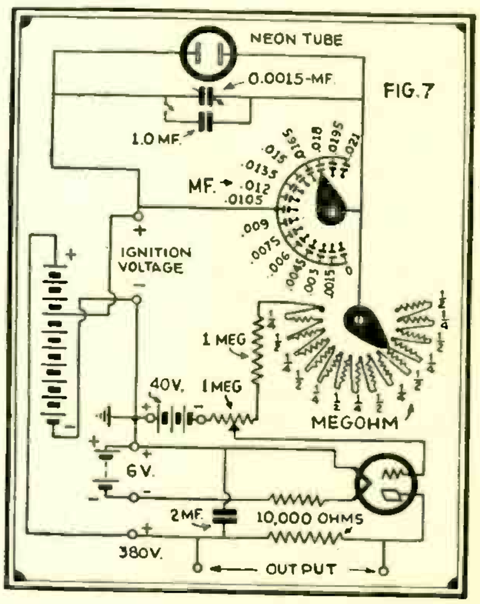
The exponential curve obtained by the charging of a condenser through a resistance, has the shape represented by "a".



Appearance of a saw-tooth oscillator built by Mr. Rappaport and used in his experimental cathode ray scanner.

Details of Amplifier for Oscillator

Many of the experimenters contemplating the construction of such an in-
(*Continued on page* 451)



Saw-tooth oscillator equipped with one stage of D.C., amplification, using a '71A tube.

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D. E. Replogle, vice-pres., of the Jenkins Television Corp., presenting a check for $100.00 and a complete Jenkins "radiovisor kit" to Mr. Hansell, first prize-winner in the New York "Sun" contest.

PRIZE-WINNING *TELEVISION* Receiver *In N. Y. "Sun" Contest*

Erik Hansell, won first prize in the N. Y. "Sun" television set-building contest, with the receiver here described. The prize was given for the most efficient and neatly built television receiving set. Yes, it is a superhet!

THE television receiver to be described was built primarily for television; although tuning extends from approximately 15 meters to 550 meters by means of plug-in coils. Most television receiver designs have been run along lines of broadly-tuned radio-frequency amplifiers, followed by a detector and resistance-coupled amplifiers. The designer of this receiver, Erik Hansell, however, adopted the superheterodyne principle to determine by experiment if it were possible to receive television broadcasts with less critical tuning, in order to pass the frequencies needed for good television reception.

The oscillator, first-detector circuit and the intermediate-frequency amplifier were designed with a broad tuning range. Regeneration control has been added to the second detector by the use of an extra tube located underneath the chassis. This control was not intended for television purposes, but to aid in tuning when working wavelengths in the amateur spectrum.

Unique Features Involved

There are several unique features involved in the making of this receiver. First, there are the two-gang tuning condensers used in the oscillator and first-detector units, which are automatically adjusted as to capacity, depending upon the coils employed. For short-wave work the smaller sections are utilized; while the larger ones are used for the longer wavelengths. Vision of the tuning is effected by means of a lens on the right side of the panel, behind which is placed a small dial lamp. On the left side of the panel is a second lens, in back of which is a very small neon lamp which acts as a monitor when tuning in television signals. With this in operation, the use of the speaker for the same purpose is rendered unnecessary. The middle dial is the on-off switch, while the others follow in sequence from left to right, as follows: Correcting condensers for oscillator; regenerative control; volume and tuning controls. The double-pole double-throw switch in the rear of the chassis is for use to connect an output transformer into the circuit if a speaker is needed.

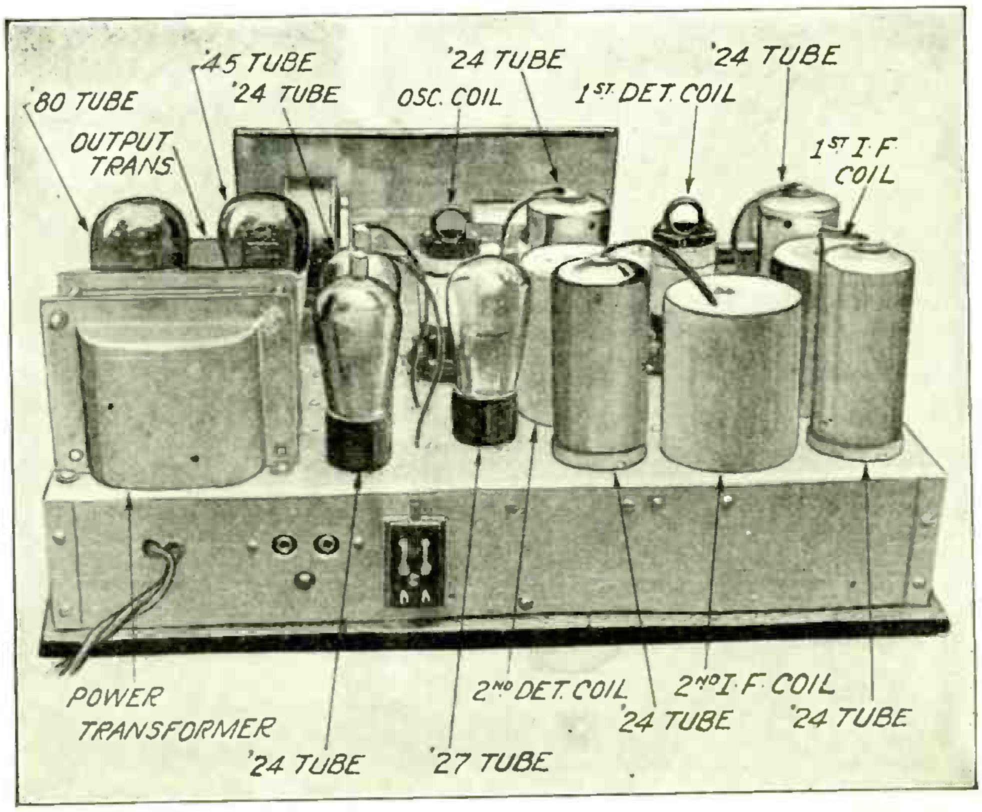
Very Compact

The outstanding feature of the set is its compactness. Everything is contained in one chassis, so that one needs only a power socket, aerial, ground and speaker for the set to function. A fair illustration of compactness is the use of a special rack for the audio resistors, which is attached by means of hinges to hold the rack fully two inches away from the base of the chassis. The advantages of this are twofold; first, the complete audio resistor and condenser unit is prevented from touching any other metal part of the receiver, and, second, by swinging out the rack access is obtained for repairs. Close above the resistor rack are condenser blocks; these slide easily right or left to facilitate repairs. Above the condensers is a '27 type tube; it is this tube which controls regeneration whenever this advantage is called for. The overall dimensions of the chassis are 18x12x8 inches. Six '24s, two '27s, one '45 and one '80 type tubes are employed.

The Oscillator

The circuit diagram shows that the output of the oscillator is coupled into the detector circuit by means of a voltage drop across a resistor in series with the detector screen grid lead. This is an adaptation of the so-called screen-grid modulation principle described by Howard Chinn in the June issue of "*QST*." The use of this method is advantageous in that a direct union of the incoming signals and beat-frequency of the oscillator take place in the first-detector tube, allowing it to act freely as an amplifier.

In addition, there is another advantage in using this type of coupling, in that reaction of the oscillator tuning on the first-detector frequency is almost eliminated. The experimenter will appreciate this; since it is one of the most serious problems in superheterodyne design,



Rear view of Mr. Hansell's superhet television receiver, which won first prize in the N. Y. "Sun" television set-building contest.

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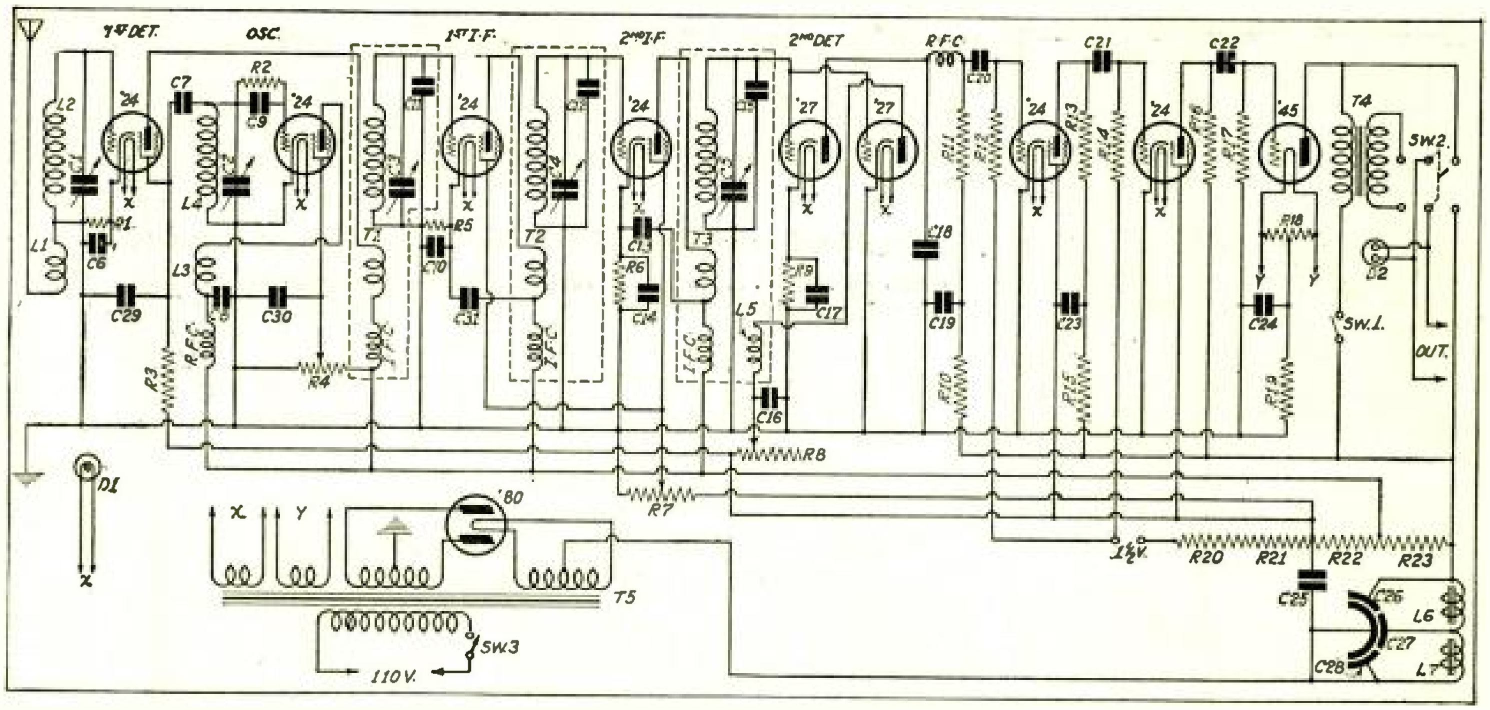


Here we have the complete wiring diagram of Mr. Hansell's prize-winning superheterodyne television receiver, including the power supply unit. A switch is provided for connecting either the loud speaker or neon tube to the plate circuit of the '45 output tube.

especially when single-dial tuning is used. The connection of the oscillator is through a 25,000-ohm resistor connected in series with the screen-grid of the first-detector tube and voltage source. The amplitude of the heterodyne frequency is determined by a 100,000-ohm potentiometer which in this case is connected in the screen-grid circuit rather than in the plate circuit. By taking advantage of this, a relatively cheap potentiometer can be used. The dial for this control is located between the three main shield cans, as shown.

When constructing the oscillator it is well to keep in mind that the beat-frequency must always track the detection-frequency by an amount which is determined by the frequency to which the I. F. stages are tuned. In this receiver the frequency employed at all times in the oscillator is 800 kilocycles below the detector frequency. It makes no difference whether the oscillator frequency be above or below the detector frequency; although some advantages point to a preference for a frequency below rather than above.

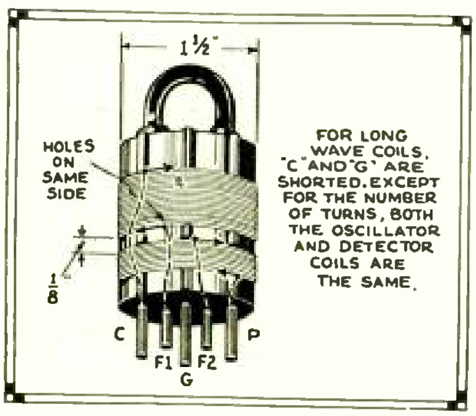
In series with the oscillator leads to the screen-grid of the first detector is a small fixed condenser. This capacity should be kept as low as possible; otherwise the strength of the beat frequency will be seriously affected by feedback. The value chosen for this particular circuit was .00004-mf. Connections to grid leak and condenser, which are part of the network in the oscillator circuit, should be kept as short as possible. The value of the grid leak and condenser should be as large as possible without permitting the unit to howl, thereby allowing the screen-grid tube to deliver a very strong beat-frequency.

The first detector employs a '24 screen grid type of tube, but has nothing unusual about its makeup. Herewith is a table of coil data:

Coil No.	Frequency Range	Oscillator: Grid coil	Oscillator: Turns per inch	Oscillator: Tickler coil	First Detector: Grid coil	First Detector: Turns per inch	First Detector: Tickler coil
1.	500— 2,500	38	25*	19	74	*	19
2.	1,500— 4,000	27	20	16	44	*	16
3.	3,500— 7,000	18	15	13	26	20	13
4.	6,500—11,000	12	10	10	15	15	10
5.	10,000—15,000	7	10	8	9	10	8

*Detector coils No. 1—No. 30 d.c.c. (no spacing)
No. 2—No. 26 d.c.c. (no spacing)
Oscillator coils No. 1—No. 26 d.c.c.

All coils are wound on Pilot Ribbed forms.
All grid turns, except those marked, No. 20 wire.
All tickler turns, No. 30 d.c.c. (no spacing).



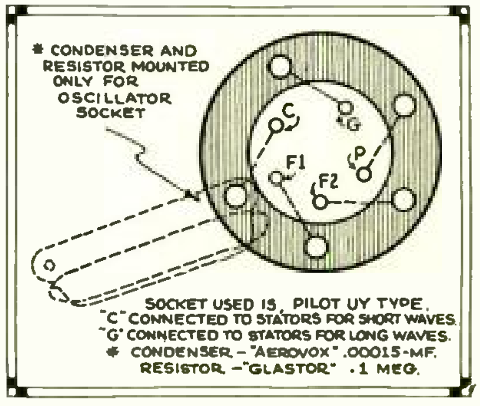
Type of plug-in coils used in Mr. Hansell's prize-winning television receiver.

The two tuning condensers are each .00025 mf. Sometimes it may be advisable to place an equalizing condenser in parallel with the first detector tuning condenser. This, however, is unnecessary if the coils are wound correctly, which can only be found by experimentation.

The Intermediate Stages

The idea of using a beat-frequency oscillator to heterodyne the incoming signals to a pre-determined low frequency that will pass the intermediate stages is obvious, in that the lower the frequency the easier it is to amplify. Each of the intermediate stages has been adjusted to have an extremely broad frequency-range. By doing this the higher frequencies required in television are allowed to pass. Broadly-tuned circuits in the set are obtained by overcoupled resonant coils. This is accomplished by increasing the impedance of the circuit. The coils are one and one-quarter inches in diameter and wound with approximately eighty-four turns on the secondary and eighteen turns on the primary. In series with these primaries are choke coils, which help to step up the impedance. Coils like these are standard and can be secured at most any radio shop.

(*Continued on page* 448)



Details of condenser and resistor mounting for oscillator socket.

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Make Your Own

All dyed-in-the-wool television experimenters sooner or later decide to build a "lens disc" scanner, in order to use a crater tube and project large images, so that the whole family may enjoy the television programs. Mr. Pajes, a specialist in this line, here tells how to make your own lens disc at low cost.

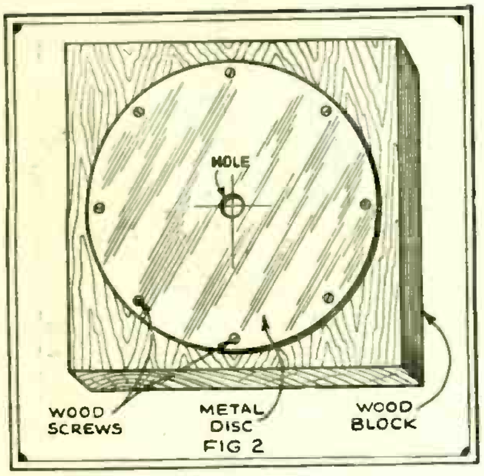

Fig. 1A—How to mount metal scanning disc on wood block for drilling.

THE lens scanning disc is the important piece of television apparatus now engaging the attention of television enthusiasts everywhere.

The reason for this is that, in order to obtain (at the receiving end) a large television image (of a size, say, 8 inches square or more), we need the combined effects of one of the new neon crater tubes, together with a lens scanning disc and motor.

Several companies are now supplying the crater tubes. We will not discuss motors or synchronizing devices in this article, as these have been dealt with elsewhere in this and previous issues of TELEVISION NEWS.

The job before us at the moment is how to lay out and construct a satisfactory lens-disc; that is, a scanning disc containing 60 lenses. Moreover the lenses used must be of a size which can be readily purchased on the open market.

Constructional data are given herewith for two different sizes of lens-discs, both designed for 60 lenses. One of them contains lenses of 13/16" in diameter; the second is designed for lenses ⅝" diameter.

In brief, a lens-disc is desired which, when used in conjunction with a crater tube, connected to a television receiver having an output stage utilizing a '45 tube, with 250 to 300 volts in the plate circuit, will yield a brilliant image on a ground glass screen about 8 inches square.

General Design of Disc

Let us consider a 22" (diameter) scanning disc; if we assume round apertures (holes) their diameter will be .015" each. This disc diameter provides sufficient area for the use of 60 lenses, each 13/16" or .8125" diameter, placed around a spiral with six angular degrees separating each two adjacent lenses.

The following shows the increase of useful light area of a lens as compared to a simple aperture. From the following mathematical relation:

$$\text{Lens area} = \frac{\pi\,(.8125)^2}{4}$$

$$\text{Aperture (hole) area} = \frac{\pi\,(.015)^2}{4}$$

$$\text{Area ratio} = \frac{.8125^2}{.015^2} = \frac{.660156}{.000225} = 2{,}934$$

This figure (2,934) indicates how many times more light we are able to pass through a lens 13/16" in diameter compared to that passed by an ordinary aperture .015" in diameter.

Of course we do not realize the whole gain figured out above; since there will be some appreciable loss during the transmission of light through the lens, and also due to reflection from the lens surface. The screen's absorption factor is of equal importance.

If we take the efficiency of a cheap lens to be $K_L = 0.75$ and the efficiency of Bristol board used as a screen as 0.80,

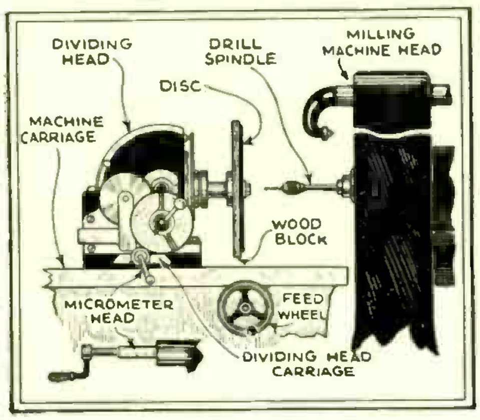

Fig. 1—Shows how disc is mounted in Milling machine, if it is to be drilled in that fashion.

we shall gain by using a lens instead of an aperture:

$2{,}934 \times 0.75 \times 0.80 = 1{,}760.4$ times as much light.

This gain will convince anyone as to the superiority of the lens scanning disc and it is safe to say that, when rationally designed, the lens scanning disc represents actually the best television receiving means which is available at the present time.

Lenses and Lens Layout

For those who would like to experiment with a home-made lens scanning disc, the following data will be found useful.

For the metal scanning disc, aluminum is very good, because of its low specific gravity; better still is duralumin, which is readily obtainable at a little higher cost than that of aluminum. Duralumin is particularly well adapted to scanning disc requirements, for it has a lot of spring or stiffness which ordinary aluminum lacks. The disc blank should be of No. 10 (sheet metal gauge) stock (thickness 0.102"); and you should order a round blank 22½" in diameter, if you are going to use the 13/16" diameter lenses; or 19" diameter if you are going to employ the ⅝" diameter lenses.

You can purchase these discs from any sheet-metal supply house; and ask them to mark the center on the disc for you.

Preparing the Disc for Lenses

If you have no small machine shop of your own, it would probably pay you in the end to take your disc to your local machinist and tell him just what you want done. Failing this, one can carefully lay out the disc and perform the operations by hand, which is a little slower job.

The writer's method is to employ a milling machine, equipped with a dividing head (accurate to 1/10 of an angular degree) which is placed on a carriage operated by means of a handle to which a micrometer head is attached.

One complete rotation of the micrometer head usually corresponds to ¼" shift in the radial direction of the disc.

If such a machine is available for laying out the disc, the following procedure will be found useful. Fasten the metal scanning disc to a piece of hard wood, using about six to eight wood-screws, as shown in one of the accompanying sketches. This piece of wood must be perfectly flat and of even thickness. Next, drill a ¾" diameter hole through

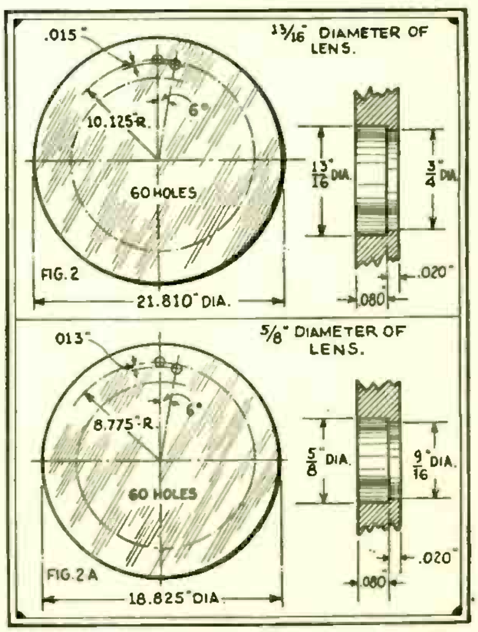

Fig. 2—Layout data for two sizes of lens discs, using either 13/16" or 5/8" diameter lenses.

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LENS DISCS

By WOLF S. PAJES
Television Engineer

the disc and wood, in its approximate center; the center of this hole must lie in the center of the dividing head during the entire procedure of drilling the 60 holes in the disc. This is done by placing our disc on a shaft protruding through the center of the dividing head. The fit between the shaft and the hole in the disc must be tight. After this has been done fasten the disc and its attached board to the carriage of the milling machine by means of several bolts and dogs; making the disc as secure as possible against moving. As a last preparation before drilling can be started, place the center of the drill above the center of the protruding shaft; that is, above the center of the disc. This position must be determined with an accuracy of plus or minus .001 inch.

Drilling the Lens Holes

Place the indicator of the micrometer head on zero. The center of our extreme outer hole will be placed at a distance from the disc center of 10⅛ inches. As each complete rotation of the micrometer head represents ¼" forward motion, we turn the head 10⅛ ÷ ¼ or 40-½ times. The center of the drill is now placed in position ready to bore the hole. Next place the indicator of the dividing head at zero on the index. The drill used is 12/16" in diameter; for the lens to be used (for the larger disc) is 13/16" in diameter, and space must be provided for the counterbore, which will leave a shoulder on which the lens will rest eventually.

When drilling the hole through the metal disc, only light pressure should be applied, and no lubrication is used. While carrying out the drilling operation on the disc, one important thing to remember is that we should not retrace the motion of the micrometer head; in other words, turn the micrometer head in one direction, for if we retrace the motion of the micrometer head, difficulty will be found in bringing it back exactly to the same position, on account of the lost motion existing in the worm gear.

After drilling the first hole, we turn the head six degrees and shift the micrometer head by .015" toward the center of the disc. We execute 59 similar operations and then have our 60-hole disc finished. Note that the total step-down or pitch of the spiral, corresponding to the difference between centers of the first and last hole, will be 59 × .015" = 0.885".

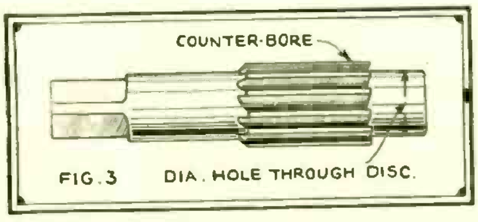

Fig. 3—Counterbore used to make 60 "lens seats" in disc.

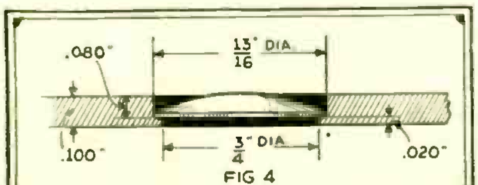

Fig. 4—Dimensions of "lens seat" and sight hole.

Counterboring for Lenses

A special tool is recommended for this operation, and a sketch of a suitable tool is reproduced herewith. The lower part

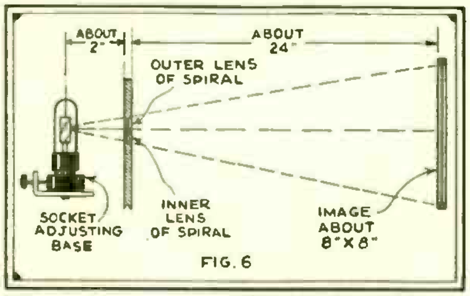

Fig. 6—Showing distance between crater tube, lens disc and projection screen.

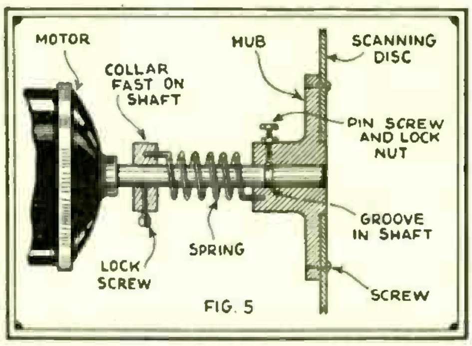

Fig. 5—Detail of spring coupling between shaft and lens disc.

of the tool has a 12/16" (diameter) round stem, which will fit exactly into our drilled holes in the disc. This is done in order to secure exact centering of the counterboring tool; the diameter of the cutting part of the tool which connects the actual counterbore is 13/16" and this leaves the proper-sized recess in which to set our lens. The depth of the counterbore in the disc is .080", thus leaving a shoulder .022" thick on which the lens rests. The operation of counterboring is best carried out on an ordinary drill-press. It is best to keep the disc fastened to the wooden board during the counterboring operation; and extreme care must be taken in setting some sort of a stop or limit gauge on the drill-press, so that the counterbore cuts out the metal only to a depth of .080".

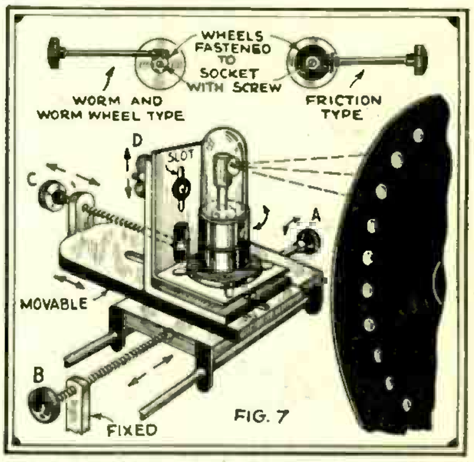

Fig. 7—"Four direction" focusing mount for crater tube, devised by H. W. Secor.

Method of Fastening Lenses

The method of fastening the lenses in the disc, once the latter has been drilled and counterbored, is one of the most important and troublesome items in building a scanning disc of this type. There is one very satisfactory method known as "spinning" the lens in place, but this requires special tools which are quite expensive. The lenses may also be secured in place by "pinning" them in place as shown in one of the accompanying sketches; but this operation must be done with extreme care, in order not to crack the lens. The "pinning" is accomplished with a small punch and a light wooden hammer; this serving to force some of the metal, around the edge of the hole, slightly upward.

The diameter of the finished disc (using 13/16" dia. lenses) may be computed as follows: The center of the extreme outer hole from the center of the disc, 10.125"; radius of lens 13/32, or .406"; rim of disc beyond outer lens periphery 0.375"; adding these figures together and multiplying them by 2 gives us the diameter of disc which is 21.81 inches. The disc can be turned to this diameter after drilling and counterboring.

Neon Crater Lamp to Use

A neon crater tube of the Jenkins, Raytheon or Cable type is to be used with the lens-disc above described. Best illumination and definition of the image will be obtained if the diameter of the crater emitting the light is between .030- and .035-inch. The writer has used very successfully the Eveready-Raytheon Kino lamp. The crater lamp must be accurately focused with respect to the lens-disc and the "throw" between the disc and the screen; which last can be made of ground glass.

Driving Power

Theoretically the power required to drive our lens-disc at 1200 R.P.M., must be great enough only to overcome the friction of the shaft bearings and the air resistance of the spinning disc. When such power is available, our disc will run up to speed after a certain time; this time-factor, however, is of very vital importance and it is desirable to make it very small—not exceeding two to three seconds. The reason for this is that the process of "framing" requires switching the motor on and off several times. If we have to wait each time

(*Continued on page* 453)

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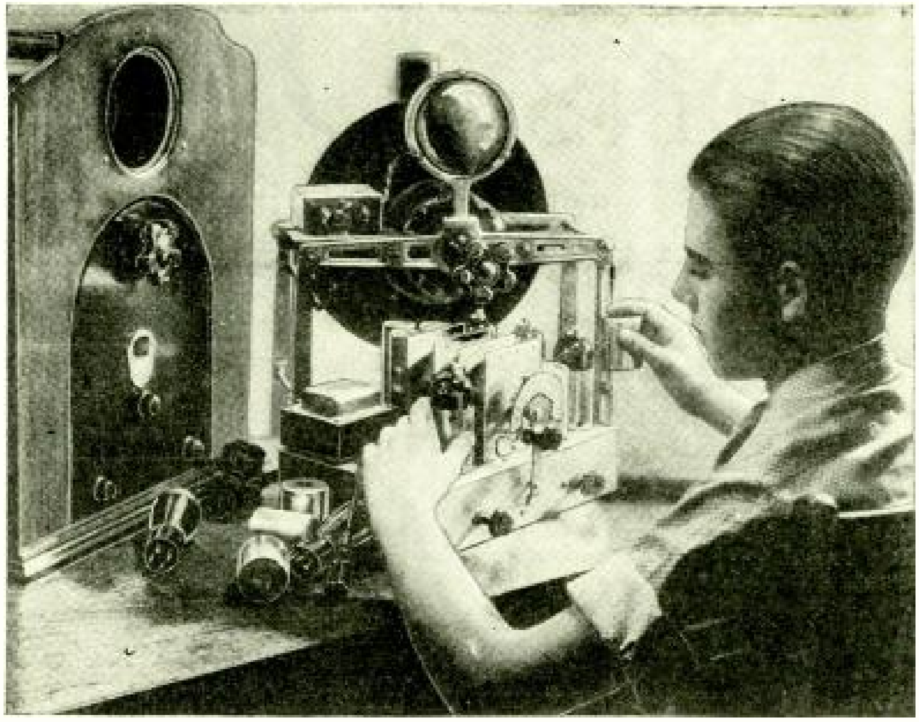
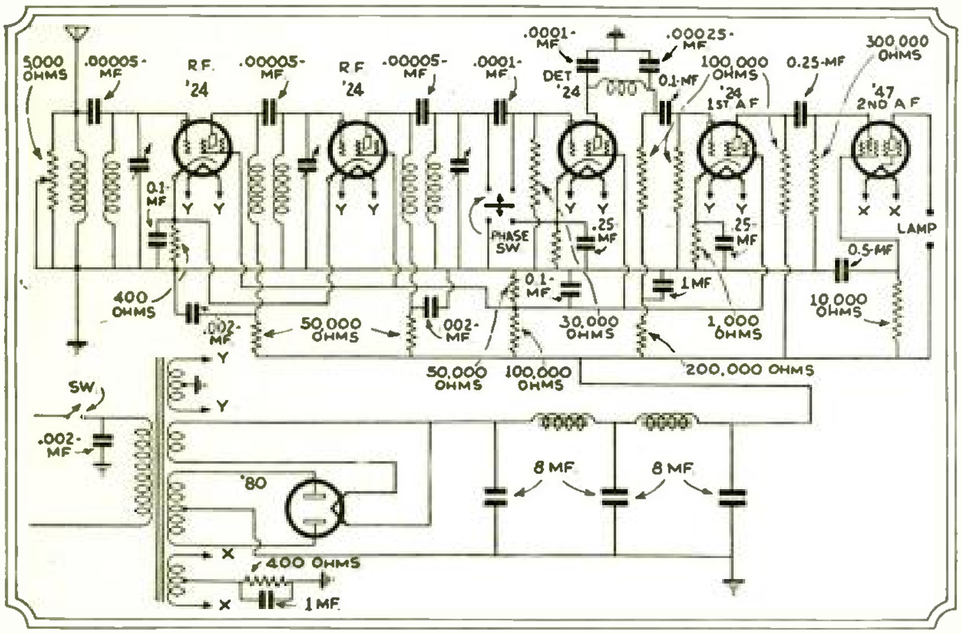
A New SCANNER and RECEIVER For *Positive* or *Negative* Signals

By L. R. CONRATH*

An extremely compact receiver and scanner, with a switch for receiving either positive or negative signals, special image framer, and pentode output tube.



Assembling the Trav-Ler television receiver and scanner kit is a very simple matter.



Wiring diagram of Trav-Ler receiver, with phase-changing switch in detector circuit.

THE television receiver and scanner here illustrated have been designed to meet these requirements. The ease of operation is achieved by single dial control, phase-reversing switch, convenient framing control and the use of a self-starting synchronous motor. The assembly has been made compact and of pleasing appearance by supporting the scanner directly above the receiver, and enclosing both in a mantel type cabinet similar to that used in modern midget radio receivers. Economy has been secured by the use of a compact chassis in which all components are utilized to best advantage.

* Engineer, Trav-Ler Radio & Television Corp.

2 R.F., S.G. Detector and Pentode Output

The receiver is composed of two stages of screen grid radio frequency amplification followed by a screen grid detector, a screen grid first audio stage and a pentode output stage. It will be noticed that only two audio stages are used instead of the customary three, but these two, employing high gain tubes, give sufficient audio signal strength to completely modulate a plate or spot-type (crater) neon tube.

The use of only two stages tends to reduce circuit noises which are sometimes apparent in the picture, and the pentode tube, which favors high frequencies more than does the triode, serves to bring up a drooping audio frequency response which is characteristic of nearly all amplifiers.

The use of circuit isolating filters and chokes, together with a generous B supply filter system, prevents oscillation and motorboating which are common to high gain resistance coupled amplifiers.

The radio frequency end of the receiver has been designed so that it will pass, without serious discrimination, the wide side-bands encountered in television broadcasting. Three tuned circuits are used in which the capacity inductance ratio is fairly high, and in which specially designed tuning coils are used, in a system employing both inductive and capacitive interstage coupling. The detector is so arranged that by simply throwing a switch, it may be converted from grid leak to plate circuit detection, thus enabling the operator to use it for either positive or negative broadcast signals.

The "Scanner" Unit

The scanner unit is composed of a self-starting synchronous motor, scanning disc, neon lamp and magnifying lens. The motor is mounted on two aluminum castings, in such a way that it can be rotated about its axis. A shaft fastened to the front of the motor and bearing a large knob at its end, provides a means of turning the motor and thus framing

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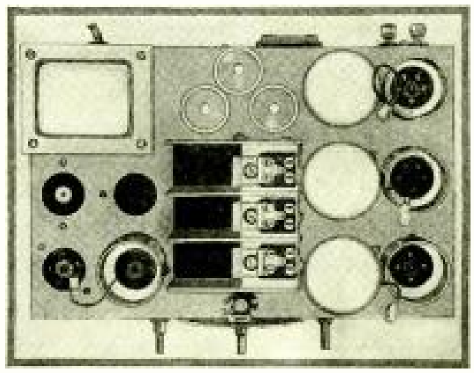

Top view of Trav-Ler television receiver.

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What of the— TELEVISION BUSINESS?

By WILLIAM H. PRIESS
President, International Television Radio Corporation

Mr. Priess, one of the best-known radio engineers in this country, has some interesting things to say as to how and what we may expect in the development of television as a business. He has some brand-new ideas on television equipment.

William H. Priess, President of the International Television Radio Corp., has patented, designed and built many of the best-known government and commercial radio apparatus. Among his inventions, he numbers the "untuned" R.F. amplifier, military radio sets, condenser manufacturing machines, automatic vacuum tube manufacturing equipment, numerous radio receivers such as the "D10" and "Straight 8," screen type television set, etc.

WHAT are the factors that determine the nature of Television as a business? Along what lines will its apparatus develop? How will it retain and achieve a progressive appeal to the vast American public? These are typical questions whose answers will define the foundations of the television art.

Place yourself in the boots of Edison after he had made his first successful incandescent lamp. How was he to obtain its public use? What industry could give him a model to follow? He concluded that the gas light companies as his overshadowing competitors had both the apparatus and business experience that should, allowing for the modifications entailed by the difference between gas and electricity, be translated bodily into his own enterprise. Therefore, he chose a system of distribution of energy to mains, he developed meters for installation on the premises of each consumer. He designed his lamps for about the same brilliancy of a standard gas jet, and planned a system of generating plants for connection to the mains as the consumption grew, so that an equality of electrical pressure at the consumers' end might be maintained. He answered the three questions we have asked ourselves and transformed his toy lamp into an universal necessity. Another vast network of wires, another vast army of workers, and the magic of clean white light so simply available that a child can control it by merely pressing a button.

Never in the history of industry has man been confronted by such significant parallels as those furnished to Television by the radio broadcasting and the motion picture industries.

Step by step the art developed from the crude crystal set with a range of 20 miles to the multitube receiver and the loudspeaker. The fun was in building a set at home. Knock down kits sold in huge quantities. The programs at the transmitting stations were crude. A few worn out phonograph records, unpaid talent such as little boys and girls reciting Mother Goose Rhymes and rambling talks against time were the library. Then another important factor made itself felt in the field. Here and there an artist performed at the broadcasting stations. The grown folks listened in and were enchanted. They demanded good programs and factory made sets in attractive cabinets. They got both.

The Priess dual "voice and image" receiver.

What has happened to the experimenter, the fan who learned all about circuits, tubes, filters and other radio parts? Your copy of TELEVISION NEWS has the answer. The fan is in his basement workshop, or cluttering up the kitchen with parts for building a television set. We have long since passed the advance guard of thousands and are numbering them by tens of thousands. The programs now broadcast are crude but the fun is in the set building.

The quality of both Television sets and programs have improved at a rate faster than that which occurred in radio broadcasting history.

The radio industry is responsible for some seventeen millions of radio sets in this country. Adding sight to each of these would be a logical program for the future. At an average price of two hundred dollars the field should absorb in time three thousand four hundred millions of dollars of merchandise. Indeed, television points out a tremendous industry. The country needs it for it is an agency that will entertain, enlighten, create the will to buy its televised wares such as garments, and in turn offer employment to another army of workers.

Some Technical Considerations

It is opportune at this point to go into some general considerations of the receiving apparatus. All television receivers must have an amplifier to build up the weak received impulses to a value sufficient to operate the television lamp. The amplifier looks somewhat like a radio broadcasting amplifier. However, a requirement is imposed on it that far exceeds the ordinary radio amplifier. Frequently in publication the television amplifier is described as a simple design problem differing but little from the usual radio amplifier. This is emphatically not true. The television amplifier must do many times the work, and must maintain a more exact level than the radio broadcasting amplifier. Where the latter need only pass electrical sound modulations as short in time as 1/4000 of a second, to reproduce the musical scale; the former must be capable of responding to an electrical light modulation as short in time as 1/86,000 of a second.

The general type of radio broadcast

(*Continued on page* 455)

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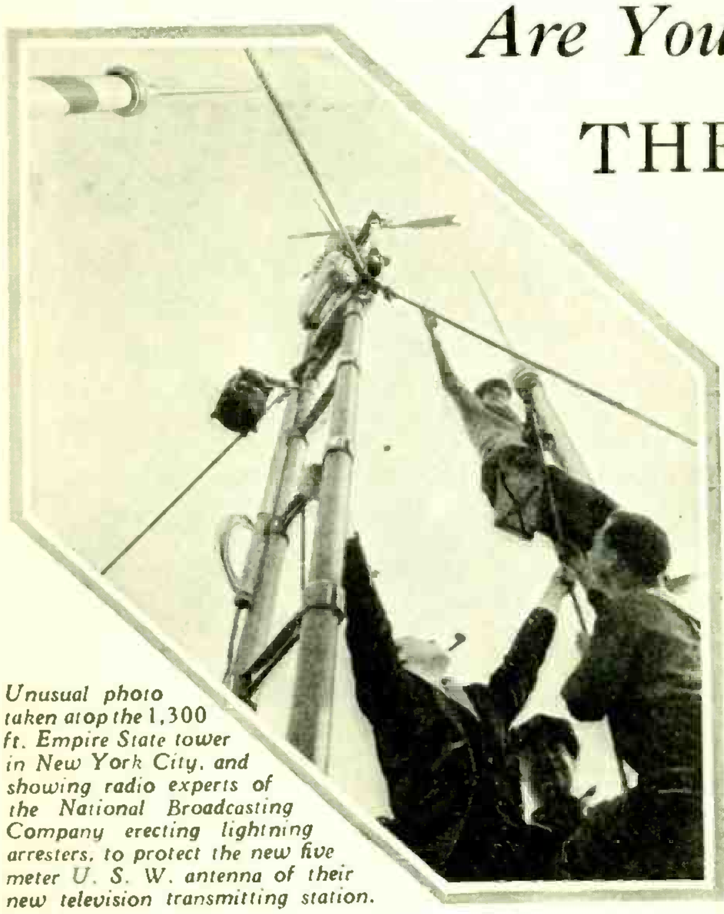
Are You Ready to Receive THE 5 METER *TELEVISION* SIGNALS?



Unusual photo taken atop the 1,300 ft. Empire State tower in New York City, and showing radio experts of the National Broadcasting Company erecting lightning arresters, to protect the new five meter U. S. W. antenna of their new television transmitting station.

By C. H. W. NASON
Television Engineer

Be ready to receive the ultra-short wave television signals on wavelengths of 3.75 to 7 meters as Jenkins and N. B. C., are about to begin test transmission on the ultra-short waves. The new N.B.C. television transmitter, atop the Empire State Building in New York City, is about completed. The editors engaged C. H. W. Nason, well-known television specialist, to design a receiver capable of picking up the signals broadcast on these ultra-short waves.

THE transmission of Television signals in the frequency range between 43 and 80 megacycles—43,000 and 80,000 kc.—or as expressed in wavelengths, between 7 and 3.75 meters—has long been recommended by authorities of such rank as John V. L. Hogan of New York and Manfred von Ardenne in Germany.

So far as we are able to discover up to the present time, these waves are limited as to range to the maximum optical range possible—that is to say that they are not receivable at points where a straight line between the transmitting and receiving antennas is intercepted by the arc of the earth's surface, or where high ranges of hills or buildings intervene. Transmissions of a satisfactory character might be carried out from antennas mounted atop mountains or high buildings, and used advantageously for limited service areas. The television station affiliated with WGY at Schenectady (W2XAW) has been transmitting programs on a wavelength of about five meters for some months past. These transmissions—although they have received some slight publicity—are really intended for the experimental benefit of the General Electric Company and as yet we have no reports regarding their reception by amateurs.

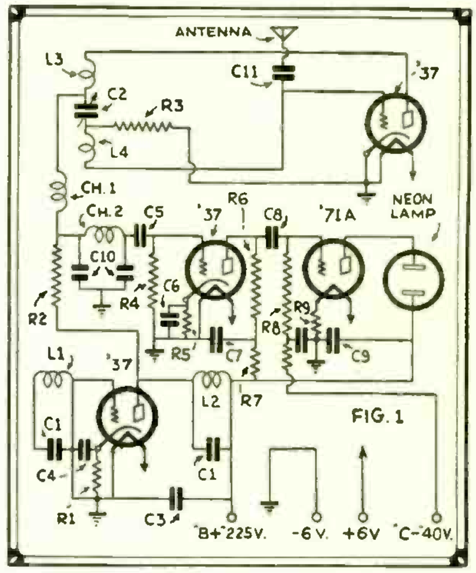
Within the past few weeks, rumor has had it that the RCA-Victor interests at Camden are experimenting on these frequencies, and have regular television programs on the air and even at this writing an antenna which, when viewed through a telescope, leaves little to the keen imagination of the amateur has reared its head tauntingly atop the new Empire State Building in New York. To be sure, there was some speculation among the uninitiated as to whether or not the antenna might be the rigging for a symbolic Brown Derby heralding the next presidential campaign; but a call to the N.B.C. studios elicited the information that while it was their antenna and was to be used in connection with their new television transmitter, "they had nothing to say." Since the antenna is definitely and geometrically constructed for operation in the bands provided by the Federal Radio Commission for television transmissions we can pierce the veil of secrecy surrounding the station and get busy on apparatus for the reception of the signal when it is forthcoming. This writing finds work progressing apace, and by Christmas the New York amateurs who have sufficient forethought should be experiencing a new thrill.

Receiving Signals of About Sixty Megacycles

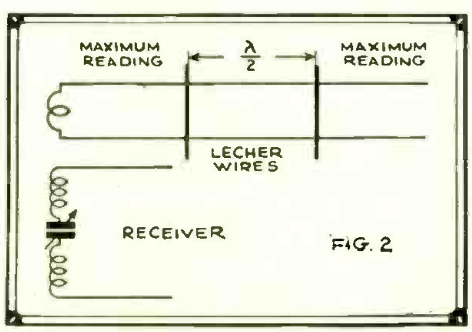
Although a simple regenerative circuit can be made to operate at these high frequencies, the sensitivity would be rather low. The natural answer would be the use of tuned radio-frequency amplifier stages ahead of the detector. It is an unfortunate fact, however, that R.F. amplifiers are inoperative at much lower frequencies than these—and another answer to the problem must be forthcoming. Commercial receivers for these frequencies usually employ the superheterodyne arrangement and, had the information come with less overwhelming suddenness, we might be prepared to offer a superheterodyne receiver for operation in these ranges. This must wait for our next issue—by which time sufficient experimental work will have been done to warrant the presentation of a "super" of another class than that to follow directly.

Some of you may remember the furore created in 1923 by the advent of Arm-

(*Continued on page* 445)



Hook-up of 3.75 to 7 meter range U. S. W. television receiver.



The receiver can be calibrated by using the Lecher wire system shown above.

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WHAT HAPPENS in a Cathode Tube?

By W. ZEITLIN

What is the cathode ray? How is the ray deflected and why? What is the purpose of the Wehnelt cylinder? What controls the degree of luminosity in the cathode tube? Read the opinion of an expert.

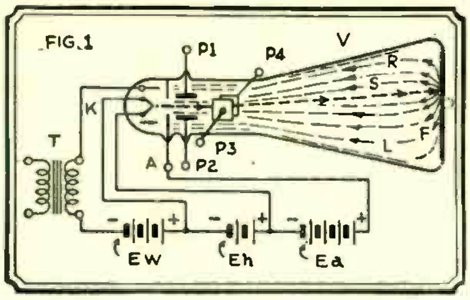


Diagram of hook-up for cathode-ray scanner, showing action of ray. The author here discusses the cathode tube with Wehnelt cylinder control for television.

AMONG the Braun oscillographs, the electro-oscillographs provided with the Wehnelt cylinder take a special position, mainly because of their simple construction and great efficiency. It is at the same time interesting to consider in detail the physical processes on which this design is based.

What Constitutes the Cathode Ray?

The oscillographs operate with electron rays (cathode rays), like the familiar radio tubes. These rays scan a fluorescent screen with varying intensity. One must imagine the electron ray as consisting of many electrons, which move at approximately the same speed. By repulsion or attraction (by means of electric fields, at right angles to the electron path) one can alter the direction of the electrons. This is shown by Fig. 1, which represents an ordinary electro-oscillograph with a Wehnelt cylinder. The electrons are accelerated between cathode K and anode A, and are conducted between the deflection plates P1, P2, P3, and P4. If, for example, plates P1 are positively charged and P2 negatively, then the deflection occurs, as illustrated. The same holds for plates P3 and P4; but the deflection is perpendicular to the first deflection, so that the fluorescent screen F can be scanned at will.

We therefore have in these deflection plates a pictorial-element distributer. Instead of the deflection plates, one can also arrange two electro-magnets, perpendicular to each other, beside the electron path; and then they likewise deflect the electron ray S. It is obvious that the deflection apparatus must operate in synchronism with a television transmitter. (This article will not go into the details of this synchronization, since it has already been described elsewhere.)

The cathode ray tube would seem to be the ideal scanner; there being no moving mechanical parts.

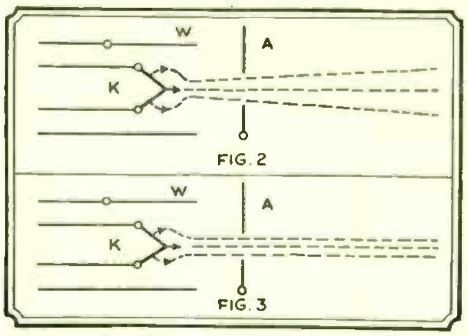
Brightness of Fluorescent Screen

All this sounds very simple and plausible, but the real difficulty appears when we want to change, not only the *deflection* of the light ray for scanning purposes, but also the *brightness* of the fluorescent spot, (*i. e.*, using the light modulation necessary for picture reception. In fact, the electrons are the more unsatisfactorily deflected, the higher the accelerating potential of the tube; because with increasing potential their velocity and momentum increases, so that the deflection becomes less. From this it follows that the electrons must move at constant speed, in order that the deflection may also remain constant. The obvious thought, of controlling the brightness by changing the discharge potential, is therefore impossible of execution.

The brightness of the fluorescent screen may be expressed by the Leonard formula:

$$H = \mu N (V - V_0)$$

where μ is the material constant of the fluorescent screen, N the number of electrons striking the fluorescent screen and V the voltage which accelerates the electrons. V_0 (about 50 volts for zinc sulphate) is the so-called starting voltage, at which light emission begins from the screen coated with the fluorescent substance in question. According to the above considerations, the voltage V in this formula must remain constant, while N may be changeable.



Dotted lines show electrons emitted by cathode "K", passing through hole in anode screen "A"; where ray strikes fluorescent screen, a bright spot appears.

But what is N ?—N is the number of electrons which strike the screen in a unit of time; or, simply, the current intensity of the electron ray. The number of electrons may be varied in different ways: by regulating the heat of the glowing cathode, which occurs with much lag and therefore does not come into question for inertialess control; or by the so-called "space-charge" control, which can, for instance, be effected by the Wehnelt cylinder W.

The author is one of Europe's best-known experts on the cathode ray tube—the newest scanning device.

Hook-up of An Oscillograph Tube

Fig. 1 shows the hook-up of such an oscillograph. The transformer T or some other suitable coupling device conducts pictorial impulses from a televisor in the form of an A.C. potential, to the Wehnelt cylinder W, just as to the grid of an ordinary amplifier tube. The anode A and cathode K are connected to a source of constant potential supplied by the battery E_a; that is, the electrons move at a constant speed and are therefore deflected uniformly.

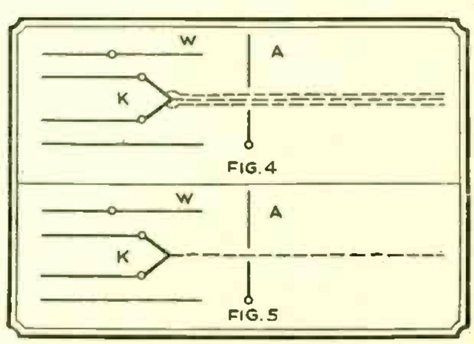
Europe leads again—cathode ray scanners were shown at the Berlin Radio Show.

Now consider the mode of operation of the Wehnelt cylinder on the basis of Figs. 2—, in which (for the sake of simplicity) only the glowing cathode K, the anode A, and the Wehnelt cylinder W are drawn.

Fig. 2 shows that the surface of the glowing cathode K, which emits electrons, is fairly large; and from this surface there goes out an electron-ray pencil, which spreads out perceptibly on passing through the anode screen A. Correspondingly, a broad dot of light is produced on the fluorescent screen.

Fig. 3 shows a condition with higher negative potential on cylinder W. The pencil is in consequence more condensed and is practically parallel; while the active surface of the glowing cathode has become somewhat smaller. The light-spot on the fluorescent screen has become correspondingly sharper. With

(*Continued on page* 457)



With increase of the negative bias on the cylinder W, the cross-section of the cathode ray becomes smaller and smaller and the light becomes weaker.

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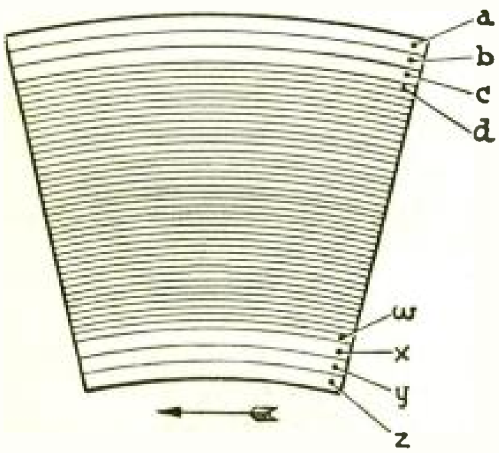
AGAIN THAT SCANNING PROBLEM

Several interesting fresh angles on the gentle art of "television scanning" are here disclosed and discussed by an Italian expert.

BAIRD constructs discs in which the first three holes and the last three holes of the spiral are rectangular rather than square, being in short equal in their breadth, in the direction of motion, for all the holes. (Fig. 1.) With this arrangement, while the frequency remains constant (because the number of holes is always the same) the width



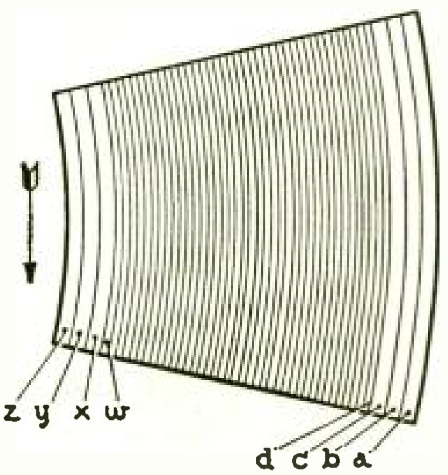
of the figure remains constant, as well as the frequency of the modulation; being the same for all the holes with their widths in the direction of motion. This gives greater fineness of detail in the central part; even though in this system, by the widening of the streaks, the elementary area is smaller therefore less detailed than is the case where all the holes are of the same size.

With this arrangement, it is evident that the proportions of only two opposite sides can be changed; not all four sides of the image. On the other hand, it will not always be convenient; because ordinarily, especially if the picture transmitted is that of a person, the upper and lower edges should have the same richness of detail as the center of the image.

In particular, at the instant when the scanning is completed in the horizontal or vertical (Baird system) direction, one can render in less detail the lower or upper zone of the image or (with vertical scanning) the lateral zones, as shown in Fig. 1, which gives the idea of the different density of scanning for both cases.

Vertical scanning is that ordinarily used (in Europe); in systems of the usual kind, with equal holes. This is precisely because it is rather easier to distinguish details in a vertical direction than horizontally. With this system, one more quickly obtains a better adjustment of the frequency of modulation.

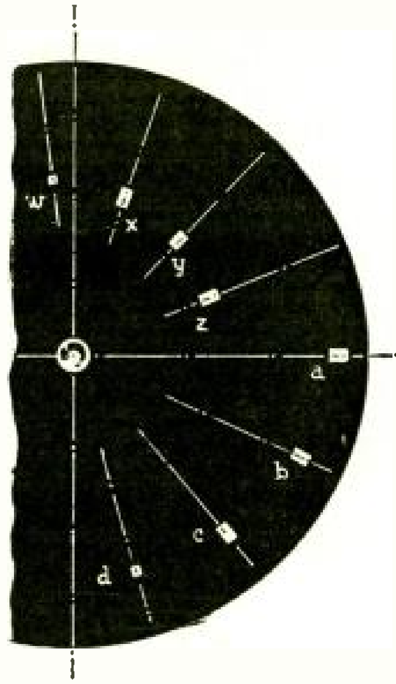
To reproduce the received image exactly similar to that transmitted, it is evidently necessary that the transmitting disc and the receiving disc be exactly similar; that the respective spirals be run in an identical fashion;



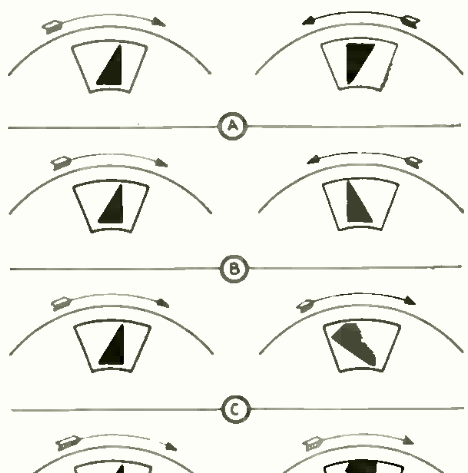
and that the velocities be identical; and it is necessary also that the two discs revolve perfectly in phase.

The necessary condition is that the discs be alike, not that they be equal. The dimensions of the discs, in fact, may be different; but if there is an exact proportion between all the respective elements of the two discs, the received image will appear exactly similar to the original, but larger or smaller, according to the ratio of the sizes of the discs.

Fig. 2 gives an idea of the inconvenience in reproduction encountered when the receiving disc revolves in a different fashion than that normal to the system. At the left is shown, in each of the four cases, the transmitted image and the direction of rotation of the transmitting disc (or analyzer); at the right, the detail A shows the inversion of the image, caused by a rotation of the scanning disc in the wrong direction. At B is shown the case in which the synthesizing disc, not only revolves in the wrong direction, but also has the spiral traced in the wrong direction. Finally, in the other two cases is shown the distortion of the image which one obtains with a velocity of the scanning disc greater than normal —C—or with the two discs not in phase—D.—*La Radio par Tutti.*



Above drawings show improvement in scanning gained by enlarging certain holes on the scanning disc, with consequent change in the amount of light acting in certain parts of the image.



This diagram, in conjunction with the text, helps to make clear what happens when the scanning disc is mounted backward, or is rotated incorrectly.

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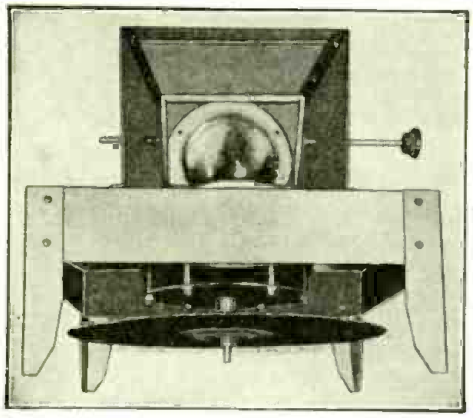
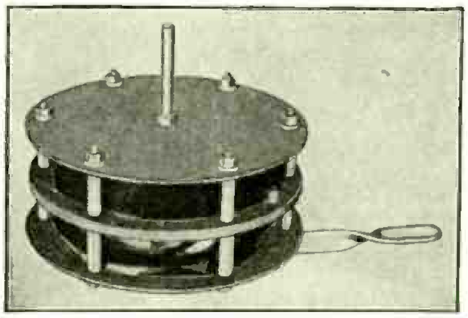
New I. C. A. Receiver and Scanner



The I. C. A. "visionette" television scanner produces a large image in a mirror, so that several people can see and enjoy it simultaneously.

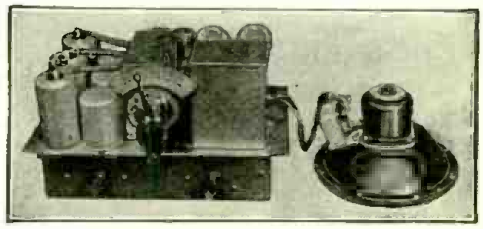
THE new Visionette sight reproducer permits the whole family to view the television images simultaneously instead of one at a time, as in former devices. The essential parts of the Visionette are a special television motor, a neon lamp, a novel magnifying lens system, a brand new adjustable *mirror screen*, a shadow box and an attractive, compact, metal housing.

The special television motor employs a single stator winding for its field and two rotors, both on the same vertical shaft. One of the rotors is of the squirrel-cage induction type, and is used for bringing the scanning disc up to speed. The other rotor is of the laminated iron, toothed synchronous type. This is brought within the field by means of a simple and convenient lever arrangement. If the motor happens to get out of synchronism (resulting in a picture out of frame), a touch of the lever brings the induction motor into play, thus speeding the scanning disc up to synchronism and framing the picture without fuss or delay. This is an immense improvement over previous methods of framing.



Double motor used in "Visionette" scanner, comprising an accelerating and synchronous motor, with framing lever.

The Insuline Short Wave and Television Receiver, available either as a separate unit or in conjunction with the Visionette kit, employs a new, simplified circuit having two tuned r.f. stages with variable mu tubes, a tuned detector using the '24 screen grid tube and a single power stage employing the pentode tube. The rectifier utilizes a full-wave '80 type tube. The built-in r.f. coils are of special design, covering a wevelength of from 75 to 200 meters. The same receiving set can be used for short-wave reception or for television, merely by flipping a toggle switch.



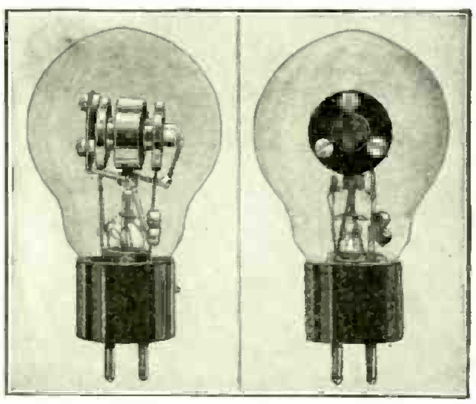
The new Insuline television receiver.

New Jenkins Apparatus

PROBABLY one of the most interesting new pieces of television apparatus brought out by the Jenkins Television Corp., is their new crater tube, shown in the accompanying picture. This improved type crater lamp was designed especially for use in the Jenkins Radiovisor, No. 400, and also their model A console, but it can be used, of course, in any lens type of scanner.

This tube is a heavy duty type and operates on 30 to 60 milliamperes and will stand up to 100 M.A. The crater tube is the new "spot-source" of light necessary with lens disc scanners, used for the purpose of reproducing a large image.

Another photograph shows the newest model of the Jenkins model JD 30 dual-purpose receiver, with a tuning range of 80 to 600 meters divided into two bands and due to the special design of the coils and condensers, ideal selectivity is provided in each band. The audio amplifier is of the latest type, resistance-coupled design, and has a range of 20 to 40,000 cycles. This receiver uses two screen grid tubes '24 type, 2 '35 tubes, 1 '27 tube and 2 '45 power tubes, with an '80 rectifier.

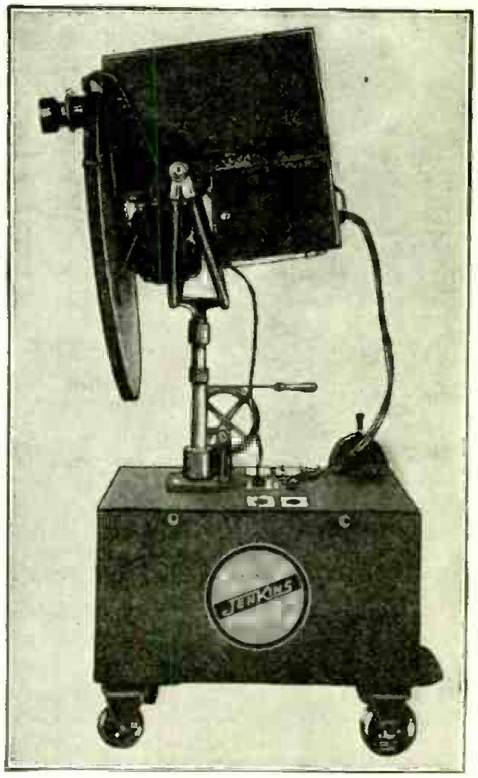


Above—Side and front view of new Jenkins crater tube.

Left—Jenkins 80 to 600 meters "Dual range" receiver with speaker built in.

A switch is provided which allows the operator to switch the signal from the loud speaker, built in the set, to a television scanner.

A new television "pick-up" camera is shown in one of the accompanying photos, which employs a new photo-electric tube providing much greater detail in the image; it also provides much greater sensitivity to light than that heretofore obtainable, which renders this new "pick-up" camera ideally suited for outdoor "pick-ups".



Latest Jenkins pick-up camera suitable for "outdoor" work. It employs a new specially sensitive photo-electric cell; batteries for the head amplifier are contained in the bottom compartment.

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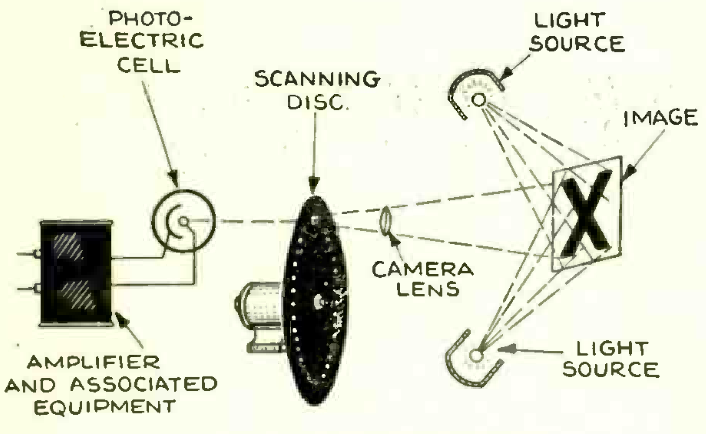


DIRECT METHOD OF SCANNING

FIG. 1

Direct method of scanning at transmitter, the subject is illuminated by the lights shown and the reflected image is picked up by the lens, scanning disc and photo-cell.

The DESIGN *of* *Television*

The author gives many valuable pointers on the theory and operation of television transmitters and receivers in this article, without wearying the reader with a lot of dry-as-dust mathematics. We recommend the reading of this article by all those interested in

THE television system about to be described is a partial answer to an outstanding problem.

That problem is to provide a means by which visual representations may be sent broadcast from one point and received at many others. Several methods might be used in solving this problem.

It is conceivable that some combinations of lenses or mirrors might be arranged whereby this broadcast could be effected by purely optical methods.

By purely optical methods we mean the linking of an observer with an observed object by light from that object directly and without the interposition of any auxiliary system of transmission.

It is understood, of course, that lenses or mirrors would only modify the direction of light and would therefore not introduce any new system.

A purely optical system would be dependent upon atmospheric conditions and its operation would presuppose the absence of intervening obstructions. Its many other limitations are quite evident and the broadcasting of visual presentations by optical means alone is obviously impractical.

It is necessary then for the practical solution of the problem to provide some auxiliary system interposed between the observer and the observed to effect visual broadcasting.

A system, electro-mechanical in nature, has been devised and today visual broadcasting is being effected by interposing that system between the observer and the observed.

A simple optical system includes a source of light, an object to be viewed, light given off by the object, an eye to intercept some of this light and a nervous system wherein would be created the sensation of seeing.

That is, in order to be seen an object must give off light. This light may emanate from the object itself or from another source and be reflected by the object. The object radiates this light, some of which reaches the eye of an observer. Entering the eye it falls upon thousands of sensitive nerve ends stimulating them to send pulses to the brain. The brain integrates these pulses into a sensation peculiar to that object and forms a vision of it.

A television system includes a light sensitive device and an electrical circuit interposed in the path of the light waves to convert them to electrical waves which may be transmitted with greater facility. It also includes a device for reconverting the electrical waves to light waves at the receiving end.

Photocell

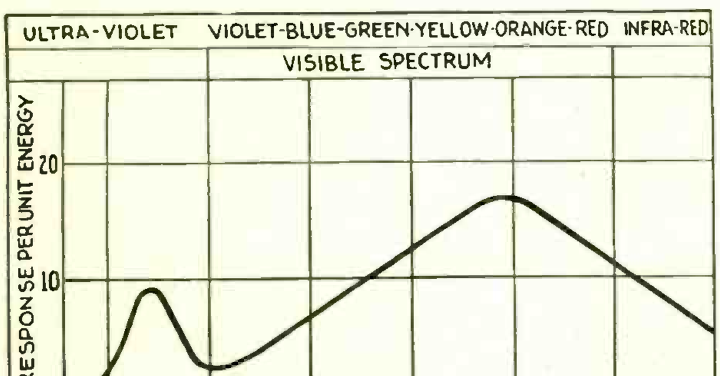
A device called a photoelectric cell is placed in the path of the light from the object. This cell allows current to pass in proportion to the amount of light falling upon it. More light more current and vice versa. This current is amplified and transmitted to the other end of the circuit where it excites a lamp to give off light in proportion to that intercepted by the photoelectric cell. Now, it is evident that if the light from all parts of the object were allowed to strike the photocell at one time the lamp at the other end of the circuit would light with an intensity proportional to the overall brilliancy of the object. Therefore, no details of that object would be transmitted and it is necessary to scan the object a step at a time and view the light at the receiving end so that light from it reaches the eyes from the same angle as it would if the object were being viewed directly.

The explanation of how this is done has been given so often that it will not be gone into here.

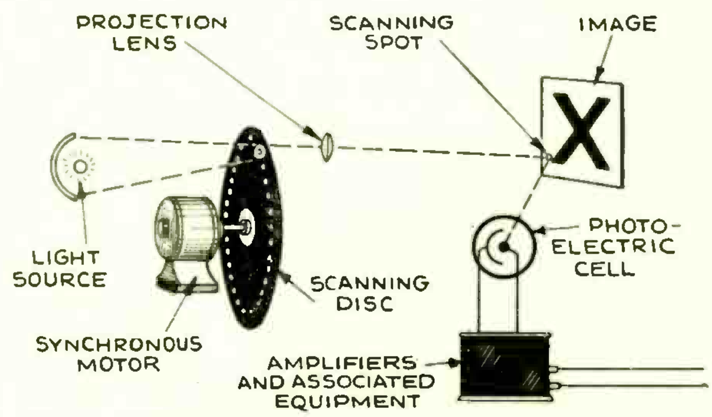
The purpose of this paper is rather to describe the component parts of a television system and show their relation to each other.

Referring to Fig. 1 we have what is

‡ *Presented before the Radio Club of America, April 8, 1931.*
* *Television Engineer, DeForest Radio Co.*



COLOR SENSITIVITY
CAESIUM OXIDE PHOTO CELL



INDIRECT METHOD OF SCANNING

Fig. 2—At left, shows graphically the color sensitivity of a typical caesium oxide photo-cell; Fig. 3—above, shows the indirect method of scanning at the receiver.

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A COMPLETE *System*‡

By C. E. HUFFMAN*

television from any angle. Mr Huffman explains how the subjects are scanned at the transmitter, what sort of amplifier and neon tube arrangement we need at the receiver, in order to "see" the reconstructed image, etc.

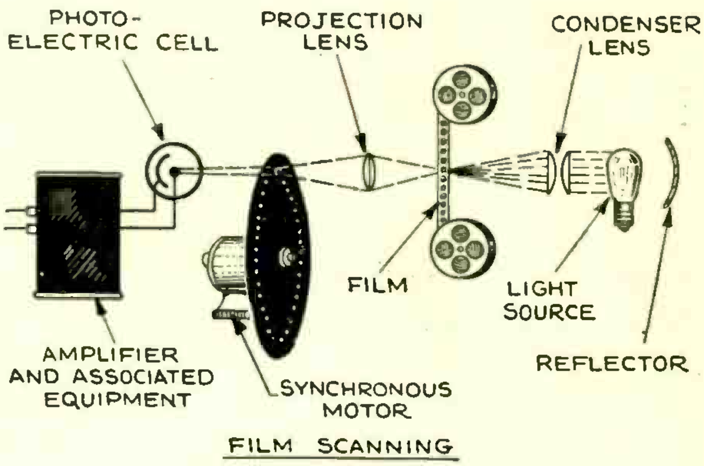


Fig. 4—Television scanning system at the transmitter, where movie film "images" are to be scanned as here shown. The film moves across the beam of light.

known as the direct method of scanning. Here the entire object to be viewed is illuminated by light which reflects into the photocell. A lens collects as much of this light as possible and passes it through a hole in the disc a unit at a time in rapid succession. The photocell delivers current to the amplifier in proportion to the amount of light reflected from the successive units.

As only a small part of the light thrown on the object reaches the hole in the disc, it is necessary that the object be illuminated strongly over its entire surface.

As shown in Fig. 2 the photocells in use are sensitive to invisible light as well as visible and by the use of proper filters a subject being scanned is unaware of the intensity of light thrown upon him.

It is possible, however, to reduce the apparent brilliancy of visible light by the method shown in Fig. 3. In this method the scanning disc is placed between the light source and the object so that only a small portion of it is illuminated at one time. The illumination can therefore be much more intense without causing discomfort when a person is being scanned. Also the photocells may be placed closer to the object and thus pick up more reflected light.

Motion picture films are scanned as shown in Fig. 4. Here the light passes through the film to the scanning disc. The holes in the disc allow light from each unit area to affect the cell in succession as in the other methods.

The discs shown rotate at a speed of 1,200 r.p.m. and scan the object 20 times per second. There are 60 holes around the circumference of the disc so that the picture at the receiving end appears as an image constructed with 60 lines.

Scanning at this speed will cause the photocell to release currents varying at a rate as high as 43,000 cycles per second.

Fig. 5 shows a schematic circuit of the amplifier associated with the photocell in each of the pickup scanners.

The network shown between the photocell and the grid of the first tube serves to equalize the response to varying rates of light fluctuation. The network shown at the grid of the second tube tends toward uniform transmission of the desired frequencies.

A special 445 type Audion is used in the output circuit so that signals are fed through a 75-ohm line to the main amplifier without undue attenuation at the higher frequencies.

Fig. 6 is a simplified schematic of the main amplifer which supplies signal to the modulator grids in the radio transmitter. Incoming lines remotely controlled by relay connect any of the photocell amplifiers to the input of this amplifier. One pickup may be faded out as the other is faded in.

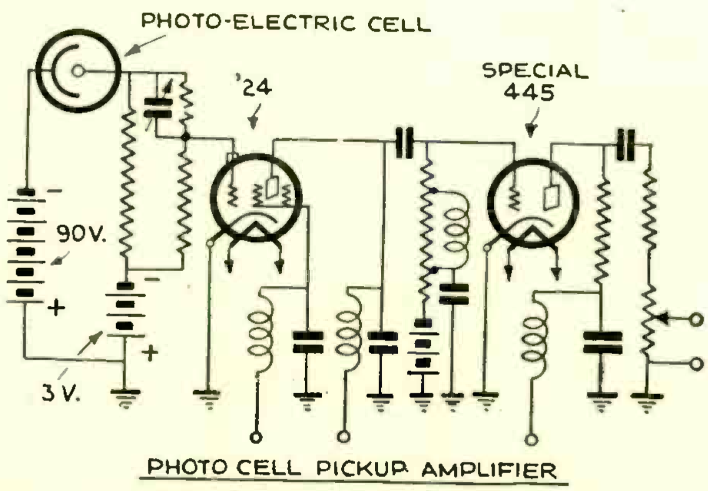
Fig. 7 shows the frequency characteristic of the main amplifier. As shown the amplifier has an overall gain of 140 db. plus or minus 2 db. from 15 cycles to 80,000.

Fig. 8 is a schematic of a radio transmitter having 250-watts output. A crystal oscillator excites a radio-frequency amplifier through a screen-grid buffer stage. The output of the r-f. amplifier is modulated by a water cooled modulator controlled by the output of the main picture amplifier just shown.

A separate speech amplifier may be connected to modulator grids for station announcements.

Dual Sound and Sight Programs

At W2XCD in Passaic sound is broadcast with the television programs over a standard deForest radiophone transmitter located adjacent to the television transmitter. No cross talk is experienced when these transmitters are operated simultaneously. The picture transmitter operates on a



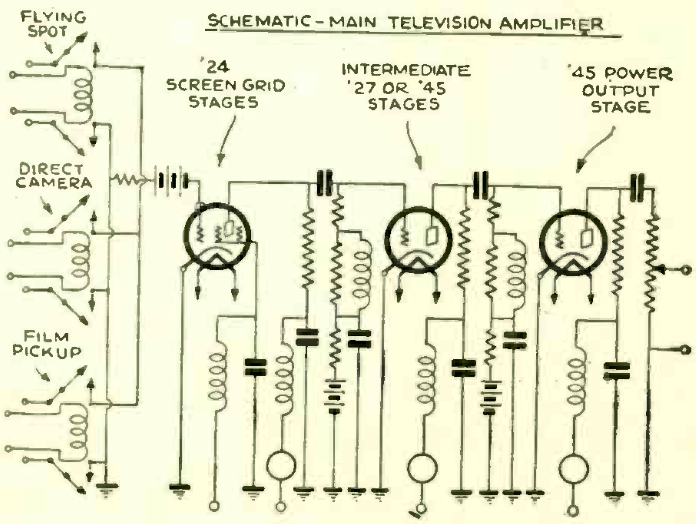
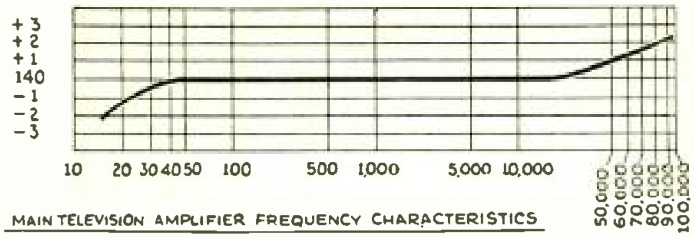


Fig. 5, above, shows a photo-cell pick-up amplifier, located near the cell; Fig. 6, at right, main photo-cell amplifier.



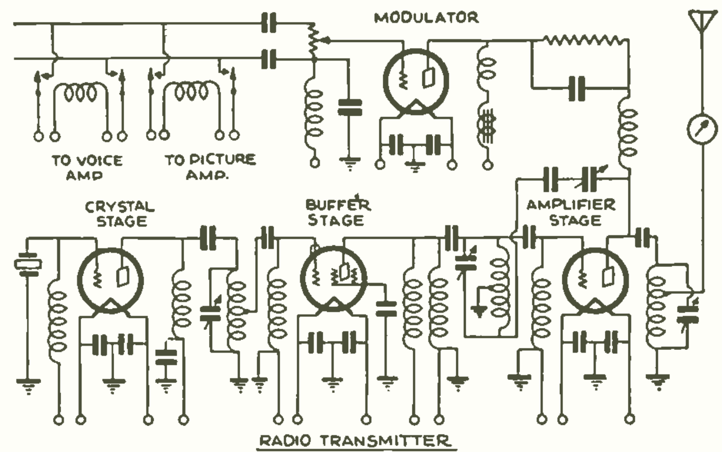
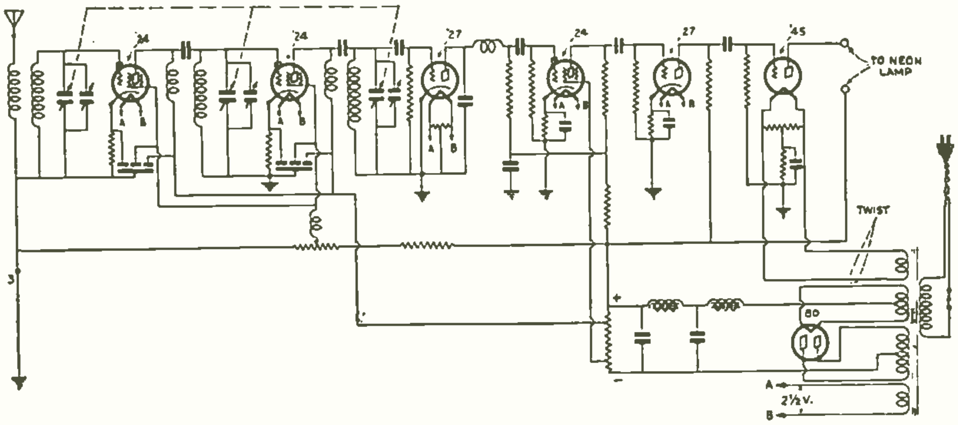


Fig. 7, above, shows frequency characteristics of main television amplifier.

Fig. 8, right, shows modulator and power amplifier stages at transmitter.

frequency of 2,050 kc.; the sound on 1,604 kc.

Changeover from one sound and picture pickup to another is effected by relays operated from a central control panel. Signal lights indicate in the studio and at the control panel just which pickup is connected with



the transmitters and signal lights in the studio indicate when transmitters are on the air.

Monitor receivers for both picture and sound allow the quality of the transmission to be checked and adjusted from this control panel.

Fig. 9 shows the schematic circuit of the radio receiver used in picking up the picture transmissions. This consists essentially of four unit parts assembled as a whole.

The first is a power unit which provides power for all filament, plate and grid voltages as well as neon lamp current.

The second unit consists of two screen-grid audions operating between three tuned circuits to select and amplify the desired signals without discrimination against the side frequencies.

The third unit is a detector which recombines the carrier and side frequency to produce the picture frequencies at its output.

The fourth unit is a resistance capacity coupled amplifier for building up the level of these frequencies sufficient to supply the picture reproducer or radiovisor.

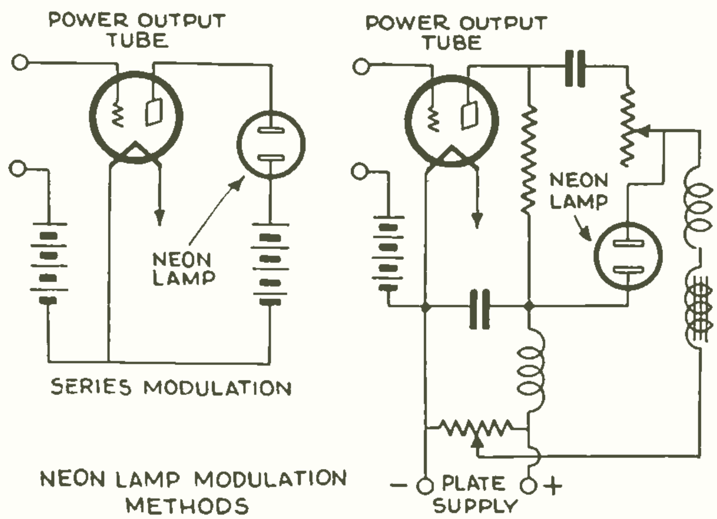
No attenuation of picture frequencies occurs between 50 cycles and 20,000 cycles. At 20 cycles and at 50 kilocycles the attenuation is 4 db.

Fig. 10 shows two methods of connecting the output of the radio receiver to the neon lamp. The usual arrangement is to connect the neon lamp in the plate circuit.

A more desirable arrangement is to by-pass the plate current of the output tube through an impedance and operate the neon lamp in parallel, as shown. The signal level and the biasing current through the lamp may then be varied by means of series resistors without affecting the characteristics of the output amplifier appreciably.

Fig. 9, above, schematic circuit of typical commercial television receiver, having sufficient power to operate the smaller type crater tube.

Fig. 10, right, shows two different hook-ups for neon tubes in the output circuits of the last amplifier stage of television receiver: parallel modulation shown at the extreme right.



NEON LAMP MODULATION METHODS

$5.00 Award for Best Image Photo

IN accordance with our offer in the last issue of TELEVISION NEWS we are awarding the $5.00 prize for the best image photo submitted, to Gilbert T. Schmidling of 505 Wrightwood Avenue, Chicago, Ill. Mr. Schmidling's photograph was a very delicate tracery and did not lend itself well for reproduction in the magazine. The interesting thing about this image was the fact that it was photographed from the image built up on the end of a cathode ray tube scanner. The picture or subject, in the form of a lantern slide, was scanned with 156 lines.

Until further notice, we will pay $5.00 for the best amateur photograph of a television image, the prize-winning photograph to be selected by the editors, who will act as the judges, and their opinion will be final. Do not send films; only prints. Address photographs to: "Image Photo" Editor, TELEVISION NEWS, 98 Park Place, New York, N. Y. Closing date for entries for next issue, January 10th, 1932.

TELEVISION R.F. COIL DATA

THE data everyone is asking for today, it seems, is how many turns and what size of wire to use on the R.F. transformers in a television receiver, to cover the band between about 90 and 200 meters. See article in next issue.

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The Newest Invention in Television Glow Tubes—

The MAGNALITE TUBE

By HENRI F. DALPAYRAT

Among the advantages claimed are: Higher amplification, a stronger source of modulated light, higher efficiency and less heat, and ease of control.

ILLUMINATION and modulation are still the most important and difficult problems to solve in television. Experimenters have been kept busy investigating the possibilities of designing new and better light-sources, as well as improving modulation systems. This search has been in progress since television became generally recognized as a possible fact, and it is still going on; but, unfortunately, very little has been accomplished in this direction.

All the efforts of the writer have been directed toward the designing of a complete home televisor, which could be just as popular and useful ten years from now as it would be today. The first step taken was to seek a better-modulated light-source which ought to have the following qualifications:

(1) To respond instantaneously and faithfully to all the signal variations it receives;

(2) To be totally extinguished or fully lighted, as required by the signal;

(3) Not to lag or distort on any voltage variations;

(4) To produce a brilliant white light accompanied by very little heat;

(5) Not to require special large power tubes;

(6) To be self-cooling (that is, not to require water cooling attachments);

(7) To operate on low power without large, expensive power packs;

(8) To be simple, easy to manufacture, and to sell at a moderate price.

Perfect Light Modulation Difficult

Although it is an easy matter to design a source of brilliant light, it is rather difficult to modulate it in a fully satisfying manner. Sources of steady light have been designed which are very powerful but, unfortunately, the external means employed to modulate the beam projected so greatly reduce the light intensity, that only a very small percentage of it is left.

Among the best known steady light sources, the carbon-arc light has been widely used, in spite of the disadvantages it has of consuming large amounts of power and requiring constant care, as well as the trouble of having to change the carbons when they are consumed.

Another source of steady light is obtained by producing an arc between electrodes enclosed within a vessel filled with certain gases or vapors. Helium, argon or other gases are often mixed with mercury vapors to obtain a stronger light and increase its brilliancy.

An incandescent lamp of high candle power can also be used with a reflector to project its light upon a small perforation in an opaque diaphragm. Once the focal length is adjusted, a pencil of parallel rays shoots out through the perforation, and this beam of light is then modulated.

The Kerr Cell—Arc Modulation

Probably the only system known to modulate directly a beam of light is the "Kerr cell and Nicol prism" arrangement. However, this system has a very low light-transference efficiency. For this reason, several experimenters have attempted to modulate the light-source itself in order to utilize the full amount of the light produced. In an arc light, the arc may be subjected to the action of a magnetic field, which blows the arc *sidewise*, in front of a perforated diaphragm. The arc being deflected, stretches and becomes thinner, and it also hides more or less behind the diaphragm, thus passing more or less light through the perforation. The most serious objection to this system are that *the light is never entirely extinguished, under the deflecting action of the variable magnetic field*, nor is it ever totally screened off when forced to hide behind the partition. Also, there is a constant amount of light never modulated—that which is given off by the incandescent electrodes. Even though incandescence could be prevented, and the heat reduced to a minimum (which is nearly impossible), the arc could not be ignited or extinguished fast enough; since it requires a certain length of time for the voltage to break down

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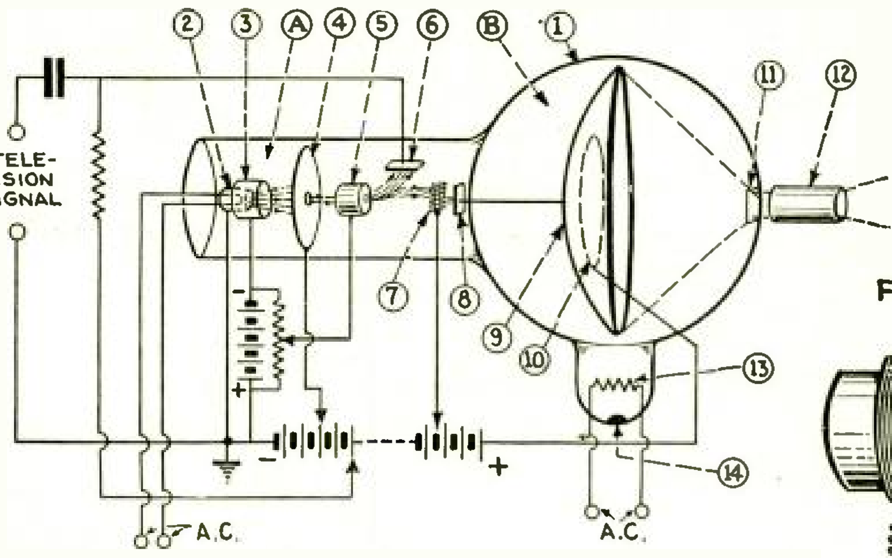

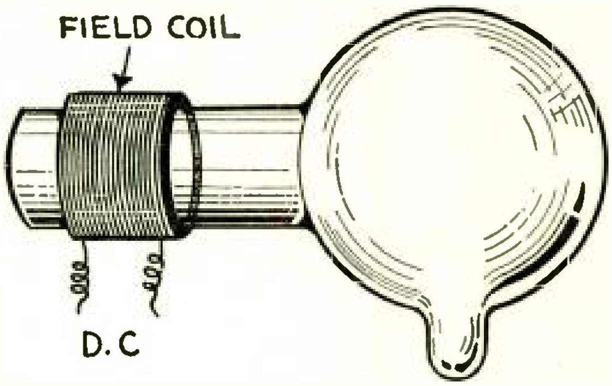

The new Magnalite tube for use at the receiving scanner is shown above, with the connections for the various voltages and the television signal input to the tube. Light from the tube passes out through window 11 and quartz-glass rod 12. A typical control coil for the tube is shown at the right.

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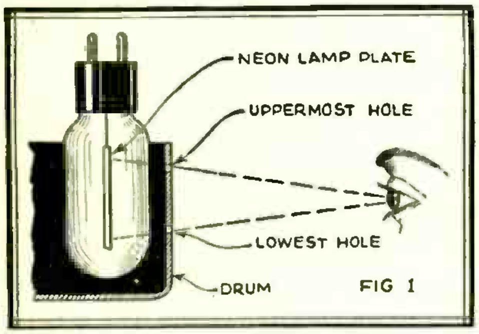
A STUDY *of the* DRUM TYPE SCANNER

By C. H. ROTH*

A most interesting scanning device is the "drum and shutter" type, perfected by Jenkins. Mr. Roth here gives some interesting and little-known data on this space-saving form of scanner, explaining just how it works and why.



Showing the angle of vision through the extreme holes of the spiral on the drum, and the relative size of the neon tube plate.

PRIOR to studying a television light-field, it is essential that one thoroughly understand the mechanical means of producing it. Near the inner surface of the upright wall of the drum, a flat-plate neon lamp is suspended, with the smooth surface of its plate facing the inner surface of the drum; so that the upper light aperture, as well as the lowest one, will lie between horizontal planes not higher or lower than the top or bottom of the flat plate in the lamp. These will be the extreme positions of the highest and lowest apertures in the drum. Since, as will be seen from Fig. 1, the lines of sight from the eye to the upper and lower edges of the neon lamp's plate are divergent, it will therefore be necessary to place the lamp in a position that will allow the diverging lines of sight to pass through the two extreme holes and then to the lamp plate, not above or below it.

When using a 7⅜" diameter drum for reception of present-day television pictures of 60 lines, the 1½" square plate of the neon lamp can be easily placed in a position that will allow plenty of light above and below the two extreme holes which expose light for the top and bottom lines of the light field.

60 Holes in 3 Spirals

The drum has 60 square light-apertures pierced through its wall, in three spirals of 20 apertures per spiral; revolving at 3,600 R.P.M., it travels at a peripheral speed of 116 feet per second. All the light apertures will therefore travel at this high speed. Fortunately for the cause of television, human vision possesses *retentivity* or persistence, resulting in an optical illusion as regards the television picture or the light-field; since only one light-line is produced, while it appears to the eye that all the lines are on the picture or the light-field simultaneously. From this, it will be seen the speed of the drum is an important factor.

We are now interested only in the One complete revolution of the drum will produce only 20 lines or one-third of the picture or frame. The slotted shutter, which revolves in front of the drum allows exposure of only one aperture at a time.

A study of Fig. 2 will disclose the defects of a light-field, as they are generally found. At the left of this figure is a representation of a portion of a light-field as viewed with neon tube lighted and with the drum at proper speed. At the right of the figure is a detailed layout of the light-apertures placed in their respective positions with relations to each other shown vertically, but not horizontally, for clarity. Normally these apertures would be pierced through the wall of the drum 18 degrees apart, horizontally. All apertures fall on a helix passing three times around the outer surface of the drum.

Note the position of the uppermost and lowest holes (Fig. 3) with respect to each other. This is a prime requisite, since hole No. 1 must not expose light to the eye until hole No. 60 has passed behind the right edge of the picture frame (Fig. 4). At the left of Fig. 2 the lines are numbered consecutively as they appear on the light-field. The first or uppermost line of light is the result of passage before the lamp-plate of the uppermost hole, delineated at the right of the figure. Line No. 2 is the result of exposure of light by the second hole from the top of the field, etc.

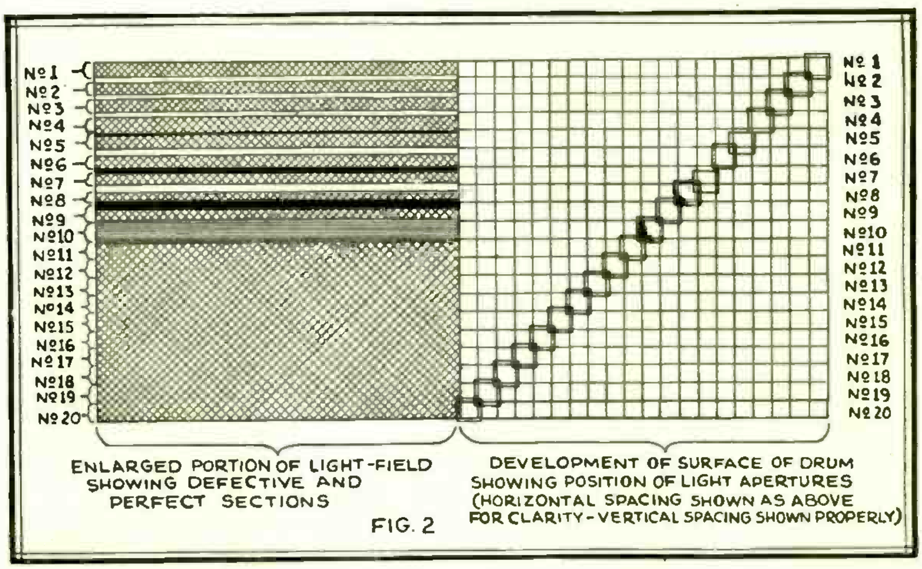
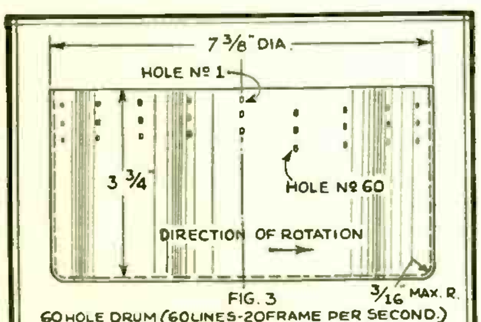


FIG. 2

This chart helps to make clear why streaks are seen in the image created by a drum scanner, when the holes are not properly aligned.

* Of the Jenkins Television Corp.



How the 60 holes in a Jenkins drum scanner are arranged in three spirals, the drum having to rotate at 3,600 r.p.m.

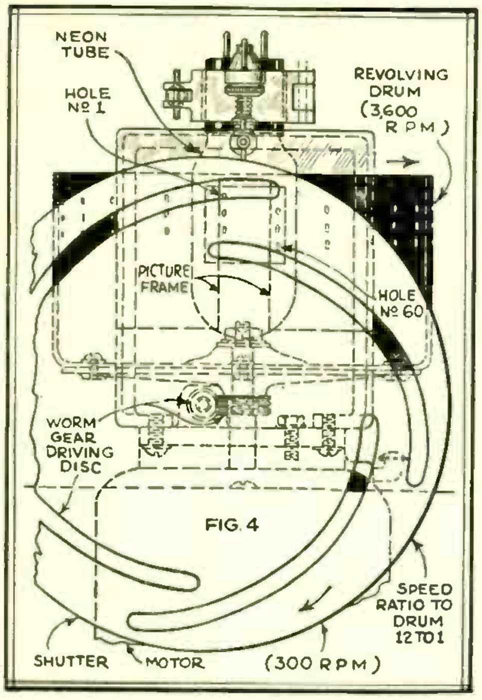
structure of the light-field. By looking closely at an operating radiovisor drum revolving at 3,600 R.P.M. with lighted neon lamp in position, one will discover a few interesting characteristics of a television light-field. The field of a drum-type radiovisor is proportionate in size to the picture projected on the present-day motion-picture screen; rectangular, with the longer dimension horizontal.

3 Turns of Drum to Expose 60 Holes

A drum pierced for 60-line pictures, transmitted at the rate of 20 pictures per second, is shown in Fig. 3. Note that three complete revolutions are required for the complete production of a picture, or "frame," as it is generally known.

Analyzing the Light Action of Drum

Without incoming signals entering the short-wave television receiver, which operates in conjunction with a neon lamp and an accurately pierced revolving drum, the resultant light-field will appear as represented in that portion of Fig. 2 covering lines No. 11 to No. 20



The slots in the shutter permit but one hole in the drum to scan at one time, the shutter being geared to the motor and having a 12 to 1 speed ratio, with respect to the drum.

inclusive. The absence of variations of color in this portion of the field is a predominant characteristic.

A uniform light-field can be produced only by the very slightest lapping of the adjacent light-apertures, as will be noted when examining the position of the edges of the apertures emitting light for that portion of the perfect part of the field. Again note that the lower edge of hole No. 14, for example, is in a slightly lower horizontal plane than the upper edge of hole No. 15. The overlap of the edges of these two holes is, however, not great enough to produce a narrow line of greater light-frequency than that of the lines produced by that part of each of these holes not overlapped.

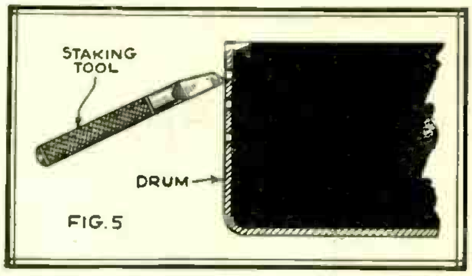
Effect of Too Much Hole "Over-Lap"

A flagrant example of the results of too much overlap can be seen between lines No. 7 and No. 8. Here the white line between these two lines is caused by hole No. 7 trespassing on that portion of the light-field that hole No. 8 should occupy alone. Hole No. 7 is invading No. 8's territory by about one-quarter of its own height.

By way of further explanation as to the cause of these narrow lines, which represent a sort of separation or boundary line between the main lines; note that the horizontal planes of the upper edge of hole No. 2 is above the plane of the lower edge of hole No. 1. Now there is a portion of the light-field, between lines No. 1 and No. 2, which (after these two lines have been produced) will have been traversed twice by, first the bottom of hole No. 1 and secondly the top of hole No. 2. The double exposure of light at the same portion of the field results in the white boundary lines, giving the field an appearance of streakiness.

Case of No Hole "Over-Lap"

Assuming that we have a drum with holes pierced so that all horizontal planes of the bottom edges of all holes lie in the same planes as the top edges of the next lower holes; we then have a condition of no overlap of the holes which are adjacent to each other. Then, in order to secure an overlap of .001" between any two adjacent holes, each hole must be



A staking tool may be used with a light hammer, to change the position of a hole in the scanning drum.

increased in size by .001". That is .0005" on the upper edge and .0005" on the lower edge of every hole. Since the holes should be square, facilitating manufacture, the horizontal dimension of the holes will then become the same as the new height, which includes the extra amount providing for overlap. Lines No. 1, No. 2 and No. 3 have too much overlap.

Nearly all experimenters have looked at a strong light through a very small hole pierced in a piece of heavy paper, or some other material, and noticed that the light nearest the edges of the hole was of less intensity than that at the center.

This phenomenon exists on a radiovisor, accounting for the necessity of the slight overlap advocated above. Between lines No. 4 and No. 5 this phenomenon will be noticed by the tapering off of the light-intensity from midpoints on both lines toward their boundaries.

The cause of the heavy black line between lines No. 6 and No. 7 is self-evident, when it is found that the horizontal plane of the lower edge of hole No. 6 is

(Continued on page 450)

The School of Television

NEW YORK CITY now boasts of an accredited school devoted exclusively to the training of men for places in the fast developing art of Television. Under the capable direction of Mr. Paul A. Kober, formerly an engineer in the Television Laboratories in the General Electric organization, a staff of specialists has been gathered. The staff is under the guidance of Mr. Elmer M. Rave, formerly assistant professor of Communications Engineering at Maryland State University, and has been chosen not only for engineering competence, but for teaching ability as well.

The School of Television occupies an entire floor of an office building in midtown Manhattan—close to the commercial houses whose men will shortly seek entry into the new art, and also to the residential areas most suited to the needs of out-of-town students. Although the present quarters are spacious, they have been outgrown in the few weeks during which the school has been open; and negotiations are now under way toward the leasing of new and larger quarters to accommodate the class rooms and laboratories.

A visit to the present building at 360 Seventh Avenue disclosed classes in progress and the laboratories occupied by students performing experiments in elementary electricity and working on modern television apparatus. The central feature of the laboratory is a complete television transmitter of modern characteristics. Students in the lecture hall were being drilled in the elementary principles so necessary to the thorough understanding of the art. Indeed, the course is so well balanced, so far as this preliminary grounding in electricity, physics and the principles of radio is concerned, that no previous knowledge of a scientific character is necessary. The only prerequisite for entrance is a desire to learn. Because of its flexible character, the course is suited both to the newcomer and to the experienced radio-technician. In the case of advanced standing only is an entrance examination required; not as a hindrance to the prospective student, but to assure him that he is not passing over work necessary to his obtaining the best possible results from the course.

Mr. Paul A. Kober, formerly television engineer with General Electric Co., and now director of "The School of Television," in New York City.

This elementary course covers the basic principles of Electricity, Elementary Physics, Optics, the Principles of Radio, a study of the Vacuum Tube, and other important fundamentals. The advanced course covers the art of television, from start to finish. A few of the subjects covered are Photo-Electricity, Cathode-Ray Tubes, Scanning Systems, Television Receivers, Light Sources, and a study of the equipment used in the television studio. All this study is accompanied by a thorough course in laboratory technique, before entering into the actual mechanics of television. A well-stocked and equally well chosen library is provided for reference. No text-books are used in the course, however, other than the lesson books prepared by the staff.

Mr. Kober's long experience in the art, together with his personal scientific accomplishments both in his engineering capacity with the General Electric Company, and as Director of Research of the Claude Neon National Laboratories, fits him admirably for his position as director of the school's activities. Mr. Rave, because of his war-time activity as an instructor in the U. S. Army Signal Corps' Radio School, and later as a professor of Communications Engineering, is also well equipped for his post in command of the teaching staff. Those making up the teaching staff are of equal fitness for the positions they occupy.

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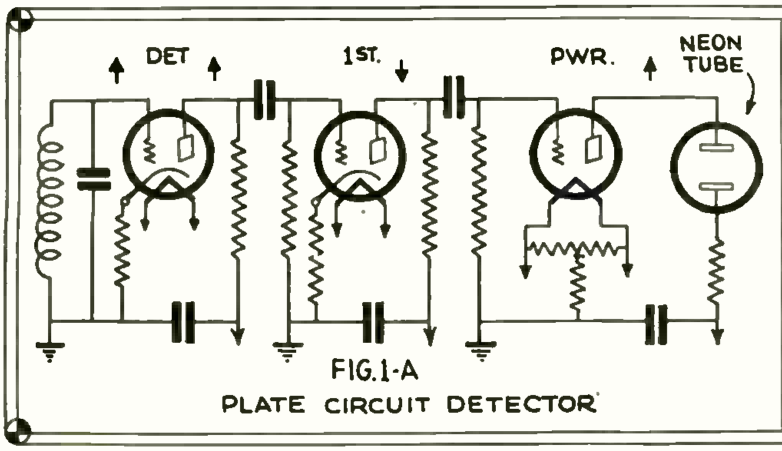
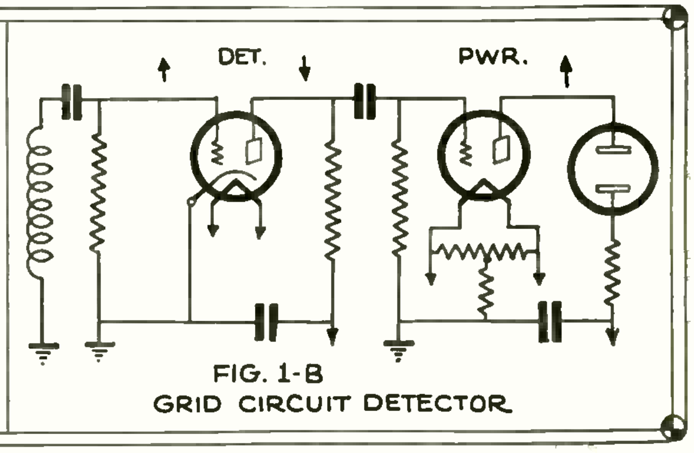


With plate circuit detection you need an even number of A.F. amplifier stages.



For grid circuit detection, you need an odd number of A.F. stages.

WHAT DETECTOR SHALL WE USE?

By C. H. W. NASON

The detector is one of the most important parts of every television receiver; don't fail to read this article, which explains how the signal is phased; the merits of grid and plate detection; the space-charge grid detector, and the value of the "diode" detector.

IN a recent issue of TELEVISION NEWS, there appeared an article on detection which has been in a measure misleading. In order to clear up certain facts regarding the operation of the detector tube in a television receiver, the writer intends here to cover, briefly, the entire field with certain added notes concerning the adaptations requisite to the peculiar needs of television receivers.

Until recently, two types of detectors have been recognized (insofar as the ordinary vacuum tube is concerned): these were grid-circuit and plate-circuit or "bias" detection. The plate-circuit or "bias" detector has been wrongfully termed the "power" detector—wrongfully, I say, because of the fact that the grid-circuit detector, properly handled, will be capable of accepting far greater input voltages without departing from a linear characteristic. Unfortunately we have many things to consider in the design of a television receiver which are not problematical in the design of detector circuits for broadcast reception—among them being the *phasing* of the output, so that the maximum positive plate voltage in the output tube will be coincident with maximum carrier amplitude.

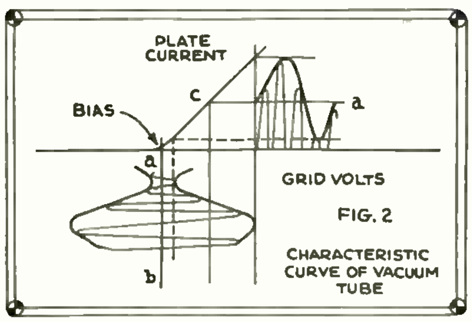
Phasing the Signal

In the *plate circuit* detector the maximum plate current is obtained when the input signal is at a maximum value. If we assume that the carrier amplitude is at a maximum simultaneously with the maximum light intensity of the scanned scene, we may evolve the fact that an *even* number of low-frequency stages must follow the detector, in order that the received image shall have its maximum brilliancy when the light in the scanned scene is maximum.

In grid-circuit detection we have the opposite condition; these detectors have their lowest plate current when the signal is at maximum amplitude. Here we must employ an odd number of stages following the detector, if the image is to be *positive* in character. *Negative* images present the same characteristics as negative photograhpic film—having their light and dark values transposed from the original.

Where we are using "bias" detectors we must use either two or four stages of low-frequency amplification—really, we are limited to two stages, for four stages would be utterly uncontrollable. With grid-circuit detection we may feed the detector directly into a pentode, where but small power output is required, or we may employ three stages to obtain the necessary signal amplitude for the operation of a '50.

In a "plate-circuit" detector the signal amplitude relations are as shown by the arrows in Fig. 1*a*. Note that the signal suffers a phase reversal through each stage of amplification. In plate-circuit detection the signal suffers no reversal in phase in the detector itself, except when the detector is heavily overloaded. In "grid-circuit" detection the phase relations from stage to stage are as shown in Fig. 1*b*. Here it may be seen that a reversal in phase occurs in the detector circuit. *If a plate circuit detector is heavily overloaded, a negative image may result!*



The diagrams above show characteristic curves of a vacuum tube.

How Detectors Operate

In Fig. 2 there is shown the characteristic curve of a vacuum tube. The vertical line *a-b* indicates the biasing potential, about which all signal variations take place. Drawn about this line is a wave representing a modulated carrier; and the effective variations in plate current may be seen readily, as they occur about the average plate current as represented by the line *c-d*. The output of the detector tube contains three components—radio-frequency energy, low-frequency energy and a small direct-current component. It is the low-frequency component which interests us and, by means of R.F. chokes and by-pass condensers (as shown in the circuit diagram) we filter out the R.F. component. The direct-current component does not

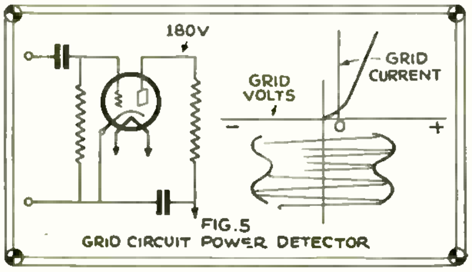


Fig. 5, above, shows characteristic curve and circuit for grid-circuit "power" detector.

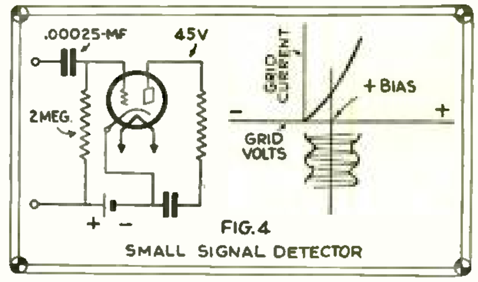


Fig. 4, above, shows diagram and characteristic curve for "small signal" detector.

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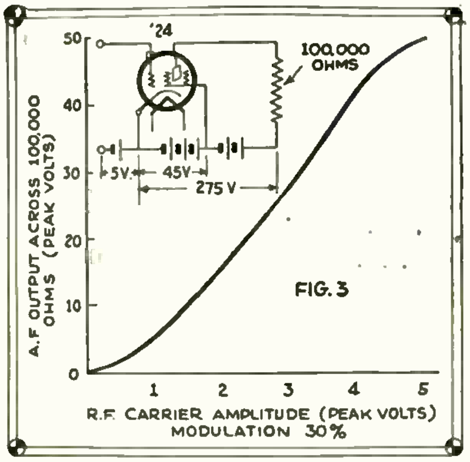
interest us; since it is not transferred to the grid of the succeeding tube.

If a '24 tube be operated as a plate-circuit detector, its output characteristics as compared with the amplitude of the incoming signal are shown in Fig. 3. The figure is self-explanatory, but one may note the fact that the measurements are taken in "peak" volts rather than in the R.M.S. values. The output voltage thus determined corresponds directly to the maximum allowable value to be applied to a subsequent amplifier having a given D.C. grid bias. The peak value of the input should never exceed the bias potential of the tube.

There are two types of grid circuit detectors—*small-signal* and grid-circuit *power* detectors. Small-signal detectors do not follow a linear operating characteristic, and are not particularly desirable where high quality is a necessity. We will merely note the manner in which they operate, so that the reader may better understand the advance brought about by the operation of the tube at its full capabilities. From the first glance, the meaning of Fig. 4 is not widely different from that of Fig. 5. In reality, however, a world of difference lies between the two.

In the small-signal detector, rectification takes place because of the *curvature* of the lower portion of the grid voltage-grid current characteristic. The tube is biased positively and given a rather small plate voltage. The positive bias is usually obtained by simply connecting the grid return to the positive side of the filament. In *power* grid detection the input signals are of such magnitude that no operation over the curved portion of the characteristic occurs, and the response is virtually linear. The bias of the grid should be zero, and the best detectors for this purpose are of the "heater" type. The '27 or the '24 types are about the best, but the '24 is probably preferable for television.

Investigation into the operating properties of the power grid-circuit detector has led to some remarkable discoveries regarding *quality*. These discoveries have been not only along the lines of the quality obtained with a detector having a substantially linear operating characteristic, but also have shown the effect upon the high-frequency response of different combinations of grid-condenser capacity and leak resistance. In television the condenser should not be larger than .0001 mf., and the leak should have a resistance of from 100,000 to 150,000 ohms.



If a '24 tube be operated as a plate-circuit detector, its output characteristics as compared with the amplitude of the incoming signal are shown in Fig. 3.

Diode Detectors

Three element tubes with two elements tied together so that they operate as two electrode devices ("diodes") are of value in some instances but, if the power grid-circuit detector is operated with a plate voltage high enough, its quality will be quite equal to that obtained with a *diode;* and the added advantage of a certain degree of amplification in the detector circuit will be had.

When using either the '27 or the '24 as a grid circuit-power detector in resistance-coupled circuits, care must be taken that the terminal voltage is sufficient to compensate for the loss through the plate-circuit resistor. In certain instances this will be quite high—particularly so because of the fact that the grid bias is normally zero, so that heavy plate current is drawn. In Fig. 6 are shown typical circuit arrangements for the '27 and '24 for operation as power grid-circuit detectors in television receivers.

More About
LENS DISCS and CRATER TUBES
in Next Issue

The Space-Charge Grid Detector

If the '24 tube is operated as a space-charge-grid tube, rather than as a screen-grid tube, its high-frequency response will be increased to a great extent. Such operation involves the use of the grid normally employed as the screen, as the control electrode, while the normal control-grid is acting to dispel the "space-charge cloud" surrounding the cathode emitter. This is the ideal detector for television receivers, so far as the personal experience of the writer extends. The rectification efficiency is high and a large voltage gain is possible. The data in Fig. 7, will guide the set constructor in the design of the detector portion of his receiver.

The Diode Detector in Television Receivers

The writer does not, personally, feel that the added complexity of the diode arrangement gives it any particular advantage over the power grid-circuit detector. However, certain of his readers may have a different view of the subject, or may wish to experiment with the circuit. For this reason there is shown in Fig. 8, an adaptation of the diode for use in a television receiver. A '27 is used as the rectifier, and a '24 for the associated amplifier.

The number of low-frequency stages following the arrangement shown will be odd—either one or three stages being needed. The writer suggests that the system be employed feeding directly into a pentode; for the input to the detector from two stages of R.F. amplification should be sufficient to give the required detector input voltage, if the modulation percentage of the transmitter is sufficiently high.

The high terminal voltages shown in the figures are obtained by connecting the detector's plate supply lead directly to the maximum plate voltage as supplied the power output tube. If those specified are not attainable, results will be fair—but not of the highest quality obtainable.

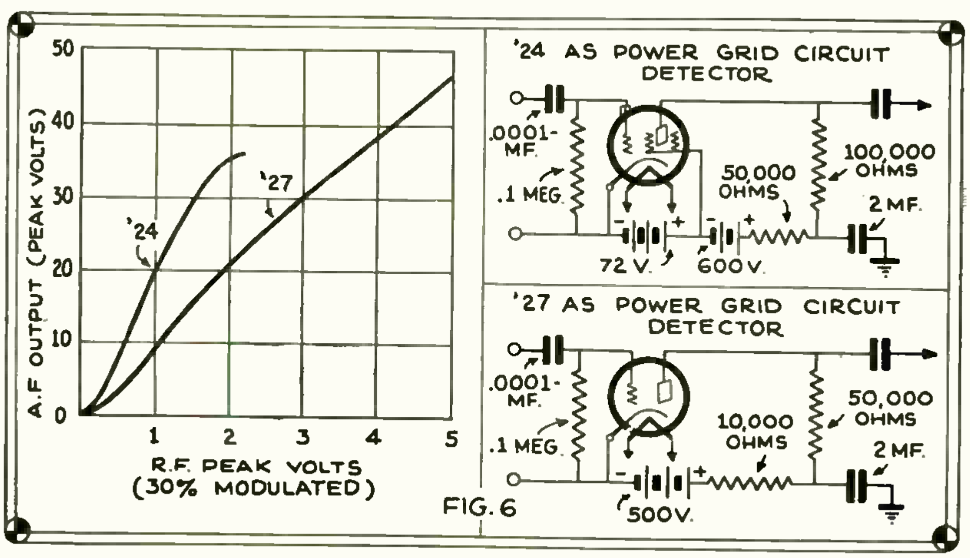
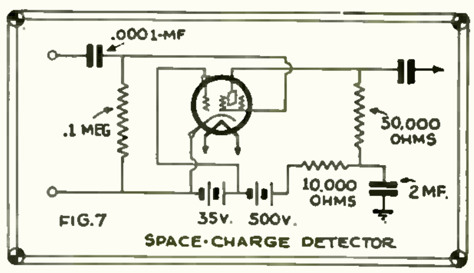


FIG. 6

Here we have characteristic curves and also circuits for using a '24 and a '27 tube as power grid circuit detectors for television receivers.



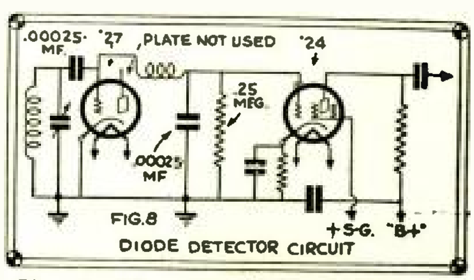


Fig. 7—The space-charge detector—the author's preference; Fig. 8—"diode" detector circuit.

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The ULTIMATE RECEIVER for TELEVISION

By C. H. W. NASON

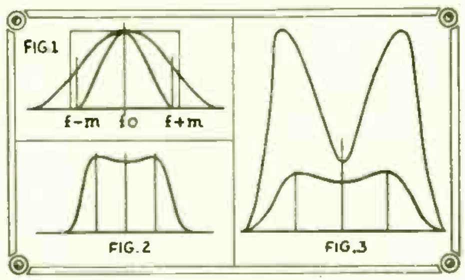
The receiver here described, combines a careful design of the radio frequency amplifier, with a powerful audio amplifier, delivering a signal strong enough to work a "crater" tube.

TELEVISION along present lines of attack can only become acceptable through infinite attention to the minor details. When we pause to consider that, despite the fact that a mere 5,000 cycles must be covered in order to provide an acceptable fidelity characteristic for a broadcast (voice) receiver, how few receivers remotely approach this requirement—it can readily be seen that in order to pass the 45,000-cycle band required for 60 by 72 element *television*, a deviation from the normal methods of design is required.

On the other hand we find that in many modern receivers, a good fidelity is achieved where 175 kc. circuits are required to pass a band of frequencies 10,000 cycles wide, representing 5.7 per cent of the base frequency; whereas in television, a band 90,000 cycles wide is but 6 per cent at 1,500 kc., and a mere 3 per cent at 3,000 kc. It therefore appears that the difficulties attending upon the design of a receiver covering the band from 1,500 to 3,000 kc., and having a good fidelity characteristic out to 45,000 cycles, are not insurmountable. Excessive crowding of the bands available to television will demand a high degree of adjacent channel selectivity, however—and success will depend largely upon the ingenuity of the individual designer.

"Good" and "Bad" Coil Effect

In Fig. 1, there are shown response characteristics for a "good" coil, for a "bad" coil—*i.e.*, one having a high resistance—and for an "ideal" system. When we consider the fact that a series of two poor coils will give us an "overall" response similar to that of a single good coil, we may readily see that we cannot find the answer to the problem by broadening the response of the individual tuned circuit. We can, however, turn to the band-selector, or coupled-circuit system, for the possible solution.



The diagrams above show resonance curves for various tuning systems, including the characteristics of a band selector circuit.

It can be seen from Fig. 2 that the "band selector" can closely approximate the response of the ideal. Now we have been taught (Aye! It has been "drummed" into us) that a television receiver *cannot employ regeneration*, because of the resultant sharpening of the circuits, and consequent loss of the higher frequencies. If we were to pause and coordinate our knowledge of band selectors, with our knowledge of the mechanism of a regenerative detector, we might readily arrive at the desired conclusion!

The effect of resistance of the coils in a band-selector circuit is that of narrowing the distance between the two response peaks, and of lowering the response throughout the band of frequencies transmitted. Regeneration, on the other hand, has the faculty of neutralizing the resistance of the tuned circuits.

In Fig. 3, we have the response characteristics of a band-selector circuit, with and without the resistance. Note that the separation between the peaks has increased and that the response at the two peak frequencies is nearly 400 per cent of that where the resistance is in the circuit. Correlating the evidence, as in Fig. 4, we have the response of a single tuned circuit—that of two tuned circuits, and that of two tuned circuits followed by a band selector, minus resistance. The final characteristic closely approaches that of the ideal. This is the arrangement we will employ in the development of a receiver capable of 100 per cent fidelity within the demands of present-day television.

Positive and Negative Images

In order that the receiver may be employed for use with the usual "flat-plate" neon lamp, or with a high-intensity crater lamp—and also in an attempt to accurately match the impedance within the output circuit—we will employ two '45 tubes operating in parallel in the output stage. The output circuit will be

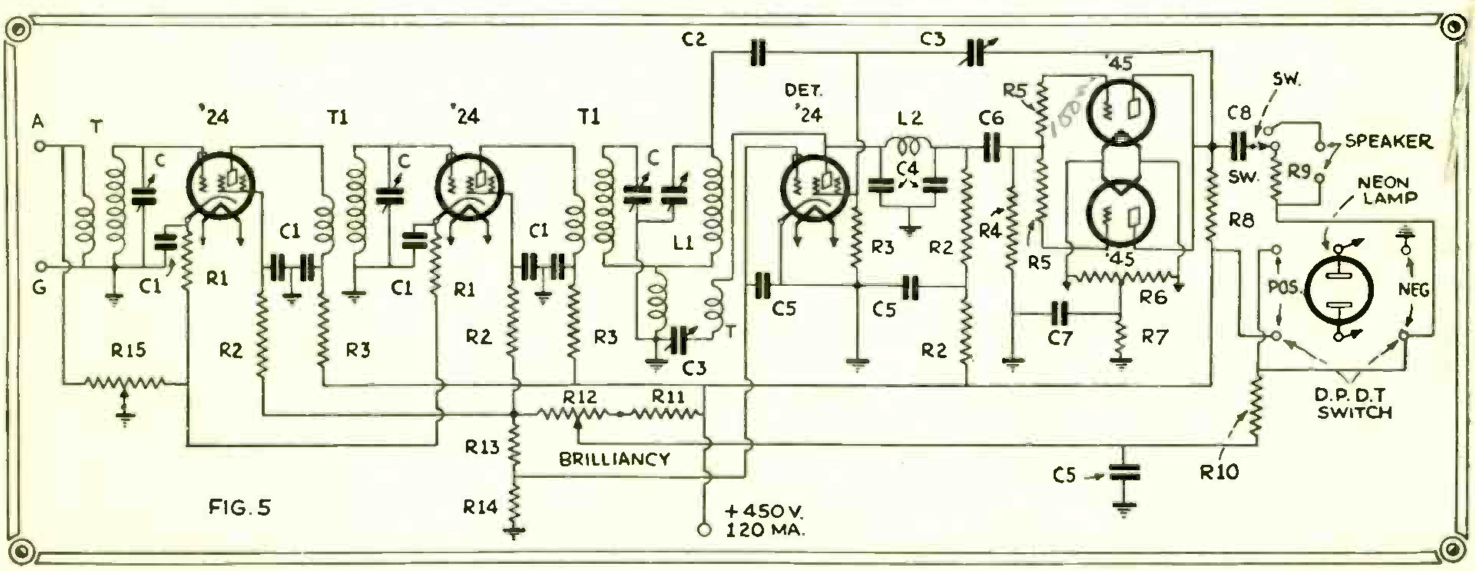


Fig. 5, above—Shows the complete wiring diagram for the "ultimate" television receiver here described by its designer, Mr. Nason. A space-charge detector is utilized, together with two '45 power tubes connected in parallel in the output stage, which furnished plenty of current for operating a "crater" tube when desired.

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also so arranged that a *positive* or a *negative* image may be obtained at will, by the use of a simple double-pole, double-throw switch. A potentiometer, incorporated in the voltage divider, enables us to accurately adjust the initial brilliancy of the neon tube without altering the supply voltages. When operating

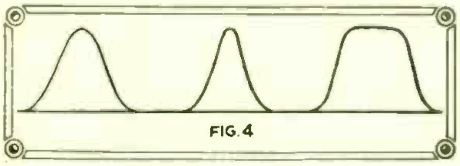


Fig. 4, above—From left to right, the resonance curve of a single tuned circuit; that of two tuned circuits followed by a band-selector, minus resistance.

tubes in parallel, oscillation often occurs and this must be avoided by inserting 100-ohm resistances close to the grid of each '45 tube, as shown in the schematic circuit.

Choice of Detector

Personal investigation has shown the writer that the only detector arrangement suitable to our purposes, is that of the '24 tube, connected as a "space-charge" grid or *Schottky* tube. It should be remembered that, for purposes of wiring, the functions of the two grids are reversed. The high efficiency of the '24 operated thus as a *power grid-circuit* detector, makes it unnecessary for us to employ an intermediate low-frequency amplifier stage. Any loss in the high-frequency response, encountered in the detector or low-frequency amplifier tube circuits, is compensated for in the use of the feedback condenser C_3 connected between the plate of the output tubes and the grid of the detector. This is a .00015-mf. midget variable condenser and the maximum high-frequency response, as evidenced by the best pictorial detail, may be obtained by an adjustment of this condenser under operating conditions.

Regeneration is provided by feeding back energy into the common inductance employed to obtain the "band selector" effect. The coupling coil is the primary of one of the transformers "L", while the secondary of the same transformer is used to obtain the energy from the detector plate circuit. Another .00015-mf. midget is used to control the regenerative effect.

While the R.F. choke may seem a bit large for use in the detector circuit of a short-wave receiver, such is not the case. The values—250 millihenries and .0002-mf.—have been arrived at by rigorous design methods and should not be deviated from.

Volume Control

The circuit—except for the regenerated "band-selector"—is quite normal in character and should offer no difficulties to the experienced constructor. *Volume control* is achieved through the use of a 10,000-ohm potentiometer, which is so arranged as to vary both the bias of the two R.F. amplifier tubes and the shunt resistance across the antenna input. Resistance-capacity filters are provided in all tube circuits, to avoid the possibility of "feedback" between stages.

In operation of the receiver, it may sometimes be noted, that with the volume turned full on, the image received will suddenly go *negative*. This indicates that the detector tube is overloaded—the over-

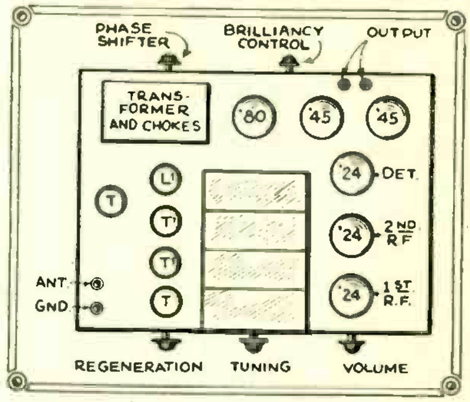


Fig. 6, above—Shows suggested arrangement of the apparatus constituting the "ultimate" television receiver.

load causing it to operate as a plate-circuit detector. Do not attempt to correct this trouble by reversing the phase of the image with the D.P.D.T. switch, but lower the value of the filter resistance in the detector plate circuit; thus raising the plate voltage slightly and raising the voltage on the grid of the tube, by altering the relation between R_{13} and R_{14}, and also increasing the power handling capabilities of the detector tube.

A loud speaker may be connected in place of R[illegible] by the use of a S.P.D.T. switch, as shown in the figure. If high output from the speaker is not essential, the speaker may be merely shunted across the resistance by means of a simple toggle switch.

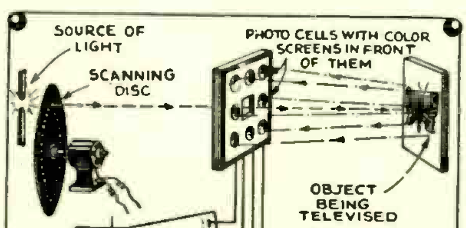
It will be noted from the *power supply* schematic, that the voltage of the power

(*Continued on page* 454)

A New System of Color Television

By HENRI F. DALPAYRAT

THE need for color in television is of course quite evident and is but a natural step in the slow process of evolution of this new branch of science. Various color schemes have been designed or proposed; invariably, they use mechanical devices which introduce complications in synchronism and are



How Mr. Dalpayrat arranges his color television apparatus at the "transmitter"; the commutator permits the transmission of the colors progressively.

difficult to adjust properly. The writer has designed a color system where the usual color disc is entirely eliminated and where the switching, or change from one color to another, is accomplished entirely without any moving parts. For the sake of simplicity, a scanning disc is shown at both the transmitter and the receiver; although the writer's patent applications show a complete universal system for any number of lines imaginable, either for black and white or natural color reproduction and entirely without any moving parts.

Looking at Fig. 1 we have a carbon arc light scanned by a disc; (the optical system is omitted for simplicity) which throws light, line by line, upon the subject to be televised. The light reflected from the subject strikes the sensitive surfaces of the photo-electric cells arranged around the window.

Three Groups of Photo-Cells Used

Three groups of cells are used—one group to be sensitive only to red light, and each cell is shielded by a transparent red glass screen. Another group is made sensitive only to blue; the cells of that group have blue filters. Still another group of cells is particularly sensitive to green and orange, and has its proper filters.

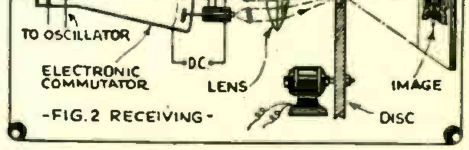
Although those colors are mentioned as an example only, others may be used, provided that an equal and even mixture of those colors will produce white light and unequal mixtures will provide successively all the colors of the spectrum. It is common practice to employ the fundamental colors red, blue and green; but yellow and pink are then very difficult to reproduce in a natural manner. For this reason, other combinations of colors, namely orange-red and bluish-green, give somewhat better and more natural results.

Each group of cells is separately connected to and disconnected from the amplifying system of the transmitter.

An Electronic Commutator

This is done without any mechanical motions, by employing a device designed by the writer, called an electronic commutator. This consists of a funnel-shaped tube, similar to the well-known cathode-ray tube used in television. A source of electrons (a heated cathode) projects a cathode ray of electrons which are attracted by a screen grid and plate collectors; three of those plates are used in the present scheme. When a "saw tooth" oscillator is connected to the deflecting plates, the beam of electrons swings rapidly up and down and in so

(*Continued on page* 452)



Color television receiver; the commutator permits each color to be registered, one after the other.

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TELEVISION COURSE

By C. H. W. NASON

At the close of our last lesson we promised an explanation of the *Weiller Wheel* or *Mirror-Wheel Scanner*. This device appears quite simple, once the basic principles underlying its operation are understood. It should be noted, however, that the accurate construction of the device is almost beyond the capabilities of all except the most skilled tool-makers.

Before entering into our description, we must recall the fact that if a light ray is reflected from a mirror surface the angle which the *incident* or original ray makes with the *normal*, or perpendicular to the mirror, will be the same as that made with the normal line by the reflected ray. In Fig. 1-a, this is shown in a graphic manner. Now in Fig. 1-b, we have a ray AB, *normal* or perpendicular to a reflecting surface MM. It thus makes a zero angle with the normal line, and will be reflected back along itself. By a simple proposition in geometry, it may be shown that, if MM is displaced by the angle ϕ (theta) the ray will make an angle ϕ with the normal; the normal being now represented by the line AN. The reflected ray will now fall along the line AC, since it must make the same angle with the normal as that made by the incident ray. It will be readily seen that, by displacing the mirror through the angle ϕ, we have displaced the reflected ray by the angle 2ϕ. *It is thus established that the deflection of the ray is twice that of the mirror.* To the writer's personal knowledge, a great number of practical experimenters have slipped up in their calculations where mirror-scanning systems were involved, through their failure to recognize this interesting basic fact.

The Weiller Wheel

Like the Nipkow disc, the mirror wheel of Lazare Weiller is of quite early origin. Here we have a series of mirrors arranged tangent to a circumference in the manner shown in Fig. 2—their planes being progressively offset from the perpendicular in such a manner as to provide the "vertical" component of the scanning motion; while the rotation of the wheel provides the "horizontal" component. Each mirror (for a sixty-line system) will subtend an angle of 6 degrees but, as we have shown above, will cause a deviation of 12 degrees in the path of an incident light ray. Suppose that we wish to project an image 5 x 6 inches in size; the side "A" as shown in Fig. 3, will then correspond to an angular displacement of 12 degrees. If we draw the figure as shown, we have two right triangles, each having an altitude of 3" and a base equal to the distance required (between the mirror surface and the viewing screen). We know that the angle at the apex of each triangle is 6 degrees and, by trigonometry, we may calculate the length of the base.

Reflection from Plane Mirrors in Motion

Trigonometry teaches us that the "tangent" of the angle (6°) is equal to the *height* divided by the *base* of the right triangle. Looking up the value of tangent 6°, in a table of natural functions, we find that the figure is 0.1051 and, by simple algebraic calculation, we find

$3/x = .1051$

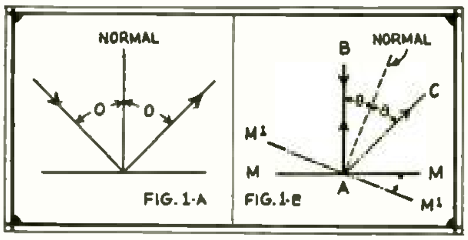
$.1051x = 3$

$x = 3 \div .1051 = 28.54$

$x = 28.54$ inches. *Answer.*

Those objecting to the mathematical reasoning need only take the answer and build their apparatus to specifications.

In this article Mr. Nason discusses the physical dimensions and also the action taking place in the reflecting type of scanners including the Weiller or mirror wheel; also design data on lens scanning discs.



Figs. 1A and B, above, show relation between the incident and reflected rays. Normal line, Fig. 1-B, is "A—N".

In a similar manner we may prove that the angular offset required to give our picture a vertical dimension or height of 5 inches is 5° between the first and last mirrors. This means that each successive mirror must be offset from the last by an angle of 1/60th of 5°, or five *minutes* (5') of angular measure.

The Size of the Light-Source

The size of our light source determines the characteristics of our optical system; for dividing the height of our projected image by 60 gives us the size of the light-spot or image of the source as effective at the screen. This is calculated to be .083-inch. A light source .015-inch in diameter, operating with an optical system having a magnification of 5.5 diameters, will give us a close approximation of this projected spot. We can refer to the last lesson for the necessary calculations—another score for the mathematics—for the equations involving the magnification of a lens:

$AB : A'B' = p : q$, or

$p = q/5.5$

We know that "q" must be greater than the distance betwen mirror surface and screen—28.5 inches—and we may assume 36 inches as a convenient value. The equation above now gives us the relation

$p = 36/5.5$ or

$p = 6.66$ (the distance from source to lens).

We have still to derive the focal length of the lens for these conditions and we find that, for a condition such as we now face, the case "B" of our last lesson obtains. We thus employ the equation:

$1/f = 1/q + 1/p$

$1/f = 1/36 + 1/6.6$

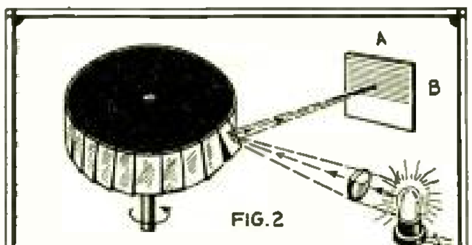
$1/f = 6.45/36$

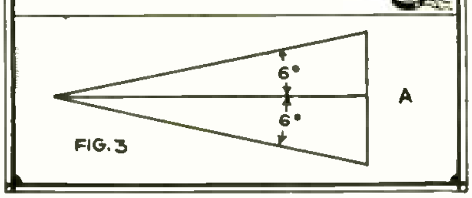
$f = 5.58$, or about 5.5 inches.

We thus find that we should employ a lens having a focal length of 5.5 inches. The larger the diameter or the *aperture*, of the lens we use, the greater will be the light efficiency of the system. The aperture of the lens we use is dependent upon the size of the individual mirror surface; for the cone of light between lens and screen must not be large, compared with the mirror's surface at the point where the mirror intercepts the ray. The size of the surface determines the size of the wheel itself, and we must not exceed a certain fixed diameter, if the power requirements for rotation at 1200 R.P.M. are not to be exceeded.

By following the process graphically outlined in Fig. 4, we may determine the diameter of the light-cone at the mirror. We know that the total distance from lens to screen is 36", and that the distance from lens to mirror is 7.5 inches. With a lens aperture of 0.5-inch, we find that the light cone has a diameter of 0.4 inch; and the mirror surface must be at least 1 inch square, if loss of light at the edges of the picture is to be eliminated. The calculations are quite simple; for the altitude of the right triangles shown in Fig. 4, will be found to vary directly with the length of the base. Therefore the diameter at the lens will be 0.5-inch where the base is 36", and approximately 0.4 inch, as noted above, where the base is 28.5 inches.

Based on a mirror surface one inch square, we find that the radius of our wheel must be 9.54 inches.





Figs. 2 and 3, above, show elements of mirror wheel scanning.

Construction of the Mirror Wheel

The Weiller mirror wheel may be described as having sixty flat surfaces, tangent to a circumference, and with

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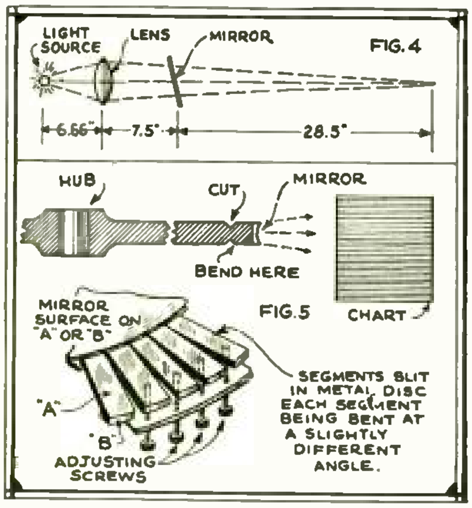


Fig. 4—Diagram used by the author in explaining graphically how we may determine the diameter of the light-cone at the mirror. Fig. 5—Different ways in which to construct a mirror or reflecting scanner wheel; in the first method, the various segments of the wheel are bent to different angles with a wrench.

their planes successively offset by an angle of 5′. The ideal method of construction would be to grind the wheel from optical glass, and then to silver and lacquer the surfaces.

The next best method would be to grind the wheel from a solid blank of Haynes Stellite, or some dense tool steel having an equally good reflection-characteristic when highly polished. This requires the services of an expert operator and the use of a precision milling machine.

Failing in this, we may construct a wheel such as that shown in cross-section in Fig. 5. Here a solid blank of brass has been ground to have sixty flat surfaces. Slots have been cut between the surfaces and the wheel cut out in the manner shown. Silvered microscope glasses are then cemented to each surface. The wheel is then mounted rigidly and a light ray projected so that it strikes one surface and is reflected to the first line, on a chart having the size of the desired image and having sixty lines carefully ruled. The wheel is then turned so that the second mirror receives and reflects the ray, and a wrench is used to bend the surface down to meet the point where the ray will coincide with the second line on the chart. This process is repeated until all sixty surfaces have been set.

Returning to the first surface, and again covering the entire range of rotation, it will be found that some of the surfaces have a tendency to spring back into position and must be reset. This aligning process may have to be repeated several times, over a period of days, before the mirror surfaces will retain their correct position. The motive power for a wheel of this type must be about ¼-horsepower, if a synchronous motor is to reach its required speed and "stay put" without hunting.

Construction Data on the Lens-Disc

The construction data on the lens-disc laid out last month were rather incomplete and, with the idea in mind that certain of our readers will be eager to build a lens-disc, capable of a high degree of excellence, we will now amplify those data to give actual constructional help.

To take a specific case in point, let us assume that we have at hand a number of lenses having apertures of 0.75-inch and focal length of 1.5 inches. Such a lens has a high "speed" or light-gathering efficiency. We will also assume that we will project an image 4.5 by 5.4 inches in size; so that the equivalent width of each scanned line must be .075-inch (4.5/60).

We already know the size of our desired image and the focal length of our lens. From this start we must derive the size of our light source and the two distances—p and q. If we place the screen nine inches from the lens disc, we set an arbitrary value for q, to add to our known quantities. We may now obtain the value of p from our previously given equation

$$1/p = 1/f - 1/q \text{ or}$$
$$1/p = 1/1.5 - 1/q$$
$$1/p = 5/9$$
$$p = 1.81 \text{ inches.}$$

We may also derive the magnification of the optical system, and hence the size of the crater lamp employed, from the equation

$$AB:A'B' = p:q \text{ or}$$
$$\text{Magnification} = 5$$

We thus determine that the size of the light source must be .015-inch or .075/5 inch.

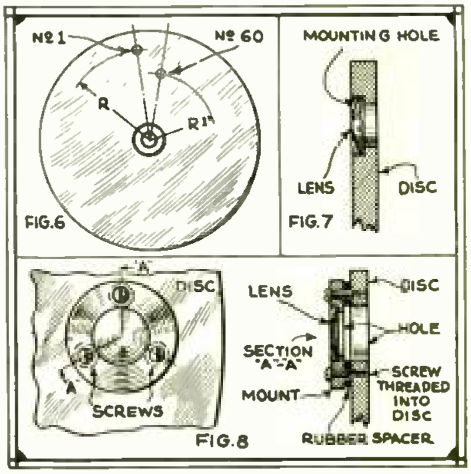


Fig. 6—Basic layout relations in a lens disc. In laying out a lens disc, we proceed as if it were to be a plain hole disc; the "hole" center then represents the "lens" centers. Fig. 7—Cross-section of "lens disc", showing lens mounted in counterbore. Fig. 8—Method suggested by author for mounting individual lenses around the spiral on the scanning disc.

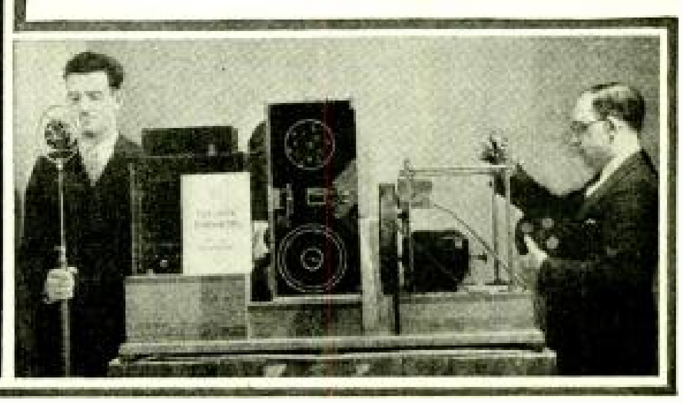
Although the derivation is indirectly taken, it may be assumed that the image as effective at the disc (determining the centers of the lenses) is equal to the projected image dimensions, divided by the magnification of the system. This process gives us 1.08×0.9 as the basis for our layout for the disc. In marking out the disc we proceed exactly as in the case of the regular Nipkow scanning disc. The arrangement is as shown in Fig. 6. The radius, as drawn from the center of the disc to the center of the first lens mounting-hole, is obtained by finding the circumference and dividing by 2π or 6.2832. The circumference as drawn through the first lens center is 64.8 inches, and the radius is thus about 10.312 inches; while the blank for the disc itself is 22 inches in diameter. The angle between successive radii is 6°, as in the case of all 60-line discs; and the successive radii are each less by .015-inch than the first. These radii should be carefully laid off and small centering holes drilled.

(*Continued on page* 453)

Television Demonstrated in Store Window

THE accompanying photographs show the I.C.A. television film pick-up and their latest model, large image, "crater tube—lens disc" receiver, as demonstrated in one of the show windows of Namm's department stores, Brooklyn, Y. This display, which was on exhibition daily, drew large crowds, and helped to educate the public in a practical way, as to just what television is. Between the exhibitions of images transmitted over the system from a motion picture film, voice announcements were made by means of the microphone shown in the larger photograph. The film pick-up apparatus provides a very good television transmitter system for use in colleges and many other cases, as all of the apparatus, including the transmitter and receiver, can be located under one roof or on a single platform, and the whole sequence of events in a complete television system, clearly demonstrated. The film pick-up and photo-cell unit utilizes standard movie film.

Large picture below shows television "film" pick-up and also microphone for making announcements over the I.C.A. televisor recently demonstrated in a Brooklyn, N. Y., department store. "Receiver" at left.



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FARNSWORTH'S Principle *of* SIDE-BAND COMPRESSION Explained

The problem of transmitting and receiving a high frequency television signal over a low frequency broadcast band is here discussed pro and con.

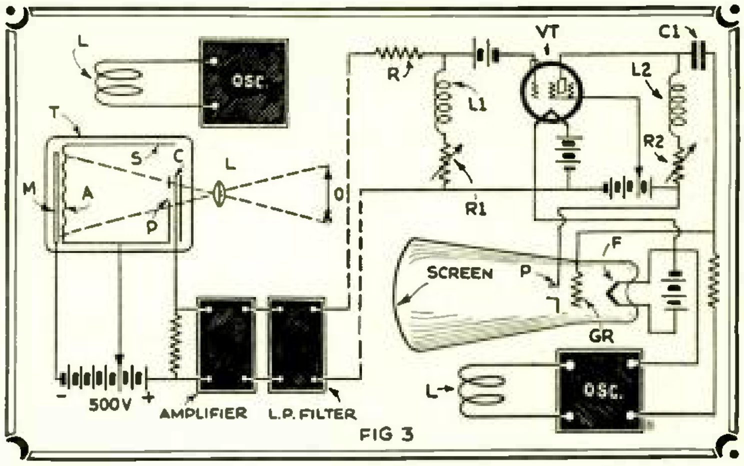


Fig. 3 above shows simplified hook-up of apparatus as proposed by Farnsworth for the purpose of transmitting television signals on a narrow band. Apparatus to the left of dotted line—transmitter; receiver to right.

As we all know, the distortion present in an amplifier takes the form of harmonics present in the output; this results from a distortion of the true signal from its original form. According to the Fourier analysis, a non-sinusoidal wave can be represented as a number of super-imposed sinusoidal waves of varying phase, frequency and amplitude. It is possible to measure the distortion of an amplifier by viewing the output in a visual oscillograph, and estimating the distortion of a sinusoidal signal.

The almost vertical wave fronts present in the television signal can be shown by a mathematical analysis to contain components ranging from zero to infinity in frequency.

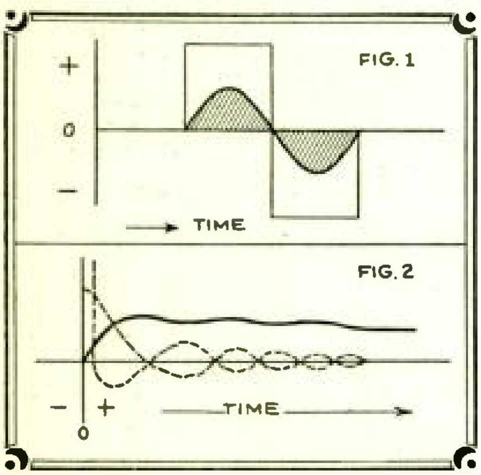


Fig. 1—Shows wave form of television signal in comparison with a sine wave: Fig. 2 shows graphically the analysis of a television signal referred to in the text by the author.

As we interpret the television signal it is inclusive of all frequencies from 20 cycles to well beyond 40,000 cycles. In the Farnsworth system (described in the March-April, 1931, issue of this Journal) this must be extended to include all frequencies up to and including 1,500,000 cycles. Now, it is quite possible for expert technicians to develop circuits which are capable of such service in the range of ultra-high frequencies; but the vagaries of these waves do not recommend them for broadcast services. It is, however, quite impossible to obtain such ranges of modulation frequencies either in the broadcast band or in the range at present employed in television.

Television Belongs in the Broadcast Band

Television rightfully belongs in the same range of frequencies as are employed for broadcasting, and Philo T. Farnsworth has recently laid claim to a development whereby the television signal can be deprived of all frequencies in excess of 5,000 cycles—the missing components being resupplied by special electrical circuits at the receiving point. While the claims are as yet unproven, there are engineers of the highest repute who have witnessed tests in which the signal from the Farnsworth "dissector" tube was passed through a simple A.F. transformer known to cut off all frequencies above 6,000 cycles—the missing components being re-supplied at the receiver—and these engineers have subscribed fully to the truth of the claims.

Analysis of Non-Sinusoidal Wave

The analysis of a non-sinusoidal wave form relies upon wide theoretical interpretations in the realm of higher mathematics. In consequence the elementary reader—for whom this has been written—will have to take certain statements with the proverbial grain of salt, for the aid of his mental digestion.

As we have said the television signal takes the form of a wave having a steep wave-front (as shown) in comparison with a sinusoidal wave in Fig. 1. The rectangular wave shown consists of many sinusoidal waves ranging in frequency (theoretically) from zero to an infinitely high value. The mathematical expression for this series involves the interpretation of "negative time"—time prior to the inception of the wave. This involves an infinite number of sine and cosine terms. The results for time prior to zero time (the actual inception of the impulse) give zero current; for the sine and cosine functions are then of equal value, but of opposite sign. For time subsequent to the inception of the wave, the various components add up to the approximation of the original wave.

The passage of a wave of the character shown through a transformer or a low-pass filter, results in the loss of certain of these sine and cosine functions; so that the components remaining will not, upon summation, give the original wave structure. The distorted wave will be of the form shown as a solid line in Fig. 2. Now we will operate mathematically upon the distorted wave, in an effort to determine what might possibly be done to return it to its original form.

The mathematically-obtained derivative of a wave involving sine functions is a sine function also, but is displaced in phase by 90 degrees. Such a derivative of the distorted wave is plotted graphically in the dotted line in the figure (Fig. 2). Its value is zero in negative time, but rises to a maximum value at zero time, and gradually falls away in amplitude, until it is damped out altogether. The derivative of this second sine function is a cosine function having zero value in negative time—rising to an infinite value at zero time, and as rapidly dropping back to zero and dying away in a series, 180° out of phase with the original wave. By superimposing the mathematically obtained derivatives upon the original distorted wave, we can achieve the original wave-form.

Circuit for Expanding the Side-Band

The problem now rests in the attempt to obtain the two derivatives and the summation, by means of electrical circuits, instead of by mathematical calculations. A circuit arrangement for this purpose is shown in Fig. 3. A signal arising from the dissector tube is passed through a transformer or low-pass filter, to remove all components above 5,000 cycles. It may now be transmitted to a remote point by means of a *broadcast*

(*Continued on page* 462)

We Want

GOOD "CONSTRUCTOR" ARTICLES

That tell just how you built your Television Receiver or Scanner!

Articles with diagrams and good photos particularly desirable. We will pay for all such articles accepted and published. Subjects of interest: LENS DISCS: SYNCHRONIZING SCHEMES: RECEIVING TUNERS and AMPLIFIERS, Etc.

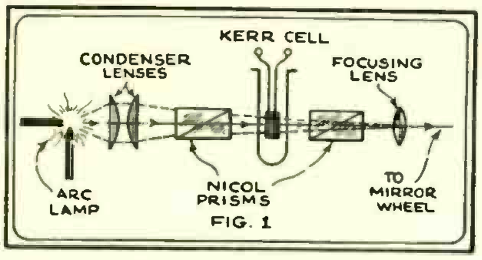


Fig. 1A—The arrangement of the Kerr cell (light valve) for modulating a powerful source of light in a television receiver.

Experimenting With
A KERR CELL

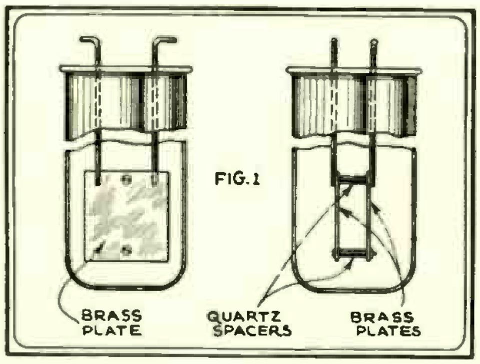
By C. BRADNER BROWN

Very little data of a practical nature has been given on this form of "light valve," which is used in producing large brilliant television images at the receiver. We feel that Mr. Brown's article is very timely.

ALTHOUGH we were operating a standard television set on nights when good signals could be obtained (at Kansas City, Mo.), the author was not satisfied with the opportunities presented for experiment, and decided to set up an entire television unit consisting of a sending and receiving set, with all of the incident amplifiers, photo-cells, etc. The scanning-disc system apparently fulfilled all requirements at the sending end, and was considered as a 32-hole affair (described in a previous issue). The disc system did not, however, appear to be the best adaptable at the receiver. In the first place, there was no lack of light at the transmitter, where a 1000-watt projection lantern was used. At the receiver, however, the 2-watt neon lamp must be used in the most efficient way, and a scanning disc with holes certainly is far from efficient. After studying over the possibilities, the standard method was abandoned, and the German mirror-wheel system chosen. The next problem to be encountered was the light-source; it was finally decided to use an arc light and modulate this beam with a Kerr cell. The system is shown in Fig. 1A.

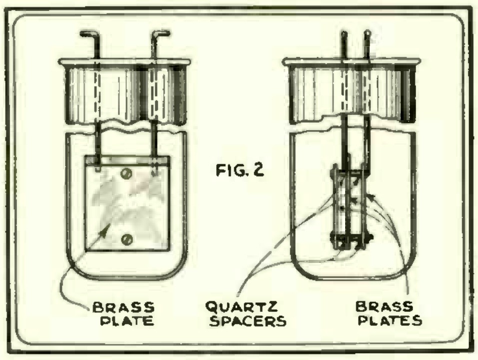
The light from an arc light is condensed to a narrow beam, and passed through a Nicol prism. The incident light is then "plane-polarized"; that is, the vibrations occur in one plane, only. It then passed through a Kerr cell, which is a device having the optical-electrical property of rotating the plane of polarization. It is a well known fact, that if plane-polarized light is allowed to fall on a second Nicol prism, called the "analyzer," it can be further polarized to such an extent that none of the light will come through the analyzer. In operation, the first Nicol prism was set with the axis of the polarizer, set at about 30 degrees to the plates of the Kerr cell. If the axis of the polarizer is parallel to the plates of the cell, no rotation is possible. The analyzer is then rotated until the plane of polarization is in such a position that no light passes through the analyzer prism. If a voltage of about 300 is now applied, the plane of polarization will be rotated until light is allowed to pass through the analyzer in the same manner as though the analyzer itself had been mechanically rotated.

The arc lamp we used was a 10-ampere affair of the Sperry type, and subsequently proved very troublesome. The area of the carbons was such that the condenser lenses were not very effective, and it proved necessary to place an aperture in front of the cell, to limit the light to a narrow beam in passing through the cell. If care is not taken in this point, some light will pass through the cell without going between the plates, and consequently will not have the plane of polarization rotated. This results in



Simple type of Kerr cell used experimentally by the author, in his tests made at University of Kansas.

a good deal of diffused light reaching the analyzer, with the result that the efficiency may be considerably reduced. The original cell consisted of two brass plates placed in a test tube, and immersed in



Improved form of Kerr Cell with quartz spacers used by Mr. Brown in actual tests with this form of "light valve". Don't use rubber; it is soluble in nitrobenzene.

a solution of nitrobenzene, as shown in Fig. 1. The main difficulty with this cell was the high voltage necessary to operate it, which ran from 500 to 1000 volts. This was caused by the wide separation of plates necessary to allow the light beam to pass. A decided improvement is the cell shown in Fig. 2. Here, only about one-half the voltage was used to obtain the same results as before.

After experimenting with this cell for some time, it became apparent that an arc light was not the ideal source of light for a cell of this source; for considerable difficulty was encountered in focusing the light to a point sufficiently concentrated for use with the mirror wheel. A projection lamn of the 1000-watt type was used, and apertures of suitable size placed between each piece of equipment. This gave somewhat better results; but the heat produced damaged the nitrobenzene, and turned it a dirty yellow. We were about to abandon the system when a friend dug up an old *Point-o-lite* lamp of a hundred-watt size. This lamp consists of a short filament, below which is placed a tungsten ball the size of a large buckshot. The lamp operates on direct current, and the filament serves only to start the operation. The tungsten ball is heated to incandescence by the impact of the electrons from the filament. Here was what we wanted. The size of the beam of light was readily reduced to about the diameter of a small lead pencil in passing through the cell; and an added projection lens brought this down to a small point for use on the television screen. The effect, on operating the mirror wheel, is to scan the screen with almost an even value of light. The dark lines so prominent in even a well constructed disc were absent; since the spot of light diffused on the edge to make for uniform illumination.

Extreme care must be taken that the nitrobenzene is kept in the best of condition. Any foreign matter introduced into the cell will cause the liquid to become hazy. This condition will absolutely ruin any definition which the light beam might have.

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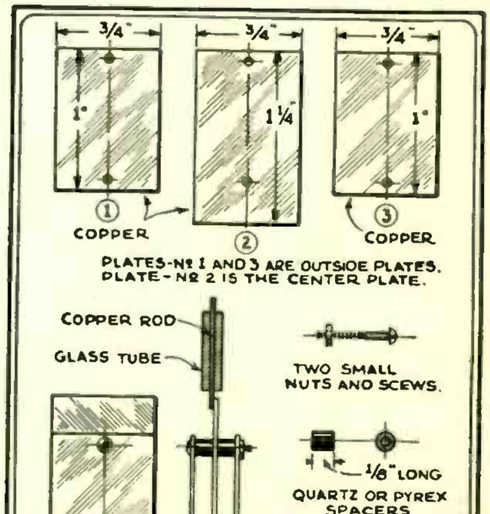

Fig. 3—Kerr Cell as finally developed and used by Mr. Brown: large holes in center plate pass the screws without touching.

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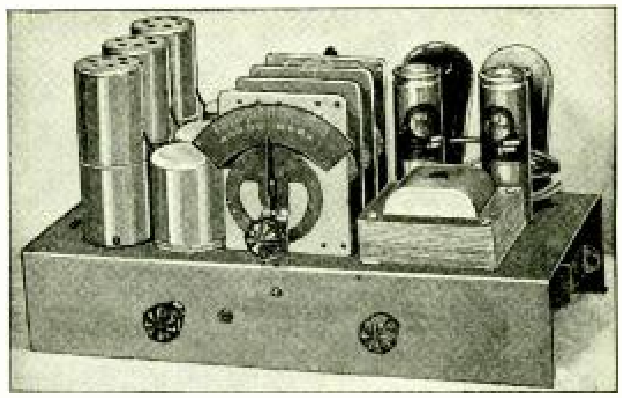
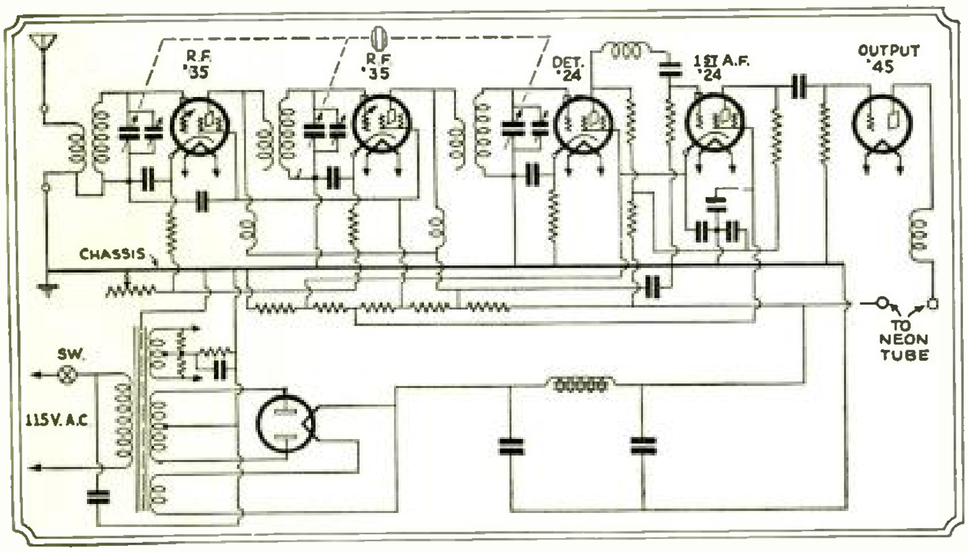
"LOOKING-IN" *with the* "SEE-ALL" Receiver *and* Amplifier



Photograph above shows neat design of the highly efficient "See-All" television receiver.

Features vari-mu tubes in capacity-coupled R.F. stages, plate detection, and a '45 output tube.

ONE of the most popular television receivers now on the market is the *See-All* receiver and many thousands of "visualists" are getting their first glimpse of television with the *See-All* scanner. Very little information, until recently, has been available, concerning the circuit used in the *See-All* television receiver; although very flattering comments have been heard on all sides, regarding the excellent quality of images brought in by this receiver.



Schematic diagram of the "See-All" television receiver.

As a glance at the hook-up shows, this receiver is a tuned-radio-frequency arrangement, utilizing two stages of R.F., which incorporates the use of '35 variable-mu tubes.

A radical departure in the design of the R.F. coupling transformers is noted, in that the primary windings are *capacitively* coupled to the secondary windings. The primary coils are wound over the secondaries, and one end of each primary is left *open*, as the diagram shows.

The audio-frequency amplifier comprises two stages of resistance coupling, utilizing a '24 in the first stage and a '45 tube in the output stage. Ordinarily, three stages of resistance coupling is used, to "phase" the image correctly; but in the *See-All* receiver the engineers have found that superior results are obtained with their apparatus by utilizing *plate* detection. If grid-leak and condenser detection had been employed, then three stages of resistance coupling would be necessary, in order to give a "positive" image on the scanner.

The rectifier circuit supplies approximately 300 volts to the '45 power tube's plate circuit, and about 250 volts across the terminals of the neon tube connected in series with the plate circuit of the '45.

Everyone today, it seems, is asking the question—can I use a neon crater tube on a television receiver of this type? The answer, generally speaking, is "yes". In any event, try it and, if the particular make of television receiver you are using does not give sufficient brilliancy, then it is a matter of consulting with the manufacturer as to the feasibility of adding another '45 tube in parallel with that already in the set, if it employs that tube.

The *See-All* receiver has sufficient power to excite an ordinary crater tube, which does not require more than 25 to 30 ma. The Raytheon crater tube, for example, does not require more than 25 ma., and the voltage needed for exciting this particular crater tube is (approximately) not more than 200. Such a receiver as that here described should give very good results. Of course, to use a crater tube, one needs a lens-disc for scanning. The Raytheon "Kinolamp" (model C25) is supplied in various sizes of craters, and has a "striking" voltage of about 200; the modulation potential averaging 110 volts, and the maximum current through the tube, 25 ma. If necessary, a variable resistance should be connected in series with the plate circuit of the '45 tube, in order to keep the current down to 25 ma. through the crater tube.

The new Jenkins crater tube can be loaded up to 100 ma., but gives a brilliant picture on 60 ma.; it will also give a very fair image on only 30 ma., operating from one pentode or '45 output tube. Where a large image is desired and a crater tube of great carrying capacity, such as the Jenkins, is to be used, one needs two '45 tubes or two pentodes in parallel in the output stage.

Many experts prefer the '45 tube to the pentode, either in single or parallel; since the crater tube is a *current-operated* device.

The *See-All* television receiver covers the usual television wavelength range, from 90 to 200 meters, and the R.F. stages (because of the capacity-coupling innovation) strike a happy medium; tuning sufficiently broad to embrace the wide band of frequencies now being transmitted on television waves, without tuning too broadly and causing distortion of the image by interference from other waves.

GOOD NEWS!

WITH this issue TELEVISION NEWS has been reduced in price, and the copy now sells for 25c, instead of 50c as heretofore.

The subscription price has also been reduced from $3.00 to $1.50 in the United States, and from $3.50 to $1.75 for Canada and foreign countries.

Unexpired subscriptions will be lengthened automatically a sufficient amount to take care of the new price. Thus, if your present subscription would expire in three months, you would get six months automatically, and so on.

And, if you like TELEVISION NEWS be sure to tell your friends about the NEW PRICE. Be a booster for your "favorite" magazine!

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Solving Some of the *Television* PROJECTION Problems

By HARRY ROSENTHAL*
Consulting Engineer

Harry Rosenthal, well-known consulting engineer, has developed many valuable new inventions in radio, X-ray and high frequency work, including improvements in X-ray tubes. He also developed the first commercial neon tubes in this country. He worked with Dr. De Forest on radio tube developments, and brought out the "solodyne" and "R" ray tubes. Mr. Rosenthal was the presiding genius of the Rosenthal Laboratories for over twenty years.

Mr. Rosenthal, well-known consulting engineer and specialist in radio and high frequency work, has devised a clever method of accurately controlling the focus and position of a crater tube in television projectors—a point heretofore severely neglected.

Fig. 3—Mr. Rosenthal's crater tube receiver, with his specially devised focusing controls.

A GREAT deal of work has been done in connection with receiving television, particularly with the regular type or scanners, having the "punch-hole" type of disc, and viewing the images obtained, either directly from the disc or in connection with a magnifying glass. This type of reception is satisfactory from a novelty standpoint; but, in order to put television in the class of real entertainment, it is necessary that the image or picture received be projected or viewed on a screen somewhere near the natural or life-size. Successful television reception, projected on a screen, entails the use of either a lens-type disc or a cathode-ray tube. The lens-type-disc apparatus embodies essentially the following:

(1) Synchronous motor or a motor which is held in synchronism.
(2) A disc for carrying the optical system.
(3) A source of light which corresponds to the optical system.
(4) A means of accurately adjusting the source of light in relation to the optical system.
(5) A satisfactory "short-wave" receiver with proper output, which should not produce any oscillation.

Results Obtained

Very satisfactory results have been obtained by using the so-called "crater" tube in connection with a revolving disc which has lenses inserted in it. In order to make it practical for home use, the disc is made of very light material and fairly small diameter. After making many designs, a disc approximately 15" in diameter, run by a small synchronous motor and carrying 60 plano-convex lenses inserted in it, gives very satisfactory results. Excellent pictures (images) from 4" by 6" up to 20" by 24" are obtained.

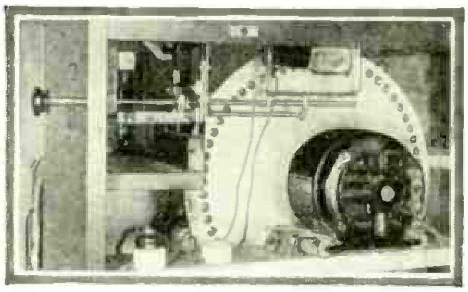

Fig. 1—Another view of the special "crater tube" focusing device.

A neon tube of the cold-crater type, striking at about 200 volts, and the source light coming from the crater through a hole approximately .025 inch in diameter, is used. Such a tube takes from 20 to 35 milliamperes and, when properly focused, gives satisfactory detail in connection with the present type receiver.

Tube Needs 4 Adjustments

In order to mount this type of apparatus, including the receiver, scanning-disc motor, and tube, in a conventional type cabinet, and to be able to control the focus of the tube and the framing of a picture, it was necessary to develop a tube holder which would have four adjustments, namely: (1) vertical (for height); (2) lateral (for framing); (3) focusing; (4) rotating (holder for tube).

The various adjustments mentioned above were worked out in a combined holder very satisfactorily as shown in the accompanying photographs.

It will be noted that Fig. 1 shows a complete focusing device for framing and focusing the crater lamp in relation to the scanning disc. The photograph, if carefully examined, shows how the vertical adjustments are easily taken care of and retained by wing-nuts. Through the side of the cabinet will be noticed the knob which controls the horizontal movement of the tube; this movement brings in any one of the frames which will give the most satisfactory picture. The frame usually brought in, is that which shows the lines running absolutely horizontal on the screen. In Fig. 2 is another view of the same focusing and framing device, which more clearly shows the adjustments, particularly from the outside. It should be noted that this focusing device is adaptable for either the "side-plate" discharge from the crater tube, or for a tube with "end" discharge. As shown in the photograph, the tube is for side discharge and a single wing-nut allows the tube to be rotated in a proper plane in relation to the disc. Fig. 3 shows a completed cabinet carrying the television receiver, scanning disc and adjustable screen; and in this photograph the side control of the framing device

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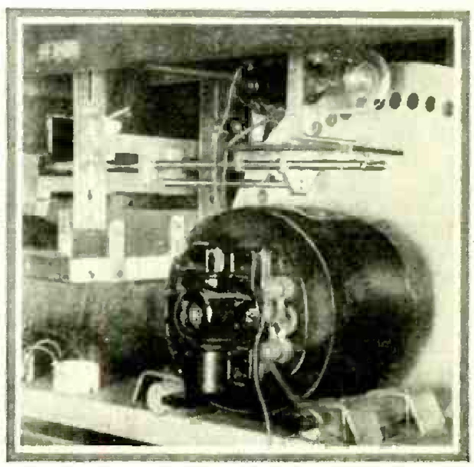

Fig. 2—Close-up of "four-direction" focusing controls.

* Television Apparatus Corp.

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TELEVISION DIGEST

Largest Output of Television Sets

The largest commercial output of television receivers ever produced for the market by any American manufacturer is now ready for distribution.

One thousand sets which will retail at prices which bring television home reception sets almost as low in cost as radio receivers are being delivered to the distributors and jobbers of the key cities, located within the radius of the twenty television stations now operating on experimental permits issued by the Federal Radio Commission.

A. M. Morgan, president of the Short Wave and Television Corporation of Boston, the company that has produced the thousand sets, reported this accomplishment recently.

Mr. Morgan is particular to emphasize the importance of the public understanding that television, which he believes will develop into a greater industry than the radio or motion picture, is still in the experimental stage, although no longer confined to the laboratory.

"It is not safe to predict when television will be ready for the general public," he said. "At the moment television has grown enough to be released from the laboratory. It is now ready for the experimenter. Its development will probably be greatly facilitated by improvements suggested by the experimenter. I, personally, feel that within two or three years television will be a flourishing industry. Certainly from now its growth will be phenomenal and it does not take a financial wizard to make the prediction that a new group of millionaires will rise through the development of television. The sooner television is ready for the commercial field, the sooner a new prosperity will affect our country. Millions will benefit financially through the commercializing of television and millions more will be entertained and educated through the programs and events which one day in the not too distant future will be available to all."

Federal Radio Commissioner Advocates Television Censor

Federal Radio Commissioner Harold A. La Fount has strongly advocated the need of statutes to control visual radio—television—before the art, as he sees it, becomes commercialized.

Taking the position that there will be many new legal, economic, and commercial problems to be met with the advent of television as a public service, Mr. LaFount said that every protection should be given to protect the American home from a surfeit of advertising by means of pictures transmitted through space, and even of "immodest" visual broadcasts. Like the motion pictures, he said, television should be carefully protected.

Mr. LaFount stated that in his opinion science will undoubtedly conquer the technical engineering problems but the next step is whether we shall be ready for this new development with the proper laws and supervision and especially if we shall have considered its effects upon our present customs and mode of living.

Television, according to Mr. LaFount, is certain to become *"the greatest force in the world."* It will have more influence over the lives of individuals, he stated, than any other single force. "The necessity of advancing cautiously and preparing carefully for the advent of this rapidly approaching development is, therefore, apparent," he said.

A question that arises, in the opinion of Mr. LaFount, is whether or not the existing radio law, designed to cover only broadcasting or voice transmission of pictures, actually applies to the transmission of pictures, particularly that portion which prohibits the Radio Commission from exercising a power of censorship. He said it is his opinion that the law does not apply to picture transmission.—*Talking Machine and Radio Weekly.*

From One Pioneer to Another

7160 Santa Monica Blvd.,
Hollywood, California,
July 30, 1931.

Mr. Hugo Gernsback,
98 Park Place,
New York City.

Dear Mr. Gernsback:

I am always pleased to receive my copy of TELEVISION NEWS. I find in its columns much useful information on many interesting subjects.

I have no doubt that in the new field of Television which is so rapidly opening up, Television News, the pioneer journal, will continue to occupy an increasingly important position.

Sincerely yours,

Lee de Forest

LdeF:HD Lee de Forest

Short Wave and Television Corporation Allowed Another Patent

The U. S. Patent Office recently notified the Short Wave and Television Corporation of Boston, Mass., that their patent application covering a new type of amplifier has been allowed. The inventor is Hollis S. Baird, the youthful chief engineer of the Corporation.

This new type of amplifier is a direct-coupled amplifier, which can be used up to any number of stages, and is particularly adapted for telephoto and television transmission. It is in contrast to the Loftin-White patent, which can be used only as two stages. This invention is particularly important at this time when many stage amplification is of utmost importance for electrical transmission experiments. Another recent invention announced by Mr. Baird is a "black and white" tube.

Television To Go Out on 6 to 8 Meters!

The Short Wave and Television Corporation of Boston, Mass., was advised recently that the Federal Radio Commission has granted a construction permit for the erection of a new 30 watt portable television transmitting station to experiment with television transmission on the Ultra Short Wavelength of 35,300 to 36,200 and 39,650 to 40,650 kilocycles, according to an announcement made by the company.

Authority was also granted to operate on the frequency around 43,000 to 48,500 and 50,300 kilocycles. The Boston experimenters have thus joined the ranks of the very small group of research men testing the efficiency of the extremely short waves *between 6 and 8.5 meters.*

W1XAV Gets a "Sound" Path on 1,604 K.C.

Announcement has been made that the Federal Radio Commission has granted a license for the newly built experimental station W1XAU to operate with 500 watts on the experimental frequency of 1,604 kilocycles.

This is to be used as the *sound path* for the television transmission of W1XAV which operates on the television band between 2,850 and 2,950 kilocycles with 500 watts power. A renewal license was granted to the latter station. Both stations are owned and operated by the Short Wave and Television Corporation of Boston, Mass.

Radio Sales Back to Normal—Thanks to Television Kit Sales

Boston, Mass.—Reports from radio department managers of the Kresge "Dollar" Stores, show that the demonstrations of Baird Television Kits have stimulated an interest among experimenters, amateurs and fans equal to that of the early days of radio, it is announced by A. M. Morgan, president of the Short Wave and Television Corporation of Boston, producers of the Baird Television Kits and Baird short wave sets.

Such interest was shown in Boston the first day a Kresge Store held a television reception demonstration, that the police were called out to maintain order.

C. L. O'Neil, manager of the Kresge Dollar Store at 2238 Third Avenue, N. Y. City, reports that the demand for Baird television kit parts, ranging in price from ten cents to fifteen dollars, has become so great that the radio department sales are back to normal for the first time in two years!

Experimenters and amateurs, he pointed out, are the best class of customers as they make weekly purchases. Kresge Dollar Stores have entered into an agreement with the Short Wave and Television Corporation to handle the Baird Television kits.

Letters From Our Readers

Doesn't Like "Visualist"

Editor TELEVISION NEWS:

I am writing to protest against the word chosen for the first prize in the TELEVISION NEWS "New Word" contest. The reason for the protest is that I believe it doesn't conform to the rules in the contest. It is not euphonious, which, by the way, means "sound well," is confused with "visionist" as indicated by the fact that you yourself used "visionist" in your July-August editorial, where it is plain that you meant "visualist." "Scanner" in my opinion deserved the prize. It is euphonious, short and has only two syllables, as compared with vis-u-al-ist having four syllables.

Another thing—how about a reduction in price on the magazine; thirty-five cents is reasonable.

Here is some information "telefans" may appreciate. The "National Carbon Co., Inc." at 10 East 40th St., New York City, sends gratis to anyone who cares to write to them, technical bulletins on neon or "kinolamps" and "photo-cells." "Radio Pictures, Inc." of 41 Park Row, New York City, will mail gratis upon receipt of anyone's name, a monthly sheet of information on television and short waves. "Romance and Reality" of Television may be bought at any Kresge store for fifteen cents.

I have noticed that the principles of television are constantly explained in practically every article. Whereas the really hard part pertaining to radio itself, as connected with television, *i. e.*, short-wave sets, and multi-stage amplifiers, is taken for granted as being already known by the reader. There are some (like myself) for instance who were not interested in radio until it was found that a knowledge of it was required in television. In other words, please be more lucid in such articles.

STAN OSOWSKI.

821 Railroad St.,
Central Falls, R. I.

(While it is hard to please all of the people all of the time, we have a sneaky feeling in the back of our head, that there are many other words which would be superior to "Visualist," to indicate the person who "looks in" on a program. At the present time and after carefully considering all of the words submitted in the prize contest, we honestly believe that "Visualist" had more than average merits in its favor, as compared to the other words submitted by our readers. "Scanner," the word you suggest, is euphonious, but somehow or other we have a hunch that this word would not become very popular with the general public. Of course we might be wrong, as it is hard to say just what the public will take to. The new price of TELEVISION NEWS *is 25 cents! O. K.?—Editor.)*

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How to MATCH *The Impedance* in Power Output Circuits to Neon Tubes

IN the Sept.-Oct. issue of this magazine, a comment appeared, regarding the problem of "impedance matching" in the output of the power tube. The writer believes that he has good reason to doubt the cause for alarm; for the impedance match is in no wise difficult to obtain. Indeed, the system to be described solves two problems at one sitting: that of matching the impedance of the tube to that of the load; and that of varying the initial briliancy of the neon tube, without disturbing the characteristics of the power tube.

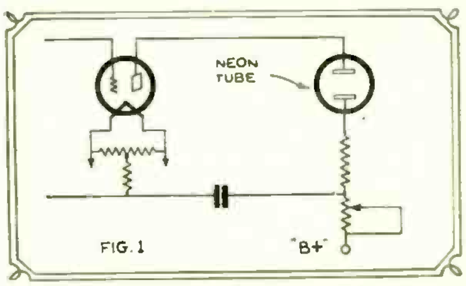
Signal Current Should Be High

First let us consider the fact that the signal current in the circuit containing the neon tube must be as high as possible. This means that the other branches of the circuit must draw as little current as possible from the source and, consequently, must have a high impedance with respect to the balance of the circuit. A resistance, in series with the neon tube, has a negligible effect upon the operation of the tube; for the device is *current operated*, and the total current flowing in that circuit will pass through the neon tube, regardless of series devices.

If we attempt to match the impedance of the load to that of the power tube, by the simple means shown in Fig. 1, where an added load impedance is obtained by means of a resistor in series with the neon tube, we find that the characteristics of the "output" tube will be changed, if we attempt to vary the brilliancy of the discharge by varying the plate voltage of the tube. In other words, we must arrange to vary the grid bias of the power tube in such a manner, that the power tube will at all times operate on a favorable portion of its characteristic curve.

In the circuit shown in Fig. 2, we have a system by means of which the two demands may be well satisfied. The impedance of the load may well be twice that of the power tube, and the initial brilliancy of the neon tube may be shifted over a wide range, without disturbing the characteristics of the power tube itself. If we operate the power tube—a '45—at its full rating we find that we have the following characteristics:

Plate voltage, 250;
Grid bias, 50 volts;
Output watts, 1.6 (undistorted);
Plate current, 34 ma. (milliamperes);
Plate impedance, 1.750 ohms.



A simple but undesirable method for attempting to match the impedance of the neon tube to the power tube.

Matching the Impedance

Maximum efficiency will be obtained (for undistorted power output) when the load presented to the tube is twice its plate impedance—*i.e.*, 3,500 ohms. If we feed the tube through a "series resistance" in the plate circuit, having a value of 10,000 ohms, we will incur a voltage drop of 340 volts; thus making the voltage output of the power supply equal to 250 plus 50 plus 340, or 640 volts. In parallel with the 10,000-ohm resistance we may place an impedance of approximately 5,500 ohms, which will include both the neon tube and its series resistance. We may estimate the impedance of the neon tube at 500 ohms and employ a series resistance of 5,000 ohms; or, if we desire, we may make this series resistance variable, as shown in the figure, in order to have a control over the signal current passed through the neon lamp. This variable series resistance may be reduced to below 2,500 ohms, before the impedance of the load becomes less than that of the tube itself. The 10,000-ohm current limiting resistance is negligible in the circuit, as its effect is hardly apparent in parallel with the low impedance of the neon tube.

The Use of a Pentode

An identical system may be used in the case of the '47 or PZ pentode, which should operate into an impedance of 7,000 ohms. In this case we have the following characteristics to be considered (the circuit being shown in Fig. 3):

Plate voltage, 250;
S.C.G. voltage, 250;
Grid bias, 16.5 volts;
Plate current, 32.5 ma.;
S.C.G. current, 7 ma.;
Power output, 2.5 watts.

This requires a total plate voltage of 250 plus 16.5 plus 325 (the drop through the 10,000-ohm resistor) or a total of about 600 volts. If we operate the pentode into the same type of output circuit as before, we will not incur an intolerable degree of distortion, and will retain the high sensitivity of the tube. An attempt to feed the tube into a higher impedance would demand an unprecedented voltage for the plate circuit. Note that a resistance of 50,000 ohms—suitably by-passed—must be inserted in the S.C.G. (space-charge-grid) lead of the tube.

How and Why Potentiometer Is Used

It will be seen that the brilliancy of the neon tube may be varied over a wide range by means of a potentiometer control, as shown in the two figures. Care should be taken that the direct current through the tube never exceeds 25 to 30 ma.; for this will result in the destruction of the tube. For this reason the potentiometer is so designed that it makes but half the total voltage available across the neon tube.

While the available power output from the pentode, with the load presented by the network shown, is not substantially higher than that of the '45, it must be remembered that the pentode has a higher order of power

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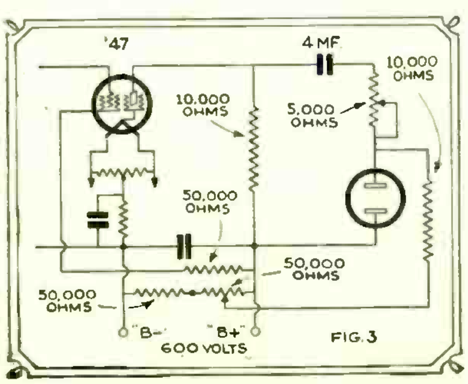
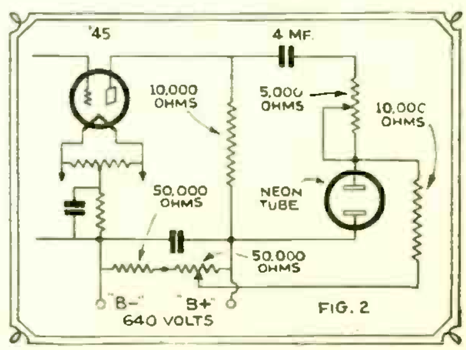


Improved impedance-matching output circuit for a "pentode" power tube.



Improved impedance-matching circuit suggested by the author, in which we can control the characteristics of the output tube, while matching the impedance.

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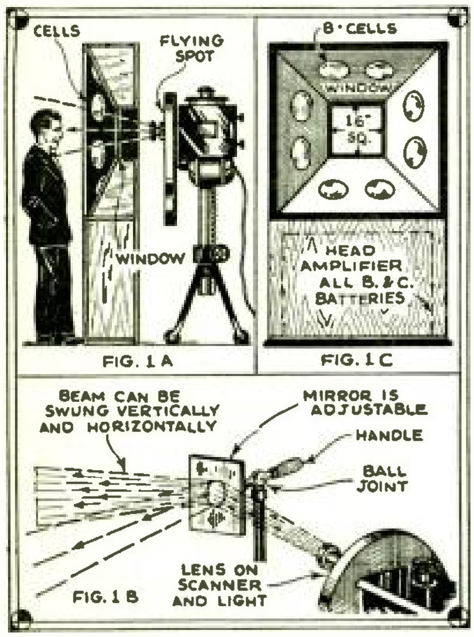
An A-1 TRANSMITTER AMPLIFIER

By H. P. AUSTIN

Here is just the data you have been looking for—with circuits employed in building a large television photo-cell amplifier, now in actual use at the First National Television School, Kansas City, Kan. Data are given on "head" amplifier, main amplifier and monitor stage.



Arrangement of photo-cell and scanning unit, as here described by Mr. Austin.

THE problem of the engineer, engaged in technical education, is primarily that of being able to present his ideas to his students so that they may be easily and quickly grasped. For this reason much use has been made of laboratory equipment which is readily opened up for inspection; and it is especially true that this is a very valuable adjunct to the lecture course in radio and television schools. It has been the pleasure of the author to collaborate with Mr. G. L. Taylor, Chief Engineer at First National Television, Inc., Kansas City, Kansas, in the design of an amplifier which is used to provide a television image from an indirect-pickup scanner located in the laboratory at the school. Thus students are enabled to see their classmates and friends being transmitted and received by television, as well as to study the amplifier by means of which this is accomplished.

Amplifier Designed for School Use

For the purposes of the school, it was felt that the design should adhere to simple, practical lines as much as possible; in order to further the students' understanding of the fundamentals involved in all television amplifiers, whether for transmitting or receiving. Since the officials of the school are to build a complete radio-television transmitter if, and when, a license is granted, the amplifier was also built with a factor of safety sufficient to insure continuous operation as the station input amplifier. This purpose, while still in the future, naturally influenced the design in many ways; one of these being that the whole amplifier was divided into two entirely separate parts, and each part was finally brought out to a low-impedance tube for connection to a line. This makes the job thoroughly flexible, in so far as that each part can be more advantageously located for its particular duty.

The "Head" Amplifier

By reference to Fig. 1, it will be seen that three stages of amplification are located at the photo-electric cells. This section, commonly called the *head amplifier*, makes use of two type '24 tubes for the high gain these tubes make possible, and the second of these feeds into a type '71-A. This third stage, while not affording much gain, has an output impedance of about 2,000 ohms, which makes possible a reasonable length of shielded line to the main amplifier, which would ordinarily be located some distance from the studio. The single photo-electric cell shown in the diagram really represents a bank of eight potassium-hydride cells, with anode voltage fed from a "B" battery common to both cells and head amplifier. For this reason, unusually complete filtering of the plate and screen-grid leads was used, to avoid any tendency toward common coupling. The "B" potential is 360 volts overall, permitting the use of large plate coupling resistors, and the operation of the tubes on the most nearly linear portion of their characteristic curves, giving both high gain and minimum distortion. The grid-bias voltages are also fed from a common "C" battery, and filtering is used in these circuits for the same reason as above.

No shielding was used between stages in this amplifier, and it, together with all "B" and "C" batteries, was built directly into the shielded case, or frame, which houses the photo-electric cells. This whole unit forms the initial pickup end of the system, and is built into the wall of the studio. A window about sixteen inches square, through the center of the cell bank, permits the entrance of the "flying spot" from the scanner.

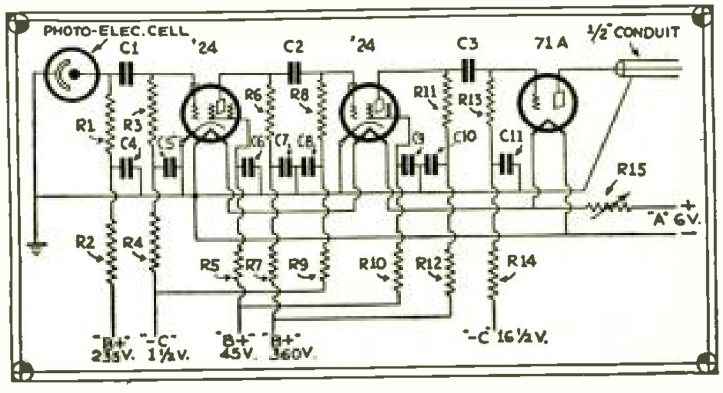
Line Connecting Head and Main Amplifiers

The line which connects the *head* and *main* amplifiers was the subject of considerable debate, before it was decided that the scheme offering the most desirable features was that of pulling a length of high-grade ignition (spark plug) cable into one-half inch conduit, and using the conduit for the common, or grounded, side of the circuit. Cable of this type has heavy insulation, far in excess of the requirements, and is thick enough to hold the relatively small wire well toward the center of the shielding conduit, thus minimizing the capacity which is so detrimental to the higher frequencies. If it is ever necessary to carry the line more than twenty-five feet, however, we felt it would be desirable to parallel another type '71-A tube with the one now in use, to halve the output impedance. This is not an unmixed blessing, in that the internal capacities of the tubes adversely affect the high frequencies also; but within reasonable limits this will permit lengthening the line somewhat. The line terminates in the main and monitor amplifier panel, which is mounted on a rack in standard broadcast-station fashion.

Details of "Main" Amplifier

Since we were not hampered in the *main amplifier* as regards space, all wiring was supported away from the aluminum panels on two-inch porcelain standoff insulators, and the sockets were supported, in turn, on the wiring. All grid and plate leads were isolated from grounded metal, as much as was reasonably possible; and the shielding which was used on this amplifier to avoid extraneous noise pick-up, and dust, was designed liberally for ample clearance from all modulated leads, and the tubes themselves, when in place.

While use was made of the type '24 tube in the head amplifier, we did not deem it advisable in the main amplifier for the reason that neither the frequency-characteristic nor the power-handling



Wiring diagram for "head" amplifier used to intensify photo-cell signals.

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ability would have been sufficiently good. We therefore resorted to type '27 tubes in the first two stages. A little calculation showed that, after these first two stages, even these tubes would overload; so the third stage was made a type '12-A, and the fourth, a type '10. Both these latter tubes were chosen because of their high "mu"; and the type '10 because it also has high power-handling ability and low plate impedance, which permits coupling into a short line, which will eventually feed the transmitter amplifier.

"C" and "A" Batteries; Plate Supply

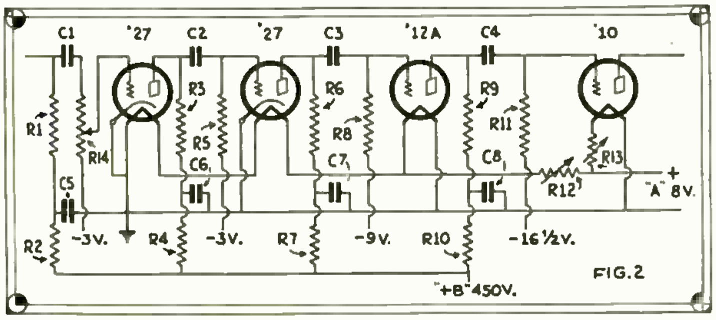
The "C" bias for the four stages is obtained from separate batteries, each battery being enclosed with the stage in the shielding associated with it. All plate leads are separately filtered as shown in Fig. 2; the common plate lead, from the first three stages and the last stage of the head amplifier, is run in conduit to the rack which carries the "B" batteries (with a total potential of 450 volts). This rack also carries the "A" batteries for both sections of the amplifier. These batteries were made up of three and four cells respectively, of 160 A.H. (ampere-hours), glass-jar, "light-plant" type cells. The "B"' circuit of the main amplifier, and the "A" circuits of both, were connected to a four-pole, double-throw switch, which connects the "A" batteries to the charger when the amplifiers are not in use.

The grid-biasing circuit with its filter arrangement is shown in detail in Fig. 3. Some such arrangement as this is essential in any self-biased circuit used in television; since the common method of bypassing the bias resistor and returning the grid resistor to ground invariably results in a degenerative effect, which cuts off both high and low frequencies. The circuit shown effectively holds the grids and filaments of the stage at the *instantaneous* impressed potential difference, regardless of the loss in the biasing resistor.

Use of Regeneration

When the construction was finished, and the customary "bugs" ironed out, a very acceptable picture was obtained on the monitor; but a noteworthy improvement was made in the detail of the image, by *regenerating* the *head amplifier* slightly.

This was accomplished by connecting two short pieces of insulated wire; one to the plate of one of the later stages of the head amplifier, and the other to the grid of a preceding tube. The two exposed ends were then twisted together until the amplifier was in oscillation; as indicated by the appearance of the typical wavy "oscillation lines" in the field. The wire was then untwisted until the oscillation just stopped. The exact connection is not shown in the diagram, as it would vary so much in different amplifiers that no constants could, of course, be given; but any true experimenter can readily discover one which will function. This method for the improvement of the high frequencies was anticipated from the beginning of the design work; which accounts for the absence of filter and resonant coils in the interstage coupling employed.



Schematic diagram of main television amplifier, which still further boosts the photo-cell signals.

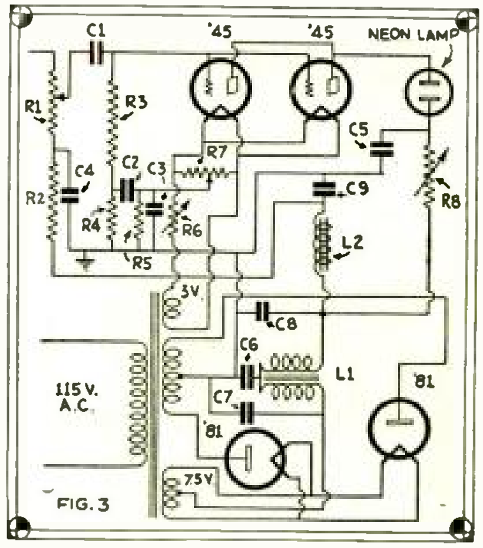
It was felt that, after the first three stages in the main amplifier, well-filtered, rectified A.C., could be used as a plate supply; so a high-voltage power pack, using two type '81 rectifiers was built in connection with, and on the same panel with, the monitor amplifier stage, which is located just above the main amplifier on the rack. Since the monitor amplifier's input volume-control potentiometer serves also as the plate-coupling resistor for the type '10 stage, it is conveniently located close to the power supply on the monitor amplifier panel, and is supplied with "B" voltage at about 750 volts, "no load".

Monitor Stage

On account of the difficulty of obtaining entirely gas-free type '50 tubes, it was decided to use two type '45 tubes in parallel, in the monitor amplifier stage. This gives an output impedance of 1,000 ohms and a lamp current of 60 milliamps, which is not too great for the DeForest "Vision" neon lamp used in the monitor. An additional advantage in the use of type '45 tubes is that the normal plate voltage (250) is low enough to permit the operation of as many as three flat-plate neon lamps in series before the full voltage of the power pack is absorbed.

Regeneration by capacity feedback in high-gain resistance-coupled amplifiers (where it may be had with small values of capacity, as in this instance) becomes increasingly effective the higher the frequency; since the inductance which determines the oscillation frequency is very small. This is in contrast to the oscillation resulting from common coupling in the power supply, which is frequently encountered when insufficient filtering is used, and over which the designer has no control. This expedient resulted so fortunately in this case, that the designer believes that it might be more extensively used in receiving amplifiers with considerable improvement in image detail.

The initial testing of the amplifier was accomplished with a loud speaker, and no trouble was encountered with "motor-boating", oscillation, or "blocking"; which, considering the number of stages, speaks well for the filtering used. No measurements have been made as to the overall frequency-characteristics, but the quality of the picture obtained leads us to believe that the range covered is from



Hook-up of parts used in building the "monitor" amplifier and the "power supply."

somewhat below 30 cycles to above 25,000 cycles. Some improvement in the low-frequency response could have been attained by doubling the coupling condensers; but it was felt that the exposure to rough handling (by the students) made this increased opportunity for leakage inadvisable. This may be done later when the requirements of the transmitter make it advisable.

Jacks Facilitate Testing

Some details of the construction may be of interest. A jack was provided in the plate circuit of each stage in the main amplifier, and one in the plate circuit of the monitor amplifier. Filament jacks were installed behind each variable filament resistor; and one jack permits reading the total "B" current drain, in order to avoid the possibility of running down "B" batteries with faulty bypass condensers. Two milliammeters, 0-10 ma. and 0-100 ma., and a 0-8 voltmeter were mounted at the top of the panel; and cords and plugs were brought out from them to facilitate testing.

The scanning and receiving equipment is that of the Western Television Corp., Chicago, and the discs used are that company's standard 45-hole, three-spiral type; with a synchronous motor driven at 900 R.P.M., or fifteen pictures per second. The scanner uses as a light-source a 900-watt incandescent lamp of the projection type, with the customary mirror and condensing-lens system. Four lenses, mounted on a turret on the scanner, make it possible to vary the size of the field being scanned. An innovation of this piece of Western Television Corp. apparatus is that the beam is directed vertically and horizontally by means of a small mirror mounted on a swivel joint, so that it is not necessary for the operator to swing the entire mechanism in following the subject.

The amplifier was built, the scanning and receiving apparatus was assembled, and all adjustments were made so that the system was in operation exactly one month after the design work was finished. The construction work was all done by Mr. Taylor, and credit is due to him for a very neat layout.

(*Continued on page* 456)

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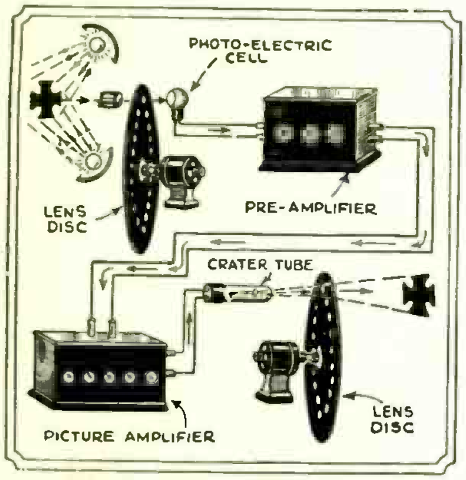
The TELEVISION QUESTION BOX

Edited by
C. H. W. NASON



Hook-up of experimental television transmitter and receiver, the transmitting scanner using a single photo-electric cell.

Television Transmitter

E. Nathaniel Skokan, Omaha, Nebraska:

I am building an experimental *television transmitter* of the type shown in the figure. I would like to have the following information:

(Q. 1.)—What type of lens should I use for the pick-up?

(Q. 2.)—What type of lenses should I employ in the optical system at the receiver?

(Q. 3.)—Where can I obtain a neon *Crater* tube for use at the receiving point?

(Q. 4.)—Can I use a two-stage, resistance-coupled amplifier to precede the two-stage Loftin-White amplifier with pentode output?

(A. 1.)—The Hugo Meyer "Kino Plasmat" F1.5—2-inch lens will serve admirably for your purpose; I doubt whether you can get by with a lens of less speed. The output of a caesium cell with the amount of light available is very small.

(A. 2.)—At the receiver, I fear you will not be able to project an eight-inch image without using a lens disc or other optical scanning system.

(A. 3.)—The crater lamp may be obtained from those concerns advertising this class of apparatus in TELEVISION NEWS. The pentode tube is not suited to this service, and I would suggest that you construct an amplifier having an output stage using two '45s in parallel, as described before in TELEVISION NEWS.

(A. 4.)—You will require at least six stages of amplification in order to operate from the photo-cell into the crater lamp. The Loftin-White system does not lend itself to use in television circuits; since its frequency response is decidedly poorer than that of an equally well-designed, straight resistance-coupled stage. The first amplifier may be built with two '24 tubes followed by a '71, which should be battery operated; as the low signal level will not permit of the slightest hum. The amplifier should be shielded and preferably built integral with the cell housing. The second amplifier will also employ two '24's, working into two '45 tubes connected "in parallel." If the gain obtained is insufficient—and I have every reason to believe that it will be—you will require an additional two stages of amplification—let us say a '24 and a '71. Design details covering such amplifiers are to be found in your back files of TELEVISION NEWS.

How to Become a Radio-Television Engineer

C. R. Johnson, La Grande, Oregon:

(Q. 1.)—I am an ardent reader of both TELEVISION NEWS and SHORT WAVE CRAFT. My experiments in television have failed so far, because of the distance between my home and the nearest television station. I am a graduate of the La Grande high school, and intend to make *radio* and *television* my life-work. I understand that it takes at least three years' study for *radio*. I would like to know for sure the type of course to take to become a *Radio Engineer*.

(A. 1.)—When the writer was in college there were no actual courses in radio engineering other than post-graduate courses intended to follow a four-year course leading to a B.S. degree in Electrical Engineering. Columbia did give certain courses in radio engineering, which fitted the trained electrical engineer to specialize in radio. Union College at Schenectady also gave courses, and still does. While Dr. Alfred N. Goldsmith was at the College of the City of New York, he gave a course in radio engineering which graduated such men as Lester Jones, Carl Dreher and Jesse Marsten—now well known throughout the country. Today there are excellent courses covering a four-year period, leading to a B.S. degree at many of the better universities. You must first differentiate between the engineer and the physicist, who deals more or less with pure science. I cannot give a complete list of the institutions giving courses but, despite a fear of the wrath of institutions I fail to mention, I can give you a fair idea of the courses I would choose for my own boy, were he old enough and inclined to follow in his father's path.

The Latest About
CATHODE RAY SCANNERS
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For training as a "physicist" I would send him to Johns Hopkins University in Baltimore, for a four-year period, to be followed by two years' work for an advanced degree at the Cruft High Frequency Laboratories at Harvard. As an alternate to this, I would send him to some one of the smaller colleges for a B.S. degree to be followed by advanced work at the University of Chicago. If he were interested in the more practical phases of the art, I would send him to the Moore School of Engineering at the University of Pennsylvania, for either four years' specialized work toward a B.S. degree, or for the full six years required for an M.S. in Physics or for an E.E. degree.

At the close of the four-year period the student will find openings available in many of the larger engineering institutions, such as the Bell Telephone Laboratories, where opportunity for advanced study is presented.

From the young engineers who have come to the writer's attention, he would not hesitate to recommend the Moore School. It is practically impossible to break into the field of radio engineering other than through specialized courses covering either a four- or six-year period. The physicist is rarely ready to assume his functions in industry short of eight years, leading to a Ph.D. degree.

Making a Photo-Voltaic Cell

Harry C. Mealman, Seattle, Washington:

(Q. 1.)—I am making a photo-voltaic cell which calls for one of the electrodes to be of copper, coated with Cuprous Oxide ($C\mu_2O$). I would like to know how to make the Cuprous Oxide adhere to the plate.

(A. 1.)—The Cuprous Oxide layer does not adhere to the plate, but is formed there by a chemical process. In order to be successful, this layer must be forced under an elaborate control of conditions, which are outside the practicability of the "home" laboratory.

Undistorted Reception From Ordinary Set?

Harry Weeks, 23-30 30th Road, Long Island City:

(Q. 1.)—Will the ordinary receiver give undistorted reproduction of the television signal? If not, is it possible to design one having the required range?

(A. 1.)—The ordinary receiver will decidedly not function for the reception of television signals; I thought we had that point cleared up once and for all. In this issue of TELEVISION NEWS you will find a complete discussion of the receiver problem and of the methods of its solution.

Cathode-Ray Tube "Scanner"

Edwin L. Kendall, Detroit, Mich.:

(Q. 1.)—Can you give me a diagram of the cathode-ray tube, together with an explanation of the various functions of the elements?

(A. 1.)—The cathode-ray tube shown in the figure is that supplied by the General Radio Company. Starting at the filament or emitter, we have a source of electrons or cathode rays. Surrounding this emitter is a shield which varies the shape of the electron cloud or space-charge cloud which surrounds the filament—this is known as a *Wehnelt Cylinder* and it is given a negative charge. Moving on, we find an *anode* which is given a high positive potential, in order to accelerate the electrons toward the screen. These rapidly-moving electrons pass through a tiny aperture in the anode, and are concentrated into a slender beam. The focusing of the beam is dependent upon the voltage applied to the anode.

Next in order, we have two sets of condenser plates, which serve to deflect the beam from the normal path, and toward the positive electrode. By varying the frequency, phase and form of the voltages applied to these electrodes, almost any desired pattern may be achieved. After passing the deflecting plates the beam impinges on a plate or screen coated with some fluorescent material—that is, a substance which glows brightly when struck by the electron stream.

In the second figure we show how a tube of this type might be connected for television. This involves a great deal of experimental work, which must be done by the individual investigator, as we can only specify the waveform—frequency—etc., to be used—the amplitude varies with the type of tube employed.

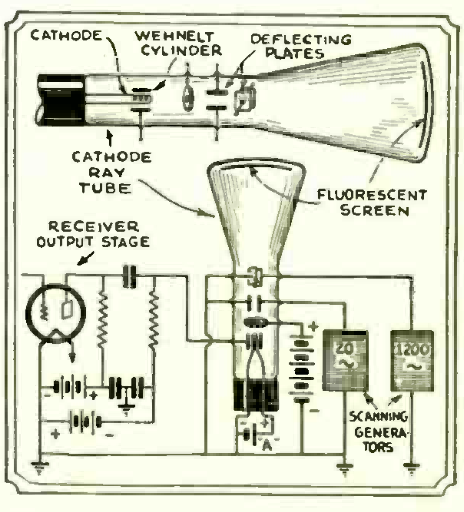

Diagram showing connections of television receiver output stage, also 20 and 1,200-cycle "saw-tooth" oscillators to cathode ray tube scanner.

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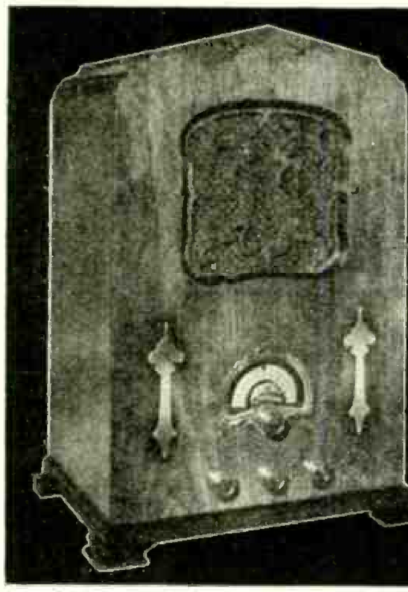

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JENKINS TELEVISION CORP
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Are You Ready to Receive the 5-Meter Television Signals?

By C. H. W. NASON

(*Continued from page* 420)

strong's "Super-regenerator." This receiver made possible the construction of an exceedingly simple receiver of a high degree of sensitivity—simple, we say—with a sardonic grin—for the simplicity ended with the number of tubes required. At broadcast frequencies the thing was the very devil to control, and it never progressed much beyond anyone's laboratory until a few German scientists working on aircraft receivers discovered that at the truly high frequencies the "super-regenerator" became simpler in operation than the straight regenerative circuit.

Operation of the Super-Regenerative Receiver

Before we go further we might explain the operation of the super-regenerative receiver. As the regeneration control is advanced in the usual regenerative set, we know that the sensitivity increases in an unprecedented manner—but we also know that in this border-line condition it is practically impossible to prevent the set's "slopping over" into *uncontrolled oscillation*.

In the "super-regenerator" a separate tube operating as an oscillator, and at a frequency *much lower* than that of the received signal, is used to modulate the detector tube; in such a manner that, during one-half cycle of the oscillator output, the regeneration is permitted to assume its full value while, in the other half-cycle, the detector oscillations are entirely quenched out. In our receiver, the modulation or "quenching" influence will be fed into the plate circuit of the detector tube in such a manner as to completely modulate the detector oscillations through variation of the plate voltage.

To restate the operation in a condensed form—during the time that the oscillator output is increasing the effective plate voltage, the detector is in a condition for uncontrolled oscillation, while during the period when the oscillator output voltage swings in the negative sense, oscillation is completely damped out. When operating in this manner the detector is many thosuands of times more sensitive to incoming signals than when operated as a simple regenerative device.

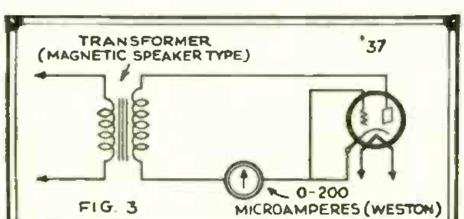

Fig. 3—Schematic circuit for an output meter to be used with Lecher wires in calibrating the receiver.

The difficulty encountered in the original Armstrong arrangement had to do with the fact that the quenching frequency needs must always represent a fair percentage of the carrier frequency—this limited the sensitivity of the device and also rendered it uncontrollable. At 1000 kc., the lowest possible quenching frequency (without infringing upon the audio-frequency range) was about 10,000 cycles or 1% of the carrier frequency. In our receiver, where the carrier frequency is of the order of 60,000 kc., we may employ a quenching frequency of 175,000 cycles with a ratio of only 0.3 per cent. The 175 kc. quenching frequency was chosen because a shielded intermediate-frequency transformer, of the type employed in regular broadcast superheterodynes, could be used in constructing the receiver, and also because the quenching frequency was well outside the television signal range.

In an oscillating detector we are limited to certain forms, which are so affected by the inter-electrode capacitance of the detector tube as to permit of operation at these high frequencies, without the need for "de-basing" the tube or other stunts calculated to reduce the circuit capacities. The circuit shown in Fig. 1, is specially designed for the minimum effect of the tube capacity as applied to the tuned circuits. No difficulty in the construction of the circuit should be experienced by those schooled in the building of the more usual types of re-

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ceivers. Others had best "stay put" in the low-frequency bands, until it is possible to furnish them with complete data as to the panel layout, etc. This does not mean that the receiver is in any way tricky—but that so many variables are present that it is really no job for the novice. The tuning condenser is subject to troublesome "hand-capacity" effects, and should be insulated from the dial by a length of bakelite rod. If this aid and a metal panel are combined, there will be no difficulty from that source. In addition to this it should be noted that some form of vernier dial, having a slow-motion gear, should be used, unless we are to slide over our desired station without noting its presence.

Calibration of the Receiver

We must again turn to a problem which makes operation at these frequencies a game for the skilled operator, rather than for the novice. That is the calibration of our receiver, in order that we may be certain of the band in which we are working. This is done by means of *Lecher wires* on which the oscillating detector will produce standing waves. Measurement by this means of the frequency of short-wave transmitters is nothing new—but the output of the detector is so low, that there is no possibility of effecting a direct reading of the current produced in the Lecher-wire system.

Credit for the method is due to C. Whitehead, in *"Experimental Wireless."* The noise in the output of the super-regenerative receiver due to the quenching action—although quite low—is measureable by the use of a sensitive tube voltmeter. When a load is imposed upon the input this noise will be substantially reduced. When a bridging wire across the Lecher system is slid along the length of the system, a point will be found where the noise as indicated in the output meter has a maximum value. By continuing to slide the bridging wire along the measuring system, successive maxima will be observed. The distance, between the points at which maximum noise is encountered, may be measured with a regular meter stick; and the distance read will be half the wavelength to which the detector is tuned. The entire range of the receiver may be thus calibrated in a short time, and adjustments of L_1 and L_2 so that the tuned circuit will cover the desired band may be found necessary. The circuit arrangement for the Lecher wire system is shown in Fig. 2; while in Fig. 3, there are shown the schematic circuit for a suitable output meter.

Materials List for the Super-Regenerative Receiver

The list given herewith may be varied somewhat to suit the needs of the individual—where possible, however, the original scheme should be adhered to.

L_1-L_2-C_1-C_2—Comprised within a standard 175 kc. intermediate transformer.

L_3-L_4—Six turns each No. 18 bare copper wire on ½-inch form, and form removed. Turns are spaced by the wire diameter. Adjustment in these specifications may be necessary upon calibration of the receiver.

CH_1—R.F. Choke make from 35 turns No. 30 wire on $\frac{3}{16}$-inch wood dowel—turns spaced twice width of wire.

CH_2—Hammarlund "RFC 250" mmf.

R_1—2,000-ohm, 1-watt, International. (Durham).

R_2—50,000-ohm, 1-watt, International (Durham).

R_3—2-meg. grid leak. (International.)

R_4—0.25-meg. leak. (International.)

R_5—2,000-ohm, 1-watt. (International.)

R_6—50,000-ohm, 2-watt. (International.)

R_7—25,000-ohm, 2-watt. (International.)

R_8—250,000-ohm, 1 watt. (International.)

R_9—4-ohms.

C_2—Hammarlund .0001-mf. midget.

C_3—1-mf., 300-v. (Polymet.)

C_4—0.1-mf., 200-v. (Polymet.)

C_5—0.1-mf., 1,000-v. (Polymet.)

C_6—1-mf., 200-v. (Polymet.)

C_7—1-mf., 300-v. (Polymet.)

C_8—0.1-mf., 1,000-v. (Polymet.)

C_9—1-mf., 300-v. (Polymet.)

C_{10}—Each .0002-mf. Mica. (Polymet.)

C_{11}—Trimmer condenser.

The antenna may be the regular receiving antenna, or copper mast five to eight feet high.

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TELEVISION TIME-TABLE

Furnished by U. S. Dept. of Commerce, Radio Division, Washington, D. C.

Location of Transmitter	Lines and F.P.S.	Call Signal	Frequency in kilocycles (meters in parentheses)	Power (watts in antenna)	Licensee and Address
California: Bakersfield	—	W6XAH	2,000 (150) to 2,100 (142.9)	1,000	Pioneer Mercantile Co., 1526 Twentieth St.
Gardena (near)	—	W6XS	2,100 (142.9 to 2,200 (136.4)	500	Don Lee (Inc.).
Los Angeles	—	W6XAO	43,000 (6.97) to 46,000 (6.52), 48,500 (6.18) to 50,300 (5.96), 60,000 (5) to 80,000 (3.75)	——	Don Lee, Inc.
Illinois: Chicago	48	W9XAA	2,750 (109.1) to 2,850 (105.3)	1,000	Chicago Federation of Labor.
" "	45	W9XAO	2,000 (150) to 2,100 (142.9)	500	Western Television Corp., 6312 Bway.
" "	45-15	W9XAP	2,100 (142.9) to 2,200 (136.4)	2,500	Chicago Daily News
Downers Grove	24	W9XR	2,850 (105.3) to 2,950 (101.7)	5,000	Great Lakes Broadcasting Co., 72 W. Adams St., Chicago.
Indiana: West Lafayette	—	W9XG	2,750 (109.1) to 2,850 (105.3)	1,500	Purdue University, 400 Northwestern Ave.
Iowa: Iowa City	—	W9XAZ	2,000 (150) to 2,100 (142.9).	500	State University of Iowa
Maryland: Silver Springs	60-20	W3XK	2,000 (150) to 2,100 (142.9), Voice on W3XJ, 187 meters. Time 5-6, 9-11 E.S.T. eve.	5,000	Jenkins Laboratories, 1519 Connecticut Ave., Washington, D. C.
Massachusetts: Boston	60-20	W1XAV	2,850 (105.3) to 2,950 (101.7). Voice on W1XAU, 104 meters.	1,000	Shortwave and Television Laboratory.
New Jersey: Allwood	60-20	W2XCP	2,000 (150) to 2,100 (142.9), 2,850 (105.3) to 2,950 (101.7)	2,000	Freed-Eisemann Radio Corp., Junius St. & Liberty Ave., New York, N. Y.
Camden	Varies	W3XAD	2,100 (142.9) to 2,200 (136.4), 43,000 (6.97) to 46,000 (6.52), 48,500 (6.18) to 50,300 (5.96), 60,000 (5) to 80,000 (3.75)	500	R. C. A. Victor Company (Inc.)
Passaic	60	W2XCD	2,000 (150) to 2,100 (142.9)	5,000	De Forest Radio Co.
New York: Beacon	48	W2XBU	2,000 (150) to 2,100 (142.9)	100	Harold E. Smith.
Long Island City	—	W2XBO	2,750 (109.1) to 2,850 (105.3)	500	United Research Corp., 39 Van Pelt Ave.
" " "	60-20	W2XR	2,100 (142.9) to 2,200 (136.4), 2,850 (105.3) to 2,950 (101.69), 43,000 (6.98) to 46,000 (6.52), 48,500 (6.19) to 50,300 (5.96), 60,000 (5) to 80,000 (3.75)	500	Radio Pictures, Inc., 3104 Northern Blvd.
New York	60-20	W2XAB	2,750 (109.1) to 2,850 (105.3). Voice on W2XE, 49.02 meters.	500	Atlantic Broadcasting Corp., 485 Madison Ave.
" "	60-20	W2XBS	2,100 (142.9) to 2,200 (136.4)	5,000	National Broadcasting Co. (Inc.), 711 Fifth Ave.
" "	60-20	W2XCR	2,000 (150) to 2,100 (142.9). Voice on WGBS, 384.4 meters	5,000	Jenkins Television Corp, 655 5th Ave.
New York	60-20	W2XDS	43,000 (6.98) to 46,000 (6.52), 48,500 (6.19) to 50,300 (5.96), 60,000 (5) to 80,000 (3.75)	2,000	Jenkins Telev. Corp., 655 Fifth Ave.
Schenectady	Varies	W2XCW	2,100 (142.9) to 2,200 (136.4)	20,000	General Electric Co.
Pennsylvania: East Pittsburgh	60	W8XAV	2,100 (142.9) to 2,200 (136.4)	20,000	Westinghouse Electric & Mfg. Co.
" "	60	W8XT	660 (455)	25,000	Westinghouse Electric & Mfg. Co.
Wisconsin: Milwaukee	—	W9XD	43,000 (6.97) to 46,000 (6.52), 48,500 (6.18) to 50,000 (5.96), 60,000 (5) to 80,000 (3.75)	500	The Journal Co. (Milwaukee Journal).
PORTABLE Massachusetts: Boston	60-20	W1XG	43,000 (6.977) to 46,000 (6.522), 48,500 (6.186) to 50,300 (5.964), 60,000 (5), 80,000 (3.75)	30	Shortwave & Television Corp, 70 Brookline Ave.
New Jersey: Passaic	60-20	W2XAP	2,000 (150) to 2,100 (142.9)	250	Jenkins Television Corp.
Bound Brook	Varies	W3XAK	2,100 (142.9) to 2,200 (136.4)	5,000	National Broadcasting Co., Inc.
New York State:	Varies	W2XBT	43,000 (6.977) to 46,000 (6.522), 48,500 (6.186) to 50,300 (5.964), 60,000 (5), 80,000 (3.75)	750	National Broadcasting Co., Inc.
United States: (Throughout)	60-20	W10XG	43,000 (6.977) to 46,000 (6.522), 48,500 (6.186) to 50,000 (5.964), 60,000 (5), 80,000 (3.75)	500	De Forest Radio Co., Passaic, N. J.

Time on the Air: The daily newspapers in the larger cities—Chicago, New York and Boston, for example—carry television programs and time schedules.

W2XCR—N. Y. City. 3 to 5 and 6 to 8 P.M. daily; 6 to 8 P.M. Sunday. Voice transmitted over WGBS, on 384.4 meters or 780 k.c.

W3XK—Washington, D. C., 7 to 9 P.M. and 10:30 to 11:30 P.M. daily (E.S.T.). 60 holes.

W2XCD—Passaic (De Forest Radio Corp.). 9 to 10 P.M. daily. Sound on 1,604 k.c.

Daily image programs are broadcast by the Boston station W1XAV (2-4 P.M. and 8-10 P.M. daily, except Sunday) and also by the Chicago stations W9XAA, W9XAO and W9XAP. (Voice on 447.5 meters; see newspapers for daily programs.)

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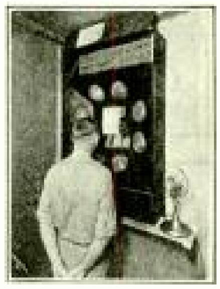
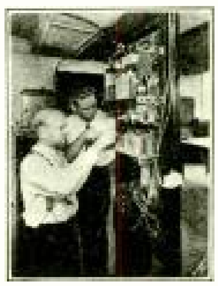
A glimpse into the projection room at First National Television School, showing students operating the projector. Students at First National receive detailed instruction under personal supervision of experts.



Inside of Television studio showing a student "doing his stuff" before the bank of photo-electric cells. Other students on opposite side of laboratory are viewing his image in the receiving sets.



Rear view of Amplifier Rack showing multiple stage amplifiers. Students are getting real experience in adjustments of amplifiers, scanning disk and neon lamp. Here's actual work on the real thing in Television. "Come and get it" where equipment is of the finest and most complete.

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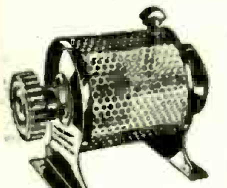

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Prize-Winning Television Receiver in N. Y. "Sun" Contest

(*Continued from page* 415)

Audio Channel

The audio-frequency amplifier is by far the most important unit in the receiver; as it has been explained already that television requires an amplifier with extreme flexibility in its choice of frequencies. In a graph the frequency could be represented by a relatively flat curve between 15 and 40,000 cycles. The only known amplifier that will insure this characteristic is the resistance-coupled device. Three stages of this form of amplification are employed, using two '24 type tubes feeding a single power '45 tube. This resistance coupled amplifier is fed from a power detector stage which employs a '27 type of tube.

The audio circuit diagram is practically self-explanatory. The first and important thing to do is to keep the amplifier resistor units away from any shielding. Radio-frequency chokes should be used freely in series with plate leads. Another important factor is the use of short leads wherever possible, and finally the use of a good make of blocking and bypass condensers.

For biasing the screen-grid tubes in this unit a flashlight battery cell serves the purpose of supplying the necessary one and one-half volts. The reason for using this cell for biasing instead of the usual method is to make operation smooth and at the same time eliminate any stray A.C. hum that might originate through the use of a biasing resistor in the power network. Biasing for the last audio tube is obtained by a 2,000-ohm resistor tapped from a 50-ohm center tap connected in the filament circuit of the '45 power tube, as shown in the circuit. The resistor is bypassed by an 0.5-mf. condenser.

Near the front, and to the right of the chassis, is an output transformer used only in conjunction with a loud speaker; the necessary changes being carried out by a double-pole double-throw switch in the rear of the chassis. When the switch is in the "up" position, the transformer is connected into the circuit; when in the "down" position, the transformer is out of the circuit, causing the output to be tapped directly from the plate and power system.

Power for the entire receiver is supplied from a transformer delivering 375 volts on each side of the center tap at 85 mils. (This is more than is needed for this receiver for ideal reception.) It also has a 5-volt filament winding for the rectifier tube, and two 2.5-volt windings for supplying the rest of the tubes with proper filament needs. Usually these windings come with different amperage ratings, a 5-ampere rating and a 10- or 12-ampere rating. The lower-rated winding should be used for the filament of the '45 and the higher-rated winding for the remaining heater-type tubes.

The positive side of the rectified supply is led through the usual method of double chokes, these being approximately 30 henries at 85 mils and each having a resistance of 500 ohms. Knowledge of this is important if the builder wishes to design his own voltage divider. The reason for this is that there is a considerable voltage drop after the chokes. (The drop can be easily computed by Ohm's law.) The condenser used for filtering is of the dry electrolytic type, which can be mounted in any position. The voltage divider is given in the list of parts and should be of a fairly high wattage rating.

Construction of the Chassis

The base or chassis is made from a sheet of one-sixteenth inch aluminum plating. Its dimensions are 21 by 15 inches, from which three-inch squares on the sides are cut out. The edges formed are then bent down, thus forming a box-like affair that has new dimensions of 18 by 12 by 3 inches. The squares cut out can be cut in half, bent at right angles and used as neat angle plates. The holes for the sockets were drilled by an expansive wood bit, since the metal is soft. In performing this operation a board must be firmly screwed to the bottom side of the metal. Before the actual drilling is performed it is always best to punch holes first so that the larger drill will have a guiding point.

The front panel is cut with the dimensions of 8¼ by 10 inches. The holes are smaller in this panel, but drilled in the same manner. The sockets used are the ordinary wafer type. The whole chassis is tightly screwed to a wooden frame made from two layers of one-quarter-inch plywood glued together.

List of Parts

C1, C2—.00025-mf. (variable).
C3, C4 and C5—Neutralizing condensers.
C7—.00004-mf. (fixed).
C9—.0015-mf. (fixed).
C11, C12 and C15—.00015-mf. (fixed).
C18—.00025-mf. (fixed).
C29 and C30—.01-mf. (fixed).
C6, C10, C13, C14 and C17—0.1-mf. (fixed).
C20, C21 and C22—0.1-mf. (blocking).
C16—.01-mf. (fixed).
C19 and C23—2-mf. (filter).
C24—.5-mf. (fixed).
C25 and C28—2-mf. (filter).
C23—8-mf. (filter).
C27—4-mf. (filter).
R2—1 megohm.
R3—25,000 ohms.
R4—100,000 ohms (potentiometer).
R5—1,500 ohms.
R6, R9—2,500 ohms.
R7—25,000 ohms (volume control).
R8—30,000 ohms (regenerative control).
R10—250,000 ohms.
R11—500,000 ohms.
RET—100,000 ohms.
R12, R15—25,000 ohms.
R14—50,000 ohms.
R16—80,000 ohms.
R17—1 megohm.
R18—50-ohm center tap.
R19—2,000 ohms.
R20—3,000 ohms (25 watts).
R21—2,000 ohms (25 watts).
R22—6,500 ohms (25 watts).
R23—2,500 ohms (25 watts).
SW 1, 2 and 3—Switches.
T4—Output transformer.
T5—Power transformer.
D1—Dial light.
D2—Small neon lamp.

—*Courtesy N. Y. Sun Radio Magazine.*

In Next Issue
Second Article
on the
CATHODE RAY SCANNER
—Practical Operating Hints—
By M. RAPPAPORT, E.E.

The Magnalite Tube

By HENRI F. DALPAYRAT

(*Continued from page* 427)

the resistance of the gap and this lapse of time, although quite short, is objectionable in television.

To deflect an arc behind an aperture produces a double modulation effect, resulting in distortion or unnatural reproduction; because the amount of light passed through the aperture is not always in proportion to the deflections of the arc.

It has also been found that the greater the heat of an arc and its electrodes, the greater is the difficulty in modulating it—(an exception is allowed for the neon-crater arc tube, but requires a large power tube to operate it.

Best Modulation Obtained to Date

The best source of modulated light, designed up to the present time, is probably the neon "crater" tube or its improved modification the "crater-arc" tube. These tubes furnish quite an intense, concentrated light which is easily modulated so long as the electrodes are kept cool; but, when they become overheated, the operation is sluggish and unreliable. Considering all these facts, it is easy to realize that there is much room left for improvements in the fields of illumination and modulation.

Another imperfect and little suspected link in the chain of television reproduction is the last amplifier tube, or power tube, in the television signal receiver. Most power tubes are specially designed for loud-speaker operation; that is, the impedance of the tube and its coupling circuits are carefully matched to insure a large and uniform output of undistorted current. Power tubes are essentially current amplifiers and do not work as well when used as voltage amplifiers or on different frequencies from those for which they were designed for (except in oscillator circuits). The control-grid, in a power tube, does not control or repel all the electrons emitted by the filament. High-velocity electrons shoots through the grid, regardless of its voltage, and a small current (which is not always modulated), constantly flows through the tube and its output circuit. This means that, if a source of light is connected directly in the circuit, and its operation is entirely dependent upon the current modulation, its light is never totally extinguished. A light-source can also be so adjusted as to work between two limiting voltages (called the ignition and the extinction voltages), but in that case the voltage variations below and above those values are not changed into light fluctuations.

A steady unmodulated light affects the quality of the picture reproduced, by preventing a sharp definition of the details. In a power tube, the grid becomes heated and emits electrons in small but noticeable quantity. The plate also gives off electrons, liberated by the heat; and certain electrons bounce back from the plate (this phenomenon is known as "secondary emission"). The secondary-emission electrons travel in a direction opposed to the useful electronic stream and offer a certain amount of resistance to its passage, in addition to impinging on the grid and altering its voltage. The filament is also continually surrounded by a negatively-charged cloud of electrons, called the "space charge", which is not affected by the signal.

All those unused or unusable electrons introduce much friction or resistance within the tube. They are responsible for its sluggish response on higher frequencies; for much distortion, uneven amplification, and a higher percentage of unmodulated current.

The "Magnalite" Tube—A New Invention

In the "magnalite" tube, a device designed by the writer, none of those objections are present. Fig. 1 shows an evacuated glass bulb (1) consisting of two separate chambers; a tubular section A and a spherical section B. The cathode (2) is heated to incandescence by a source of A.C. current. The electrons emitted by the cathode are concentrated into a narrow beam by a static deflector (3) which carries a high negative charge. A perforated anode (4) is positively charged; which attracts the electrons and permits a very thin pencil of electrons to shoot out through the central perforation. This beam of electrons then goes through a ring (5) further to concentrate the electrons into a fine stream.

When the control plate (6) is positive, it attracts all the electrons emitted. When this voltage is reduced under the action of the signal, fewer electrons are attracted and more are allowed to reach the collector plate (8) after having been accelerated by the screen grid (7). The electrons then close the circuit between the screen-grid (7) and the plate (8).

The spherical section B is filled with mercury vapors and argon gas. The mercury vapors are obtained by heating a drop of mercury (14) by a filament (13). A spherically-concave electrode (9) has within it a metallic ring (10), as shown in the diagram. The space between the ring (10) and the reflector (9) is made conductive by the mercury vapors. The plate (8) obtains its potential charge from the ring (10) through the vapors. A flow of electrons provides a conductive path between the screen-grid and the plate. A current then flows from a source of high D.C. potential, to the ring,

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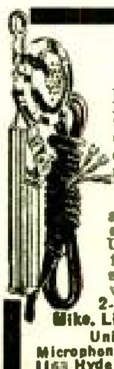

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through the vapors; producing between the ring (10) and the reflector (9) an arc (or glow according to the gas pressure, the distance between elements, and the voltage applied). The electrons then flow from plate to screen-grid, thus forming a complete circuit.

This device is to be operated on rather high voltages—about 2,000—and to draw very little current.

The resistance of the beam of electrons and the glow discharge being high, the current will be small, and very little heat will be formed. The inside surface of the reflector may be nickel-plated or brightly polished to concentrate as much of the light as possible through the clear glass window (11). This light is then transferred through a solid quartz-glass rod (12) which has its longitudinal surface mirror-plated. The outside surface of the reflector (9) is coated with a non-conductive substance, to prevent the glow from spreading outside its concave side.

The spherical glass tube (1B) is entirely opaque, except for a small, clear glass window at 11.

In the tubular section A, the electrodes 3-4-5 may be omitted and replaced by a powerful magnet coil placed over this part of the tube, as shown in Fig. 2. This magnetic field repels the electrons at right angles, to the direction of their flow; thus concentrating them into a very thin line. The system of deflection control (plate 6) is much superior to the ordinary grid in a radio tube; because in a radio tube, the grid is bombarded by secondary-emission electrons which prevent its voltage variations from taking place freely.

The control plate (6) in the "magnalite" tube, being in the same plane and very near to the stream of the electrons, is not affected by the secondary emissions, which is collected by the screen-grid 7. Plate 6, being at all times positively charged (more or less according to the signal variations), attracts all the electrons including the space charge, when the signal is zero or at a very low minimum. Therefore the mercury glow is at maximum brightness for a maximum signal voltage, and totally extinguished when there is no signal; a feat which cannot be accomplished with ordinary radio tubes.

Summing up all these details, it is easy to recognize the following advantages:

(1) A complete unit containing both electronic relay and a source of modulated light;

(2) A high-voltage, low-current device, creating little heat;

(3) No water cooling is necessary;

(4) All the light is utilized, as projected from element 9.

Due to the sensitive control of the elements in section A, and the concentrated light in section B, together with the reduction of the heat to a minimum, it is believed that this device has enough important advantages to make it superior to similar devices and to predict a bright future for this invention.

Although it is necessary to employ a mechanical scanning device with this new light-source, the writer firmly believes in electrical scanning, and will give a full description of an entirely new tube, with which the scanning is done electrically, at an early date.

A Study of the Drum Type Scanner

By C. H. ROTH

(*Continued from page* 429)

above the plane of the upper edge of the next lower adjacent hole. Light, of course, will not pass through the material of which the drum is made.

Effect of Dust In Holes

At the lower left corner of hole No. 8 is represented a particle of dust or lint. A faint black line is evidence of a condition such as this and will be found between lines No. 8 and No. 9.

Hole No. 10 has the appearance of allowing only one-third exposure. Under these circumstances, line No. 10 will be the result. This condition exists when lacquer, dust, lint or other foreign substances have been rubbed into the hole and collected on the side edge. This may be done when one tries to stop the drum rotating by holding the hand over the surface surrounding the light apertures, applying friction in his efforts.

All the defects on the portion of the light-field between lines No. 1 and No. 10 inclusive can be corrected on the drum by mechanical means. For example, the excessive overlap can be removed by reducing the size of the holes by using a "staking" tool and hammer as shown in Fig. 5. In the case of holes No. 1 and No. 2, the lower edge of hole No. 1 must be staked, so that the metal will be displaced to a higher point; while on the upper edge of the second hole the metal must be formed downward.

If the metal has been formed or staked more than necessary, filing must be resorted to. A small needle file can be used advantageously when it is necessary to remove metal from the top or bottom of the holes to make them the proper size, so that the minimum amount of overlap will eventually be obtained. This, of course, is a tedious operation and can only be done by the "cut and try" method. The necessity for repair work of this nature exists only when holes have been pierced inaccurately, or when the drum has been distorted in handling.

Dust, lint, lacquer or other foreign substances can be removed from the light apertures by means of the same needle file mentioned above. Sometimes a hardwood stick of about .010" square cross-section will be found useful (when dust or lint does not cling to the drum) by merely pushing the stick through the holes that appear to cause heavy black lines on the field.

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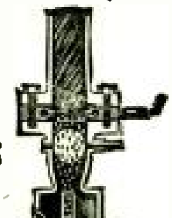

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is at a premium. With this consideration in mind the drum type radiovisor has the advantage over the scanner employing the Nipkow disc. The same size light field or picture can be obtained with a drum type radiovisor using 7⅜" dia. drum operating in conjunction with a slotted shutter as can be obtained with a Nipkow disc scanner employing a disc approx. 23" in diameter.

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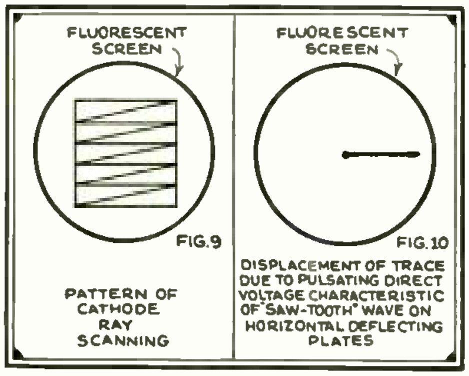
A Cathode Ray Scanner Anyone Can Build

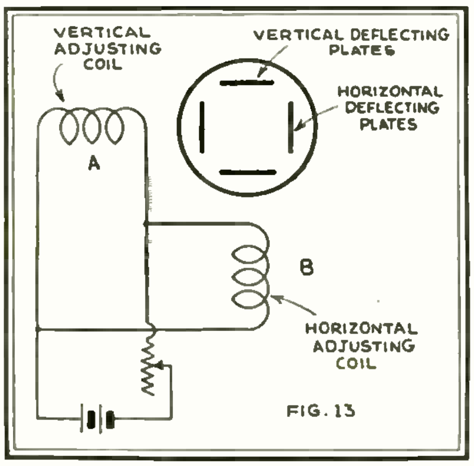
By M. RAPPAPORT, E.E.

(*Continued from page* 413)

strument, would naturally desire to use it for other purposes than television, but would be at a decided disadvantage when a much lower impedance load is used. I have overcome this handicap by using one stage of direct-current amplification. The direct-current amplification was found to be most satisfactory, because it amplifies the extremely low, as well as the high frequencies, without distortion. Fig. 7 shows the combination oscillator and amplifier. If we now place a low-impedance load across the output of the amplifier, the frequency of oscillation will not be affected.



These diagrams show pattern followed by cathode ray in scanning.

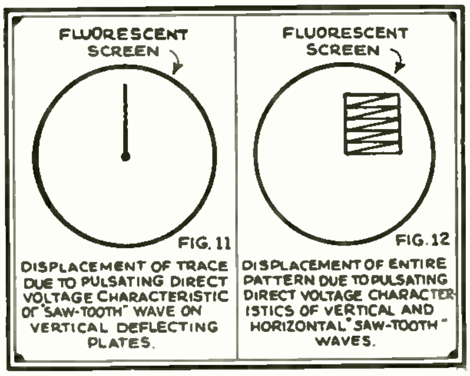


Here we see how the two magnetic adjusting coils are placed with respect to the deflecting plates within the cathode ray tube.

When constructing the oscillator-amplifier combination, a one-megohm potentiometer is substituted for the two-megohm component and a one-megohm resistance is placed in series with it as shown.

Connecting Saw-Tooth Oscillator to Cathode Tube

In Fig. 8 may be seen the method employed in connecting the "saw-tooth"-wave oscillators to the cathode-ray tube for scanning the image. The oscillator which performs the horizontal scanning is adjusted to a frequency of 1200 cycles per second. Another, operating at a frequency of 20 cycles per second, does the vertical scanning. The resulting pattern shown on the fluorescent screen is that of Fig. 9 (greatly exaggerated for the sake of clarity). By adjusting the output voltages of the "saw-tooth" oscillators, a rectangular pattern of any dimensions may be obtained which, of course, is limited by the diameter of the fluorescent screen.



This diagram shows how scanning would be restricted to one-quarter of the fluorescent screen, if localizing coils were not used.

The "right-triangular" wave is a pulsating direct voltage, as may be noted from its theoretical explanation. When it is applied across the horizontal deflecting plates of the cathode-ray tube, the spot of fluorescent light will start traveling from the center of the screen and move towards the outer boundary as shown in Fig. 10. In a similar manner, the trace of the vertical scanning oscillator will appear as shown in Fig. 11. The resultant pattern is naturally shifted from the center of the screen to a corner as shown in Fig. 12.

In order to bring the pattern to the center of the screen and, as a result, utilize the entire screen, magnetic deflecting coils must be employed as shown in Fig. 13. By allowing the necessary amount of current to flow through the coils *A* and *B*, the resulting magnetic field will shift the pattern to the center fluorescent screen.

The incoming signal is sent through a multi-stage amplifier, the output of which is used as the anode potential on the cathode-ray tube. The brightness of the rapidly moving spot on the fluorescent screen varies directly as the impressed anode potential. As a result, we obtain the desired modulation to give us the televised image.

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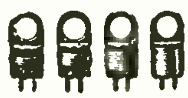

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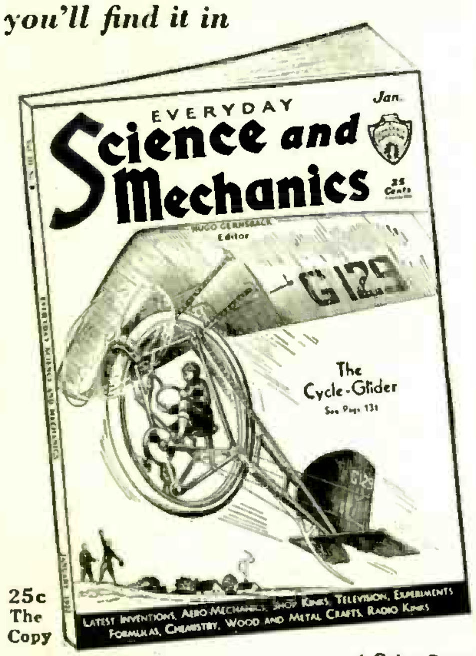

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Short Wave Television at Doberitz

By HERBERT ROSEN

(*Continued from page* 411)

up, and the television transmission, or from our present standpoint, the "reception," begins.

First there are the two girls' heads, which we have been able to see since the beginning of the television experiments (in Germany). But this time there are really new pictures; for improvements in transmitting technique are making greater and greater progress. Here one is especially surprised at the quality and perfection of the pictures, since such a quality has probably never been attained before. Everything is sharply and clearly perceptible, and even the delicate traceries of the eyelashes are sharply distinguishable; every quiver of the mouth can be plainly followed. There is present a sharpness and richness of detail, such as even the film projections in the motion-picture theatres cannot surpass. And, above all, there is an absence of the fearful flickering; one can even go very close to the receiver, without having the eyes hurt and burn. In short—one almost believes that one is viewing an ordinary film presentation, so excellent has the television image become.

First of all, this is due to the fact that here transmitting is done with an increased number of pictorial elements; since for broadcasting there is used the 142.9-meter wavelength, in the shortwaveband. The format or image shape has a ratio of 3 to 4, and the number of revolutions is 25 per second, with 48 lines; so that we have 3000 elements, which is twice that of the Witzleben (another German) transmitter.

Dual Reception

The receiver is so equipped that by simple switching the image can be transmitted directly from the film apparatus by wire, or received by radio through an antenna. The difference between these two reception possibilities is, however, so trifling that at the Döberitz station it could not be perceived at all. Now it is only a question whether reception in the City of Berlin will be just as good and perfect. Up to now the reception observations, both in the Reichspost Central Office and in the Heinrich Hertz Institute, have attained only favorable results; very shortly reception experiments will also be instituted in other quarters of the metropolis. As yet there are no fixed times for transmitting by this station; but as a rule it begins at about 5 to 6 P. M. and stops between 8 and 9 P. M.

Large Scenes Are Well Reproduced

While we learn all this, the endless film is replaced by a "photo-play" film, which shows not only heads (*i. e.*, close-ups) but also street scenes, actions of great extent, etc. Here, too, one can determine a very considerable advance over former broadcasts; even if the great mass scenes or extensively detailed pictures are still very hard to recognize. At present it is just for the perfection of these last that work is being done under high pressure:—"until we can give any film at all throughout, clearly and plainly," as the director of the television research assures us. However, good results have already been attained here, but they are not sufficient for the introduction of television just now. The Reichspost is striving to eliminate even the last flaws.

In conclusion we also inspected the actual transmitter in the adjoining room, as well as the source of current, concerning which there is nothing of importance to be said; since this is a regular short-wave transmitter, such as has been familiar for years. It is, however, interesting that here in Döberitz there are two transmitters, so that in the future "sound" films can also be transmitted; *i.e.*, with the sound on another wavelength.

A New System of Color Television

By HENRI F. DALPAYRAT

(*Continued from page* 433)

doing closes the circuit first between one plate and the screen, and then the others; and so on. A similar electronic commutator is also used at the receiving end; each of its plates (8) is connected to a source of modulated light, so that only one source of light is turned on at a time. Each light source has its own color filter (11) so that only its particular color will be projected. The electronic commutator at the receiver, works in synchronism with the transmitter; when a certain shade of red for example is sent, the light source with a red filter is connected at this time and will reproduce that shade according to the intensity of the signal then received. All the light from those three light sources is focused upon a lens-disc scanner.

The frequency of deflection in the commutator tube is such that one light-source will be connected during the time that it takes to scan one picture. In the case of the popular systems now employed, if a picture frequency of 21 frames per second is used, the frequency of deflection of the commutator ought to be seven times per second. Each frame will be painted one color or shades of that color, and the superimposition of those three colors with its variations will reproduce all the natural colors of the person, object or scenery being televised. The frequency of commutation could be greatly increased to reproduce more faithfully all the colors and shades of the subject and reduce the "jumpy" effect usually observed. Unfortunately, this would require a wider channel of transmission, which would interfere with other stations.

However, these difficulties can easily be solved by the use of the electronic commutator; for example, the frequency of deflection could be raised to equal the picture frequency, and 21 small commutator plates could be used, forming 3 groups of 7 plates each. All the first plates (red) would be connected together; all the second plates (blue) together; and all the third plates (green) together.

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Make Your Own Lens Discs

By WOLF S. PAJES

(*Continued from page* 417)

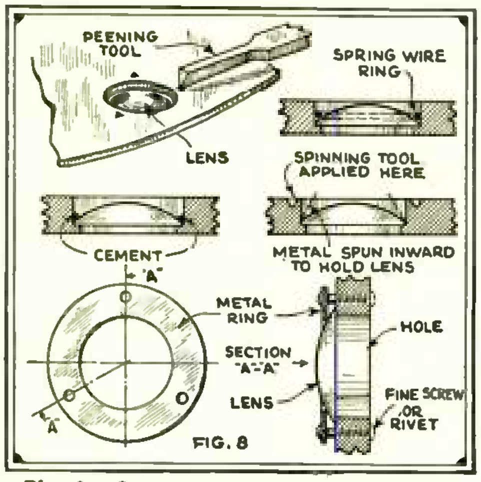

Fig. 8—Several schemes for securing lens in disc, suggested by H. W. Secor.

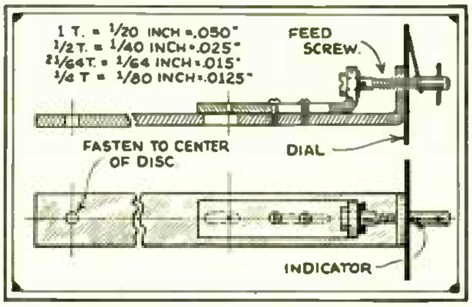

Fig. 9—Simple hole layout jig; by turning the 20 pitch screw the required fractional part of a turn, and moving the jig arm 6 degrees each time, any hole layout can be made. Drill disc on vertical milling machine for high accuracy, with disc solidly backed.

until the motor runs up to speed the process of "framing" will be very tiresome; and therefore a greater power is recommended than that theoretically necessary to overcome air resistance and friction alone. In our case, a motor of ⅛ H.P. will be sufficient to fulfill our conditions. Ordinarily a synchronous 110-volt 60-cycle A.C. motor will be satisfactory. In case the machine is used at a remote point, where the A.C. supply is not permanently in phase with that supplying the television broadcast station, the synchronous motor is useless. Here we use an induction motor or a series motor, to the shaft of which we add a phonic wheel, as explained in previous issues of TELEVISION NEWS.

Another important feature (supplied with the Baldor motor) is a spring-coupling between the disc and the motor shaft; one can easily make this spring-coupling as shown by one of the accompanying drawings.

This spring-coupling allows the motor to start up more easily, and has a number of other good features. In making your own spring-coupling for use between disc and shaft (the disc rotating freely around the shaft) be careful to choose or make a spring which is wound in the right direction; that is, when the motor rotates, the spring must become tighter or "wound up" as it were. Reversing the position of the wrong-type spring, will not serve, either; but the spring must be wound right in the first place. In our case the spring may be made of 3/32" diameter steel spring wire (or phosphor bronze). Four turns of the spring wire will give the motor sufficient time to fall into synchronism.

Television Course by C. H. W. Nason

(*Continued from page* 435)

The next operation is the cutting of the lens holes to a size slightly smaller than that of the lens itself. In our case, the holes should be about 20/32" in diameter; so that a second cut having the same diameter as the lens may be taken in the manner shown in Fig. 7. The disc should be made from ⅛-inch brass or steel, with the hub carefully centered. If care is taken in making the openings for the lenses, no corrections should be necessary; but, if we set up the disc to throw a ray upon a chart (as suggested in aligning the mirror wheel), we may correct for misalignment of the lenses by placing bits of paper under the edges until alignment is perfect.

Fig. 8 shows another and more accurate aligning method. Here the lenses are inset into bits of brass, and cemented into position with Duco cement. The brass frames have three holes drilled to coincide with similar holes drilled in the disc. A rubber gasket is placed under each mounting and, by adjusting each frame by means of the thre screws, a perfect optical alignment of the disc may be achieved.

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A New Scanner and Receiver for Pos. or Neg. Signals

By L. R. CONRATH

(*Continued from page* 418)

the picture easily and quickly. The entire scanner unit is mounted on rubber silencers to ensure quiet operation. The scanner may be obtained either with a 45 hole disc and 900 r.p.m. motor or with a 60 hole disc and 1,200 r.p.m., motor. The receiver is, of course, suitable for use with either type of scanner. Both scanner and receiver are available either in kit form or fully assembled.

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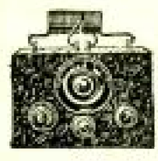

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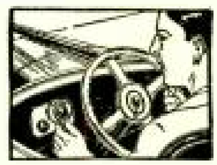

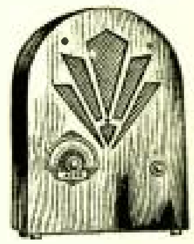

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Television in the Theatre a Reality!

(*Continued from page* 408)

pick-up and the reconstructed image of his face then appeared on the giant glass screen suspended above the studio, in the center of the stage. The actor's voice was simultaneously picked up and after passing through suitable amplifiers, it was projected to the audience by means of huge loud-speakers placed at either side of the stage. The transmitter used a 1800 C.P., incandescent lamp, with a plain hole scanning disc arranged with three spirals of 15 holes each, or a total of 45 holes. The receiver used a giant lens disc with three spirals of 15 lenses each or a total of 45 lenses, behind which was placed one of the new Taylor "gas arc" tubes; this combination projecting a brilliant image on the large screen measuring about 10 feet square.

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The Ultimate Receiver

By C. H. W. NASON

(*Continued from page* 433)

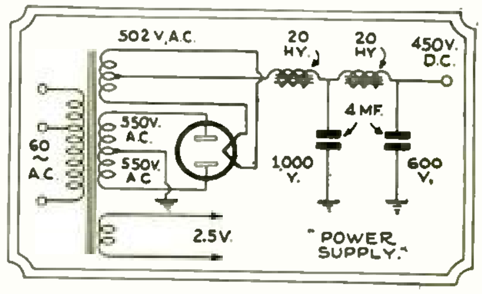

Diagram of "power supply"

transformer is quite high. This is permissible with the '80 tube, when operated with an *inductive* filter input, as shown in the figure. You may employ filter and rectifier circuits using '81 tubes, by inserting resistance to lower the voltage to the desired 450 (D.C.) at 120 m.a.

The '24 tubes should be individually shielded, as should the coils.

Parts for the "Ultimate" Receiver

2—T—Sec. 25T No. 28 En. on 1½" dia. form—Pri. 10T No. 32 En. (Enameled.)
2—T1—Sec. 25T No. 28 En. on 1½" dia. form—Pri. 20T No. 36 En.
Primaries wound over low potential end of secondaries, with wrapping paper insulation between.
1—L_1—25T No. 28 En. on 1½" dia. form. (T=turns.)
1—L_2—Hammarlund R.F.C. 250 to 250-m.h., choke.
1—C—4-gang .00025 condenser.
6—C_1—.1-mf. 200-volt.
1—C_2—.0001-mf. mica condenser.
2—C_3—.00015-mf. Hammarlund midget condenser.
2—C_4—.0002-mf. mica condensers.
3—C_5—1mf. 400-volt condensers.
1—C_6—.2-mf. 1,000-volt condenser.
1—C_7—8-mf. electrolytic unit.
1—C_8—4-mf. 600-volt condenser.
2—R_1—1,100-ohm. 2-watt.
4—R_2—50,000-ohm. 2-watt.
3—R_3—100,000-ohm. 2-watt.
1—R_4—125,000-ohm. 2-watt.
1—R_6—20-ohm. center tapped.
1—R_7—700-ohm. 5-watt.
1—R_8—4,350-ohm. 20-watt.
2—R_5—100-ohm. non-inductive, 2-watt.
1—R_9—1,000-ohm. 10-watt.
1—R_{10}—5,000-ohm. 10-watt.
1—R_{11}—2,000-ohm. 5-watt.
1—R_{12}—3,500-ohm. variable 5-watt.
1—R_{13}—2,850-ohm. 5-watt.
1—R_{14}—4,650-ohm. 5-watt.
1—R_{15}—10,000-ohm. 10-watt.

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What of the Television Business?

By WM. H. PRIESS

(*Continued from page* 419)

amplifier circuit in use today—the tuned amplifier—will not function on such a short period modulation frequency. They distort a televised narrow vertical line into a wide spread, whose left and right band sides are of variable, intensely shaded areas. Some practical idea of the type of distortion that a tuned amplifier produces, can be had by adding a horizontal coarse shading to both sides of all vertical lines in a newspaper cut. This shading, for example, places a beard on a female subject, makes a pair of horn-rimmed eye-glasses result in a pair of black eyes and gives a generally hazy and indistinct appearance to the televised object that is absent in the original. The untuned amplifier constructed with staggered coupling means and employing suitable dampings can be made to define not only the size of a dot now used by our present television broadcasting, but it has a band adequately wide to cover a many-fold increase in the number of dots comprising the picture. In other words, the untuned amplifier can clearly reproduce not only the current crude television broadcasting, but is capable of responding to the additional picture detail that we look forward to in the progressive developments in the television broadcasting art. The broad band or *untuned amplifier* is the only essential part of a television set that has no known efficient substitute.

The remaining essentials are the light source and the televisor. Here we come to a wide diversification of fundamental design. One school prefers the so-called "electrical" scanning, the other school the "mechanical" scanning. In the former type the light source is an integral part of the televisor, in the latter, it is separate and may take many forms. The followers of the "electrical" scanning school have a number of talking features that are highly persuasive. However, in the "mechanical" scanning, its advantages of unlimited light intensity of the picture, low initial and unkeep costs, its flexibility as a method for projection to any desired picture size, the simplicity of its synchronization and the consequent elementary nature of its radio wave, make it the more logical type for the experimenter.

We are all familiar with the mechanical television comprising a motor, a Nipkow scanning disc and a neon lamp. The picture usually is between a half inch and an inch square and is painted against the flat illuminated plate of a neon lamp.

The system described is very poor from the optical and light efficiency angles. In the first place, the image can only be viewed from a position on the axis of the lens, thereby limiting the audience to a single person and in the second place with the present standards of television broadcasting only 1/10,000 of the light of the neon lamp is made available for the eye, and we need a more natural light than the pink glow of the neon lamp.

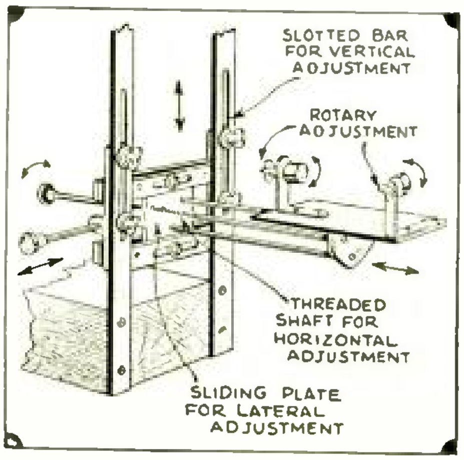
These defects have been corrected in the laboratory by providing a picture projected on a screen and a lamp of nearly white quality, whose entire illumination is utilized as a scanning beam. The projected picture permits of a wide angle vision, which in turn makes the picture visible to an audience of many instead of to an individual only.

Solving Some of the Television Projection Problems

By HARRY ROSENTHAL

(*Continued from page* 439)

is clearly shown, as well as the focusing-device control on the front of the cabinet, which is mounted *in the slot* at the lower right-hand. This control regulates the focus of the tube, in relation to the focus of the lenses and allows for fine micrometric adjustment, which brings out the greatest detail. This adjustment is found very valuable and is often used when different-sized pictures are projected on the screen, with a given size of opening in the crater tube, and properly designed optical lenses in the scanning disc. This focusing control gives very sharp pictures from the smallest to the largest image.



Focusing scheme for crater tubes.

John Logie Baird Speaks His Mind—

As Told to H. W. SECOR

(*Continued from page* 410)

is broadcast in London over the B.B.C. system on 256 meters wavelength. "Voice" is simultaneously transmitted on 365 meters wavelength.

With regard to color television, this was demonstrated by Mr. Baird in 1928, the three primary colors, red, yellow and blue being transmitted progressively, in rapid fashion, one after another.

In London television broadcasting, the disc has 30 holes, corresponding to 30 scanning lines. In Mr. Baird's television researches, he has used a larger number of scanning lines in mechanical scanning, and it is his opinion that we may possibly use 90 instead of 60 holes for scanning in the near future.

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How to Match the Impedance in Power Output Circuits

(*Continued from page* 441)

sensitivity, and may be relied upon to match the power output of the '45, with a much smaller input signal. Indeed, it will permit of operation directly out of a high-level, grid-circuit detector.

The high voltage required will necessitate the use of a power transformer designed for use with two '81 rectifiers.

The School of Television

(*Continued from page* 429)

Although the staff as a whole believes that the maximum benefit is to be obtained by resident study, a correspondence course is now in the course of preparation. Those interested in this course may obtain information in advance of the national announcement by communicating with Dr. Kober. It is hardly worth while to mention the advantages gathered from direct contact with the instructors and from the laboratory instruction, which cannot possibly be carried into the home. The course requires ten weeks for completion and, for those not able to meet the expense of residence in New York over that period, the possibility of part time employment presents itself. Where the student is able to devote his full time to his studies, however, there is little need that the course should be stretched out over the full period.

The advisory council of the school numbers amongst its membership such men as U. A. Sanabria, D. L. West (representing the British Baird interests in America), and Leo Beck, Chief Engineer of the Claude National Neon Labs.

The judicious grouping of the classes so that students who must continue to earn during their schooling period are free to do so, is a marked advantage for those seeking entry into television.

An A-1 Transmitter Amplifier

By H. P. AUSTIN

(*Continued from page* 443)

List of Parts—Main Amplifier

R- 1—	Durham	2 watt,	50.000	ohms.
R- 2—	"	2 "	25.000	"
R- 3—	"	2 "	200.000	"
R- 4—	"	2 "	50.000	"
R- 5—	"	1 "	2 meg.	
R- 6—	"	2 "	200.000	ohms.
R- 7—	"	2 "	50.000	"
R- 8—	"	1 "	1 meg.	
R- 9—	"	2 "	50.000	ohms.
R-10—	"	2 "	25.000	"
R-11—	"	1 "	1 meg.	

R-12—Yaxley 15 ohm filament rheostat.
R-13— " 5 " " "
R-14—Centralab 500.000 ohm volume-control potentiometer.
C-1 to C-4 Sangamo .01-mf. mica condensers.
C-5 to C-8 Flechtheim 600 volt, 2-mf.

List of Parts—Monitor Amplifier and Power Supply

R-1—Frost 50.000 ohm Heavy Duty potentiometer.
R-2—Electrad 10.000 ohm Type B wire wound resistor.
R-3—Durham 1 watt, 1 meg.
R-4— " 1 " 75.000 ohms.
R-5—Electrad 750 ohm Type B wire wound resistor.
R-6—Electrad 1 ohm Type B adjustable resistor.
R-7—Electrad 10 ohm Type B with center tap.
R-8—Ward Leonard 10.000 ohm with taps 1,000 ohms apart.
C-1—Sangamo .01-mf. mica condenser.

C-2—	Flechtheim	400-volt,	1-mf.
C-3—	"	400- "	2- "
C-4—	"	1,000- "	2- "
C-5—	"	1,000- "	4- "
C-6—	"	1.000- "	2- "
C-7—	"	1,500- "	4- "
C-8—	"	1.000- "	4- "
C-9—	"	1,000- "	2- "

T-1—Thordarson power transformer for Type-81 Rectifiers.
L-1—Silver-Marshall No. 331 Unichoke.
L-2—Thordarson 30-henry, 85 ma., 1,000-volt insulated choke.

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What Happens in a Cathode Tube?

By W. ZEITLIN

(*Continued from page* 421)

still further increase of the negative bias on the cylinder W, the cross-section of the cathode ray becomes smaller and smaller, and the light becomes weaker; since the active surface of the cathode likewise becomes smaller (Figs. 4 and 5).

Therefore, we have, by changing the negative potential on cylinder W, a means available for changing the area of the active surface of the glowing cathode, and therewith the strength of the electron flow; and, consequently, the brightness of the light-spot on the fluorescent screen, at will. The changeable diameter of the light-spot is a certainly undesirable accompaniment of the light modulation; which, however, causes little distortion, if one chooses such a size of image that the breadth of a line is approximately as large or even somewhat smaller than the maximum admissible cross-section of the luminous spot. Then the eye readily fails to notice the finer light spots, and there is a purer, and more properly pictorial, impression.

The Space-Charge Effect

But in this process there is another considerable difficulty: the *space-charge effect*. In Fig. 1 one sees (likewise represented diagrammatically) the electron distribution in the vacuum tube V between the fluorescent screen F and the anode A. After their impact on the surface of the glass, or on the non-conducting fluorescent screen, the electrons are thrown back like elastic balls and scatter in the interior of the tube. Some of them settle on the glass wall as the charge L, and at the same time hinder the further charging of the glass; while another group flow in the opposite direction, toward the anode, as a confused electron cloud—the space charge R. Then the electron scanning ray S must fight its way through against a stream of electrons R; since the electrons flowing back likewise have a negative charge, which "repels" the scanning ray. There is the added circumstance that, in light modulation the electrons in both directions possess a changing intensity. This also means a variable braking effect on the scanning electrons; *i.e.*, the speed of the electrons is no longer constant, in spite of the constant difference in potential between cathode K and anode A. This space-charge resistance is the more noticeable, the higher the current strength of the scanning electron ray.

This phenomenon also limits the maximum light strength of a Braun oscillograph but, in fact, only in the case of light modulation; while the ordinary oscillographs for measuring purposes, operating without light modulation, can be built for practically unlimited electron current strengths, as the experiments of the writer in his laboratory have shown.

To reduce these space-charge effects, gas contents are introduced to form positive ions, and thereby neutralize the negative charge of the vacuum tube. Also, between anode A and battery E_a there is connected a suitable small resistance which produces a very small change in potential; this gives the electrons a very slight second acceleration, to counteract the resistance of the space charge.

Other Problems to Consider

There are still further difficulties to be considered: As already remarked, Figs. 2-5 show that the active surface of glowing cathode K is a changeable area. The degree of this change depends on the shape of the cathode and on the distribution of the active electron layer on it. Rather small errors in workmanship can, for example, cause eccentric emission from the cathode surface; *i.e.*, the point still emitting at the highest negative potential, does not lie exactly at the tip of the cathode; or else the surface of the tip is not squarely put on. Thereby there is produced a disturbing phenomenon; because the electrons, under the light modulation, enter between the deflection plates at a different angle and are correspondingly deflected differently. Then there result on the fluorescent screen displacement of the pictorial elements. It has, furthermore, been found that the last active spot on the cathode (under cut-off by negative bias) is also the most strongly charged; since the greatest field strengths occur there and the electrons are therefore quicker used up. The areas with highest charge are paralyzed, and then comes the turn of the neighboring area. In the meantime, the exhausted surface renews itself by metal vapors or diffusion. This phenomenon can produce an uninterrupted wandering of the active emitting source of the electrons. The angle of entrance of the electrons into the anode space is then no longer constant; which leads to pictorial distortion on the fluorescent screen F. This process can be compared with the shifting of the focal point in an arc light. The life of such an apparatus is then correspondingly short.

All these difficulties show that the designing of the Braun oscillographs has not yet reached perfection; but many improvements have already been undertaken, some of which have been dealt with by the writer. At any rate, the writer believes that in a year or two the Braun oscillographs will be generally used for television apparatus, since they are without mechanically moving parts and, like radio tubes, can be used without a glow lamp. Material costs are, at the same time, very low. The previous disadvantage of weak luminosity can now be regarded as largely overcome, in comparison with other television apparatus.

—*Funk Bastler*.

Experimenting With a Kerr Cell

By C. BRADNER BROWN

(*Continued from page* 437)

If one is planning to experiment with a Kerr cell, it would be the writer's advice to obtain a large supply of the chemical and change it after it has been in use for a month or so. Care should be taken in the handling of nitrobenzene. It comes from a family of explosives and, though not dangerous in itself, should be handled with care. If possible, it should be obtained in the super-redistilled form.

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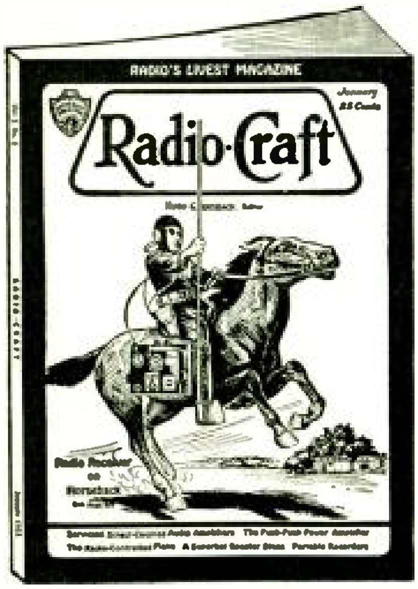

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What England Has Done With Television

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc.

(*Continued from page* 407)

out ingeniously through the medium of suitable controls on large amplifier panels, which run along the whole length of one wall of the control room. In addition, on these same panels there are modulation motor controls for signal strength. Positive and negative image corrections can be made, and duplicates of each amplifier are kept ready in case of a breakdown, to avoid any of those technical hitches which are apt to mar a program. It is also possible, quite simply, to switch from land-line demonstrations to radio and *vice versa*. One engineer is on the control board and is responsible for both the vision and the sound signals which are sent through the land-line. In addition, he effects the signalling to the studio, passing on any instructions about the position of the artists, strength of the voices, etc.

"Change of Scene" Signals

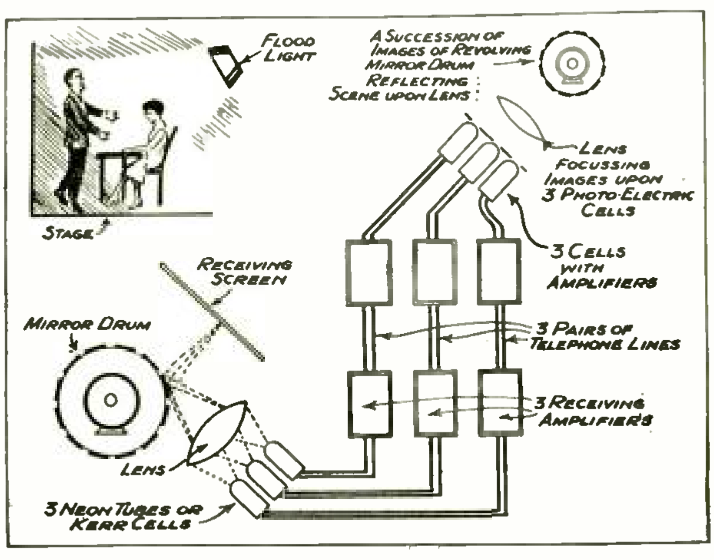
A second engineer devotes his time wholly to the transmitters themselves, either the mirror-drum or the light-spot disc, as the case may be. During the transition stage from one type of scene to another, a synchronizing signal is radiated on the "vision" wavelength, to enable lookers-in to maintain their vision apparatus in synchronism (both phase and frame) and thus be ready immediately for the next scene, without having to adjust motor speed, etc. This is a big advantage and avoids any break in the continuity of the program from the receiving end. In addition, in order to assure "visualists" that the television transmission has not failed, while this change-over is made, selections from gramophone records are transmitted on the sound wavelength; this being faded out as soon as the television transmission is ready to recontinue.

In the early days many of the critics passed uncomplimentary remarks and frequently these were based on the fact that a head and shoulder image, after the first interest had worn off, presented very little entertainment value. To a certain extent, this criticism was justified, inasmuch as it restricted the nature of the broadcast. It was possible, however, to exploit this close-up in such a manner that it produced some really interesting transmissions; as witness the televising of "*The Man with the Flower in His Mouth*" in July, 1930, with the co-operation of the B. B. C. In addition, small sketches in which only one artist had to appear at a time were successfully produced and another transmission which proved successful was the Marionette players.

What the English Visualists "See"

The whole technique has altered, however, now that the extended scenes are possible. No longer need the activities of the studio director be confined to "close-up" views; for he can show full length images of the artists. This extended scene has proved most popular and, to give an idea of the type of entertainment which can now be put over quite successfully I mention that, in addition to sketches with two or three artists complete with stage properties, *visualists* have an opportunity of watching ballet, cabaret and Scotch dancing, tap, buck and wing dancing, classical dances, illustrations on how to play tennis, cricket and badminton, hints on physical culture, Jiu-jitsu, etc. Furthermore, there are illustrated talks in which the demonstrator can show models; while another popular turn is to watch the pianist at the piano, both piano and pianist being in full view of the looker-in. A short time ago, three short rounds of a boxing match provided excellent entertainment and, according to reports received, this came over remarkably well.

I could continue to add to this string of successful extended scene transmissions, but I think enough has been said to convince the most rooted sceptic that television has, as a form of entertainment, finally established itself and will continue to progress; together with the development of the new technique which has arisen inevitably from the point of view of producing these television plays, and we can look forward with confidence, happy in the knowledge that the art will grow apace. I can well remember the early theorists proving, quite conclusively, by means of the "dot" theory, that a television transmission of the nature which I have just discussed was absolutely impossible. No one can deny that television has a difficult furrow to plough, but why strew hypothetical obstacles in the path?



Pictorial representation of the Baird system of "three zone" television, in which three channels or circuits are employed to carry the image signals as indicated.

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How Do We "See" Television Images?

The width of the frequency-band for large television images, complete with intimate detail, is certainly an acute problem, but it is beyond my comprehension why so many people attempt to examine the question by quoting a *picture-point analogy*, when *strip* scanning is used almost universally for television purposes. If you examine a television image quite closely, you can readily trace this strip effect; but obviously you will not adopt this policy of watching an image of this character with your eye a few inches away any more than you would attempt to criticize a painting wrought by the artist's brush by standing up close to it, or expect to have an evening's enjoyment free from eyestrain and headache by sitting through a motion-picture showing in the front row of the theatre.

In the image, the light and shade is distributed throughout in a form of a "wash drawing" or continuous surface; and it is necessary to stand two or three feet away in order to appreciate the beauty of the image that is being built up before your eyes. There are two other facts which are nearly always overlooked by people when discussing television. These are the tolerance, or self-accommodating nature, of the human eye and the fact that, although every subject televised undergoes movement, this question of *visual persistence* makes television and cinematography possible—and, furthermore, when we look at a scene we unconsciously "scan" it by allowing our eye to wander over it in much the same manner as a television scanning spot.

Before we have had an opportunity of absorbing all the detail of a television subject or a person in one position, it has moved to another; and thus, unconsciously, the amount of noticeable detail is less than would be the case for stationary objects. Bear these points in mind, and also the fact that, although the frequency problem is a great one where television broadcasting is concerned, it is not so for land-line transmissions, such as might take place for transmitting television to large screens. Keep these aspects of the problem quite distinct whenever you indulge in a discussion on the subject, and then the issue will not be confused.

Television on a Large Screen

The next point that I want to take up is television on a large screen. Dealing with the subject generally, we are justified in saying that, at present, there are three primary methods for projecting images upon a large screen. The first method, which was shown by the American Telephone and Telegraph Company in 1927, consisted of a screen built up from a continuous neon tube, different areas of which were activated in sequence by means of a commutator.

The second method—demonstrated in England by Mr. Baird, in America by the General Electric Company, and in Germany by the Telefunken Company—depended upon the projection of a spot of light on to a screen; the spot of light being made to traverse the screen by means of one of the usual forms of scanning device.

The third method, the bank of lamps, is fundamentally different from the two preceding methods. In the bank of lamps we had a receiving screen built up from 2,100 tiny metal filament lamps, each lamp being set in a "cubicle" or cell; so that the screen resembled somewhat a gigantic honeycomb with 2,100 cells, the centre of each being the small electric lamp. In front of these cells was a sheet of ground glass, while each lamp was connected to a separate bar of a gigantic commutator whose function was to switch on only one lamp at a time and, as the contact of the commutator revolved, each of the lamps was switched on in succession. The whole of the 2,100 lamps were switched on and off in just over one-twelfth of a second and, since the selector brush revolves at 750 revolutions per minute, it will be seen that 26,250 contacts are made every second.

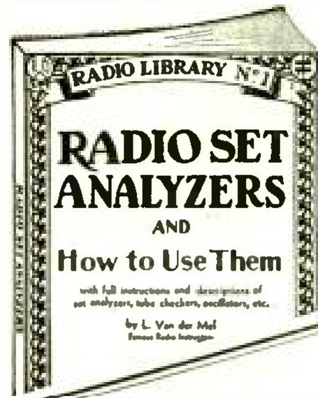
In operating the incoming television signal is first of all amplified, and this powerful current is then fed to the revolving commutator where the lamp switching takes place. As in normal television working, the current is strong at the bright parts of the image and weak at the dim parts, so that the small lamps are bright or dim accordingly; and the image is evolved or built up from this mosaic of bright and dim lamps and, of course, the intermediate shades.

At the time when the lamp screen was demonstrated, synchronism was obtained with synchronizing gear, differing from the standard Baird toothed-wheel synchronizer in size only. A bank of lamps of this character has luminous inertia; that is to say the luminosity of the screen persists, so that we do not have a traveling spot of light reproducing the image as in the two previous methods I mentioned, but a semi-permanent image remains on the screen—*persistence of illumination* supplementing persistence of vision. This process, with a large number of the small lamps being alight simultaneously gives the effect of great brilliance and considerably reduces flicker.

Of these three methods the first has the disadvantage of expense. While the second has the advantage of comparatively simple construction, in the early days it suffered from the disadvantage that it was difficult to obtain sufficient brilliance to illuminate adequately a large screen. This, however, has been counteracted by Mr. Baird's latest invention, the *Modulated Arc*, with which I shall deal later on.

The third method has also the disadvantage of expensive construction, but the advantage that any degree of illumination up to the most intensive brilliance can be secured, and also the further advantage, stated above, that owing to the persistence of illumination, image flicker can be greatly reduced.

The lamp screen was designed originally to receive the standard Baird transmissions, now being sent out through the B. B. C., and (as these transmissions are limited by regulations governing sound transmissions) the screen had, accordingly, only a limited number of lamps. There is nothing, however, to prevent a screen of any desired magnitude being built for theatrical or other purposes and it is a public fact that the Baird Company has built up a lamp screen using twice the number of lamps, for experimental purposes. After this lamp screen made its debut on the roof of the Baird Laboratories at Long Acre, it was shown at the London Coliseum, and after this it traveled to Berlin, Paris and



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Stockholm, while the press was unanimous in their praise of the developments that had been made.

Brilliancy of the screen will become a more acute question as the quality of the transmission channels improves; since, the greater the number of elements the picture contains, the less is the brilliancy where a traveling light spot is employed. This is because the light spot becomes proportionately smaller in relation to the screen as the number of elemental areas contained in the picture increases. One way of overcoming this particular difficulty is to transmit the picture in sections or *zones* (using a plurality of light spots); but the complexity of this method for radio purposes is a serious practical drawback. Where land-lines are concerned, however, there is no difficulty in transmitting a series of zones.

Three-Zone Television

On January 2, 1931, *three-zone* television apparatus was demonstrated to the press at the Baird Laboratories. The images were shown projected on a small glass screen, and full-length figures of as many as eight persons were seen, together with an impromptu tea party, a boxing match and demonstrations of cricket strokes. These pictures were made up of three sections transmitted side by side, and an examination of the transmitter revealed the fact that its essentials comprised a large mirror-drum with 30 mirrors which, revolving rapidly, caused a succession of images to be moved over three different apertures, admitting light to three separate photoelectric cells. Each of these cells transmitted one-third of the total scene; the picture being split up into three adjacent zones.

At the receiving end was an apparatus so arranged that the light from three neon tubes was controlled by the current from the corresponding cells at the transmitter. Spots of light from these neon tubes were made to traverse the ground-glass screen, building up an image of the scene in front of the transmitter. In effect, there is really no limit to the number of zones that can be utilized in this way. Obviously, the larger the picture, the greater the number of zones and, unfortunately, the greater the complication and the expense. These last two items are, however, not serious matters where a public service, such as a theatre, is concerned; and it is for this purpose that zone television, in its present form, is primarily adaptable. It is noteworthy to record that the system was described in one of Mr. Baird's patents taken out as far back as 1925, but has only recently been developed; as it is unsuitable for radio broadcasting since several communication channels are required.

Daylight Television Pick-up

The apparatus which was demonstrated had one rather noteworthy feature: an ordinary floodlight was used in place of the moving light-spot with which we are so familiar. This suggests immediately the great advantage that the apparatus can be used with ordinary daylight and, a short time after this zone-television demonstration, another development made its appearance in the form of daylight television. (The first *Daylight Television* demonstration was made as far back as June, 1928, but the apparatus employed then differed considerably from that used in the later experiments.) It was on Friday, May 8, 1931, that an actual street scene was transmitted by television. Unfortunately, the weather was of the usual fickle character associated in England with that month; but even with an overcast sky, it was possible to see Covent Garden porters, policemen and the usual business people walking up and down Long Acre, in the small screen of the Baird commercial "Televisor."

The transmitting apparatus was housed in a grey caravan and from the van's open door the scene was picked up through the medium of a mirror drum revolving at a speed of 750 revolutions per minute. By this means, a succession of images of the scene being transmitted was projected upon a special photoelectric cell, and, in this way, a conversion into an equivalent form of varying electric current was effected. A few days prior to this, an experimental transmission was made (through the B. B. C.) of a scene on the roof of Long Acre, and it reflects great credit upon the Baird Company's engineers that they were able to concentrate on this apparatus and perfect it in such a manner that it was capable of producing these daylight scenes. It may be recalled that in the early days of Baird television, it was pointed out that the application of the principles would enable such scenes as the Derby race to be televised, and critics used this fact to pour scorn on the whole scheme; but June, 1931, saw that promise fulfilled. This was the first experiment of its kind to be made in the history of science, and was carried out by the Baird Company in conjunction with the B. B. C. By the side of the rails at Epsom, opposite to the grand stand, the same caravan was erected on a wooden stand; and it was possible to see the parade of the horses—first in one direction, then in the other—and, finally, watch both horses and jockeys flash by the winning post.

To secure a change of vista, a very ingeniously contrived mirror was fitted on the caravan side, furthermost from the race course, and when turned this reflected different pictures of the adjacent activities. It was these reflected images that were scanned by the revolving mirror-drum. Housed in the caravan were powerful amplifiers, which handed on the vision signal to telephone lines passing under the race course and then linked up to other lines passing through to Long Acre. From thence they passed to Savoy Hill, from Savoy Hill to Brookman's Park, and were finally broadcast into the ether to be received and watched by anyone possessing a "Televisor." This experiment, though somewhat restricted in the size of the scene it was possible to televise, proved beyond all doubt to the most sceptical of "diehards" that television has emerged from the studio into the realm of topical events. The restriction of four walls and artificial light had been broken down, and Mr. Baird had fulfilled the promise which, as I indicated earlier, had brought down a storm of disbelieving contempt on his head.

Mr. Baird's Latest—the "Modulated Arc"

Let me now pass to Mr. Baird's latest invention, namely the modulated arc. To anyone interested in television, it has been apparent for some time past that, if the scope and size of television images are to be increased to any appreciable extent, a more powerful source of modulating light had to be evolved. A television image is, in effect, really built up from a single small spot flying across the screen, so rapidly that the eye does not dwell on the mechanism of the process; but receives the impression of an evenly illuminated area. It is obvious, therefore, that the spot must be of great intensity and, whereas the present area of the spot in the Baird image is 1/2100 of the screen, if the detail is to be increased this ratio will go up proportionately, as will the necessary intrinsic brilliancy of the spot. Apart from the lamp screen, only two forms of light have been used for television with any success. These are the neon tube with its comparatively faint red glow, while the other device is known as the Kerr cell.

In the latter the light from an arc is first polarised by a Nicol prism, and then passed between two metal plates immersed in nitrobenzene. If this resulant Kerr cell is followed by a Nicol prism *crossed* with respect to the first prism, no light will pass; but should a potential be applied to the plates of the cell there is produced a rotation of the light, causing it to pass through the second prism. In this way the arrangement becomes in effect a light valve but, since only about 20% of the light actually gets through this system (the remainder being absorbed in the cell and prisms), it will be appreciated that in the present state of the art this does not afford the best solution of our problem.

Now, the most intense light source known is the electric arc, and this form of illumination immediately suggests itself; but when one tries to put it into practice, it is found that the simple arc is not capable of varying its intensity with anything like sufficient rapidity for our purposes. The work of Duddell and Ruhmer, in connection with varying the light of an arc in proportion to speech currents from a microphone, can be recalled; but it has remained for the staff of the Baird Television Laboratories to evolve a new form of arc which can be modulated over a sufficiently wide frequency-band, and with the necessary consistency and accuracy, to make it suitable for television purposes. This has now been done, and it is possible with the modulated arc to obtain a brilliantly illuminated image, which can be projected successfully on to a large screen. This was demonstrated publicly for the first time in September, 1931, at the meeting of the British Association Meeting, in the section devoted to "mechanical aids to learning."

The audience was seated several feet away from the screen, which was set in a black background. First of all a large image (in this case a man's head and shoulders), addressed the audience from the screen, the voice being heard from a loud speaker accommodated in the foreground. Having explained briefly the principles involved, and pointed out how this invention in its present form opened up a new field in education (since a lecturer complete with demonstrable apparatus could be located in one central studio, yet his image seen and his voice heard at various remote points linked by wire or wireless), the announcer disappeared from the screen, his place being taken by a lady singer.

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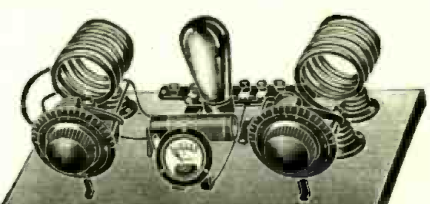

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The public was at liberty to examine both receiving and transmitting apparatus; the latter taking the form of the standard light-spot transmitter, to which I made reference earlier in this article. At the transmitting end, behind the screen, was seen the mirror drum with each of its 30 mirrors set at a slightly different angle from the preceding one. Before this drum was a lens concentrating the light from the modulated arc on to the mirrors and, as the drum revolved, this light spot was made to traverse a screen in a succession of 30 parallel lines. The light from the arc lamp flickered in and out, corresponding to the light and shade of the image, being bright at the high lights and dim at the shadows. Since the arc equipment was arranged parallel to the screen, it was necessary to include a large mirror, to turn the light beam through an angle of 90%.

Having solved the very acute problem of a powerful light source, which can be modulated successfully for television purposes, it is reasonable to hope that further development will be rapid; for the brilliancy question is one that has hitherto stood in the way of successfully projecting television images directly upon a large screen.

Another important advance is that a portable transmitter was installed in No. 10 Studio some months ago, and used on several occasions for transmitting television images direct from the building. The success achieved in that direction is reflected in the announcement which was made recently; namely that television at "long last" is to come within program hours.

This started on Thursday, October 15; the first subject to be televised being Jack Payne conducting his B. B. C. dance band from a Savoy Hill Studio. The transmission proved a great success and these new weekly transmissions will be extended in the very near future and thus continue to broaden the interest of television in the Old Country.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Television News, published bi-monthly at Mt. Morris, Illinois, for Sept.-Oct., 1931.

State of New York, County of New York, ss.

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the editor of the Television News and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Popular Book Corporation, 98 Park Place, N. Y. C.; Editor, Hugo Gernsback, 98 Park Place, N. Y. C.; Managing Editor, H. Winfield Secor, 98 Park Place, N. Y. C. Business Manager: None.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

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5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only).

H. GERNSBACK.
Publisher.

Sworn to and subscribed before me this 30th day of September, 1931.

(Seal.) **MAURICE COYNE.**

Notary Public Bronx Co., No. 81, Reg. No. 3292; Certified in N. Y. Co. No. 518, Reg. No. 2-C-367; Certified in Kings Co. No. 178, Reg. No. 2217. (My commission expires March 30, 1932.)

Farnsworth's Principle of Side-Band Compression Explained

(*Continued from page* 436)

transmitter and *receiver*, or by land line, without overstepping the frequency limitations of the channel. At the output of the receiving apparatus it passes into an amplifier across the resistance R_1 and inductance L_1. The voltage drop across the resistance will be proportional to the input signal, while the voltage drop across the inductance will be proportionate to the rate of change in the signal amplitude (*i. e.*, the first derivative of the signal wave). The two components resulting will be fed through the vacuum tube into a plate-circuit load of the same type, where the second derivative will be produced in the inductive portion of the circuit. The resistive portions of these *differentiating* circuits are made variable; so that the relative amplitudes of the distorted wave and its differentiated components or *derivatives* may be adjusted for the best image.

The three components now formed are fed into the "oscillate" *receiving tube* through a condenser, which performs the mathematical process of integration in an electrical sense. This gives us the summation of the three components necessary to the reconstruction of the original and undistorted wave.

While the writer is familiar with the higher mathematics involved he does not fully subscribe to this principle; on the ground that one of the many and annoying mathematical fallacies may be responsible for the interpretation. In view of the reputation of the scientists who have witnessed the Farnsworth demonstration of this principle and became convinced, and from the writer's personal regard for Mr. Farnsworth himself, he is quite willing to accept the principle as well-founded—the reader must judge for himself. To be sure, the thought of the television signal being sent out in full detail over a normal broadcast channel is one to conjure with.

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THE new Winter edition of our RADIO SERVICE TREATISE, twice as large as our former one, has just come off the press. It is positively the greatest book in print—NOT JUST A CATALOG. It contains a large editorial section—a veritable book in itself with more valuable information not found anywhere else. Among the wealth of new technical information listed in the editorial section are the following: 1932 Complete Radiotron Characteristic Charts.—Versatile Power Amplifier for use with Short-Wave Tuners and Phono-Pickups.—Constructional Data of Servicemen's Test Oscillator using latest A.C.-D.C. Dynatron Circuit.—All About Tone Controls.—Short-Wave Adapters and Converters.—Constructing a 3-tube Super-Het Converter.—Modernizing Old Radio Sets.—How to Select and Install Replacement Parts in Standard Radio Sets. How to Choose Power Transformers.—Bringing Your Set Up To Date with latest type Multi-mu and Pentode tubes.—All About D.C. Receivers.—Vacuum Tube Treatise.—How to Take Care of your Tubes—And dozens of new radio experiments, hints to Servicemen, valuable tables on useful radio data, etc., etc.

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Alive during morning hours with American and foreign radio telephone and short wave relay broadcasting stations. It's great sport to hear London, Berlin and Buenos Aires talking to New York; or Eindhoven (Holland) conversing with Sourbaya (Dutch East Indies).

Band Two: 19 to 35 Meters

After lunch, skip up to band two and hear Chelmsford, England; Pointoise, France; or Konigswusterhausen, Germany. Also ship-to-shore radio-telephones, and American and Canadian broadcasters. Rome may be on with an opera, or Mexico City with a news report.

Band Three: 35 to 65 Meters

Always a source of thrills. Dozens of North American, Central American and South American broadcasters, easily heard during the early evening. Entertain your guests with music from Costa Rica and Colombia, from California and Canada.

Band Four: 65-110 Meters

Actually hundreds of amateur phone stations, all over the country, operate in this band. You can listen to them for hours. Also airport and airplane stations, which are heard at all hours of the day and night.

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Nothing is more thrilling than to hear the police radio stations directing "cruiser" cars to scenes of crimes or accidents. You live with the news while it is happening! Experimental television stations are also in this band.

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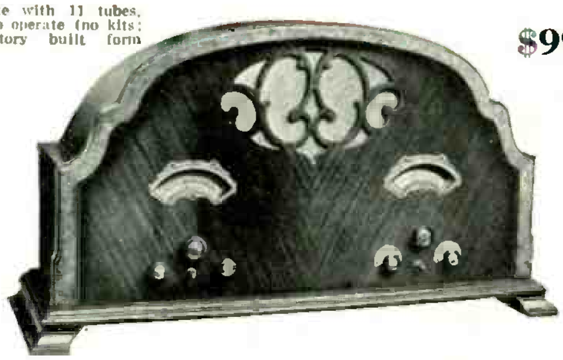
Complete with 11 tubes, ready to operate (no kits; in factory built form only) **$99.50**



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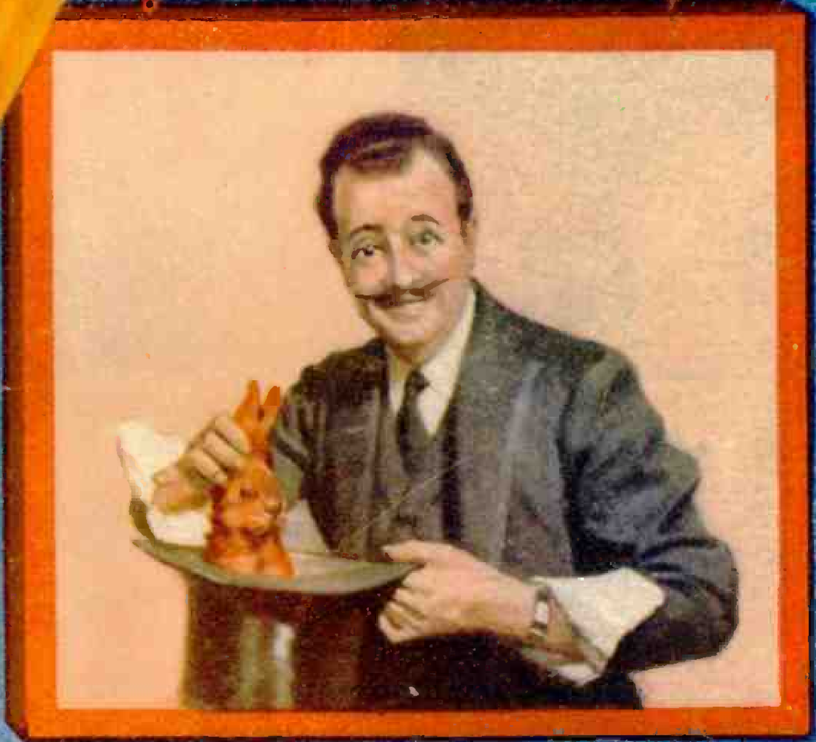

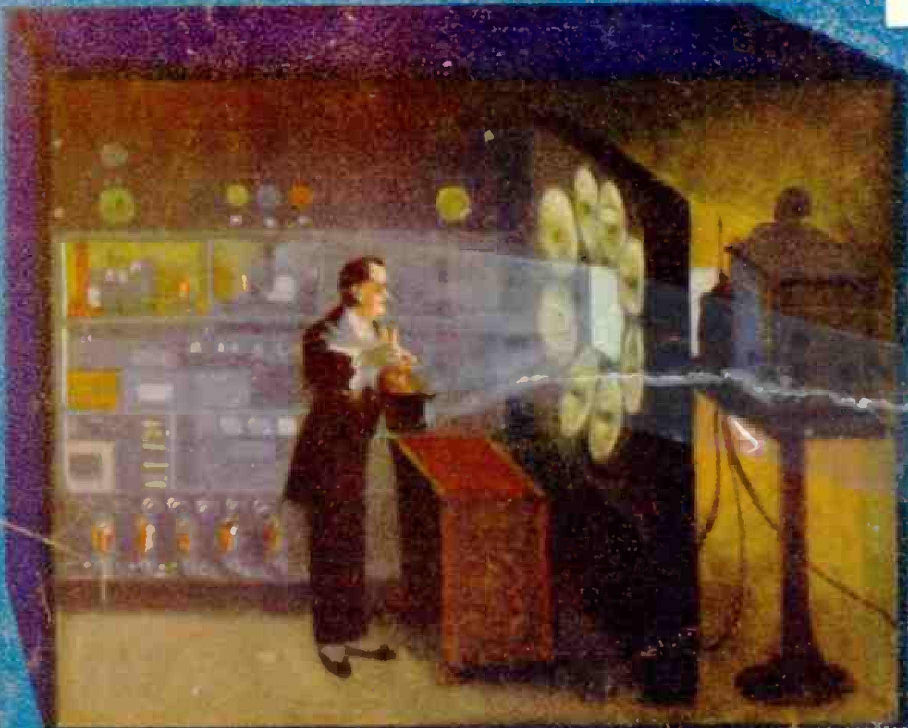

Television in the Theatre a Reality!

Reports from three or four o the country's outstanding researc groups relate of excellent ad vancements in the general tech nique of visual broadcasting. An the impressive recent develop ments of Sanabria engineers, work ing in the creatively productiv laboratories of the Sanabria Tele vision Corporation, lend tremend ous weight to the welcome rumo that we are at last on the prom ising threshold of "The Televisio Era."

Before the commercial tele vision activities of the radio in dustry will be able to get unde way with full force, however, the American public must be made television-conscious and placed i a receptive mood toward "wire less pictures"—the latest phenom enon of scientific invention. T accomplish this necessary prelim inary "selling", the Sanabria Tele vision Corporation exhibited two four and ten-foot television pic tures to crowds of 45,000 daily a the Radio World's Fair in Madi son Square Garden, New Yor City, the week of Septembe twenty-first. Dozens of celebritie and artists were televised for th wonderment of the enthusiasti audiences who saw talking images of their favorite entertainers pro- jected on the two Sanabria tele- vision screens.

Another pioneer New York show- man, B. S. Moss, contracted with Sanabria Presentations for six-a day demonstrations of Sanabria Giant Television in his beautifu new Broadway Theater for a two week period beginning October twenty-fourth. In similar fashion, Sanabria large-screen televisio equipment will tour the theater circuits of the country for the purpose of making the public tele- vision-minded, explaining the pres- ent status of the art, its potential advantages to our socio-economic life, and, in general, disseminating educational material with a view to laying the groundwork for fu- ture commercial television activi- ties on the part of the entire radio industry.

Throughout this period of missionary endeavor, the re- search engineers of the Sana- bria laboratories, inspired by the brilliant flame of Sanabria's own engineering genius, will continue to move systemati- cally, perseveringly and rapid- ly toward the perfection o those inventions which will ac crue to the patrons of the Sanabria Television Corpora tion's consulting services, an in the last analysis, we hop to the benefit of all manufa turers, broadcasters, distribu tors and consumers associate in any way with the transmis sion and reception of tele vision.

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