TELEVISION News

December

HUGO GERNSBACK Editor

FEATURES:

Baseball Game Successfully Televised

50¢

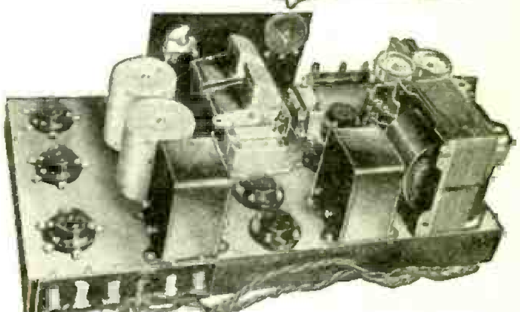
TELEVISION NEWS—Bi-monthly. Entered as second class matter February 16, 1931, at the post office at Mount Morris, Illinois, under the act of March 3, 1879.

I will train you at home to fill a BIG PAY Radio Job!

I will give You my new 8 OUTFITS of RADIO PARTS for a home Experimental Laboratory

You can build over 100 circuits with these outfits. You build and experiment with the circuits used in Crosley, Atwater - Kent, Eveready, Majestic, Zenith, and other popular sets. You learn how these sets work, why they work, how to make them work. This makes learning at home easy, fascinating, practical.

Back view of 5 tube Screen Grid A. C. tuned Radio frequency set—only one of many circuits you can build with my outfits.



Here's Proof

$100 a week

"My earnings in Radio are many times greater than I ever expected they would be when I enrolled. They seldom fall under $100 a week. If your course cost four or five times more I would still consider it a good investment."

E. E. WINBORNE
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Jumped from $35 to $100 a week

"Before I entered Radio I was making $35 a week. Last week I earned $110 servicing and selling Radios. I owe my success to N. R. I. You started me off on the right foot."

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$500 extra in 6 months

"In looking over my records I find I made $500 from January to May in my spare time. My best week brought me $107. I have only one regret regarding your course —I should have taken it long ago."

HOYT MOORE
R. R. 3, Box 919,
Indianapolis, Ind.,

If you are earning a penny less than $50 a week, send for my book of information on the opportunities in Radio. It is free. Clip the coupon NOW. Why be satisfied with $25, $30 or $40 a week for longer than the short time it takes to get ready for Radio.

Radio's growth opening hundreds of $50, $75, $100 a week jobs every year

In about ten years Radio has grown from a $2,000,000 to a $1,000,000,000 industry. Over 300,000 jobs have been created. Hundreds more are being opened every year by its continued growth. Men and young men with the right training—the kind of training I give you—are needed continually.

You have many jobs to choose from

Broadcasting stations use engineers, operators, station managers and pay $1,800 to $5,000 a year. Manufacturers continually need testers, inspectors, foremen, engineers, service men, buyers, for jobs paying up to $15,000 a year. Shipping companies use hundreds of Radio operators, give them world wide travel at practically no expense and a salary of $85 to $200 a month. Dealers and jobbers employ service men, salesmen, buyers, managers, and pay $30 to $100 a week. There are many other opportunities too. My book tells you about them.

So many opportunities many N. R. I. men make $5 to $25 a week while learning

The day you enroll with me I'll show you how to do 10 jobs, common in most every neighborhood, for spare time money. Throughout your course I send you information on servicing popular makes of sets; I give you the plans and ideas that are making $200 to $1,000 for hundreds of N. R. I. students in their spare time while studying.

Talking Movies, Television, Wired Radio included

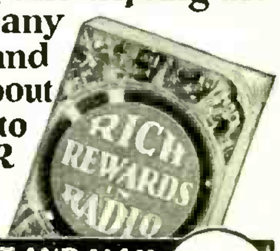
Radio principles as used in Talking Movies, Television and home Television experiments. Wired Radio, Radio's use in Aviation, are all given. I am so sure that I can train you satisfactorily that I will agree in writing to refund every penny of your tuition if you are not satisfied with my Lessons and Instruction Service upon completing.

64-page book of information FREE

Get your copy today. It tells you where Radio's good jobs are, what they pay, tells you about my course, what others who have taken it are doing and making. Find out what Radio offers you, without the slightest obligation. ACT NOW.

J. E. SMITH, President
National Radio Institute Dept. INC4
Washington, D. C.

I am doubling and tripling the salaries of many in one year and less Find out about this quick way to BIGGER PAY



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J. E. SMITH, President,
National Radio Institute, Dept. INC4,
Washington, D. C.

Dear Mr. Smith: Send me your book. This request does not obligate me.

Name ....

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Lifetime Employment Service to all Graduates

Vol. I

TELEVISION News

No. 5

HUGO GERNSBACK, Editor

H. WINFIELD SECOR, Managing Editor

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NOV. - DEC., 1931

TELEVISION News

VOLUME I
NUMBER 5

HUGO GERNSBACK, EDITOR
H. WINFIELD SECOR, MANAGING EDITOR

WHAT SIZE IMAGE?

By HUGO GERNSBACK

EVER since television came to the fore, there has been a lot of speculation, as well as misconception by the public, about the size of the television image we will obtain from our *home sets*. During the first experiments in television, conducted a few years ago, the image was not enlarged but was, roughly, about the size of a postage stamp. Such an image had its advantages, in those early stages; for the reason that, though it was extremely small, the details were still clear, always providing that the machine was a good one.

Later on, in view of the smallness of the image, it was thought advisable to use a magnifying lens and, thereby, bring the image up to an apparent size of about 6 inches. Of course, this was only apparently so; for the reason that, though it had become possible to see a 6-inch image, this did not have any better details than the small original image. Quite to the contrary: the image was not as good because, where you enlarge a small image several times, you also magnify its defects. This is about what we have at the present time, when we view lens enlargements. Nevertheless the magnified image is, of course, vastly more satisfactory than the miniature one because, even though the lines are coarser, the large window allows several people to view the image at the same time; which is not the case with the smaller one, without magnification.

Present "Big Images" Misleading

From the 6-inch image to one 10 feet square (which was recently displayed at the "Radio Show" in New York City) is a big jump, and one which serves to mislead the public as to the scope of television, particularly as applied to the home. The average man does not seem to have any adequate conception of what the television outfit of the future can or will do. This is not surprising, because the new art of television at the present time tends to confuse the layman.

We talk glibly about television in the theatre, and we are shown 10-foot television images at exhibitions; the public has therefore the right to ask *what*, after all, is television.

Best Size for Home Radiovisors

To my mind, for television in the home to be successful and meet the demands of the public, the image must be in the order of not less than one foot or, better, 14 inches square. The television set of the future must show an image of this size, which would seem to be best, because it is about right for viewing in the average living room. A life-size "close-up" of the distant speaker or performer can then be reproduced, because the head of the average human being is about ten inches high; it is, therefore, easily possible to show a full-size face on a television screen 12 x 12 inches. The image must not be enlarged by lenses, and it must appear on a flat surface; so that it may be viewed by a number of people in different parts of the room. For best results it should be at least five or six feet above the floor because, at such a height, the image can better be viewed by a number of people in different parts of the room. This makes for a "Grandfather's Clock" type of set, and there is at least one such already on the market.

Position of Screen Important

It would be advantageous, at least for the present, to have the image-screen somewhat recessed into the cabinet, say three or four inches. If it comes flush with the front of the cabinet (unless the image is very brilliant, and has light to spare) it is almost impossible to see it during the daytime, or even at night, with all the lights turned on. In both cases, the outside illumination interferes with the weaker television image, and makes it almost impossible to view.

In the distant future this problem will no longer be serious for television engineers because, by that time, such powerful illumination will be achieved that the image will stand out brilliantly, even though the room is well illuminated. But, for the present, while we are still struggling to devise sufficient illumination, it would seem that recessing of the television face-plate several inches into the cabinet accomplishes the best practical results.

What Color Image?

As to the best colors for the television image, only experience and the future will tell. At present, we have black-and-pink, though it might be better to have black-and-white (similar in color to motion-picture images today). In the not-too-distant future we will, of course, also have television in the natural colors; but this will take some time to develop.

So much for television in the home. When it comes to exhibition purposes, as for halls, theatres, and the like, it will, of course, be necessary to have a much larger image. say 10 feet square, or even of the dimensions of a standard theatre size motion-picture screen, which measures about 16 x 18 feet, up to 18 x 22 feet, in large theatres. Naturally, if we are to bring scenes to a big audience in a theatre or in a hall, where everyone must see equally well, it is necessary to employ a very large image. Of course, such large images are costly, and can be attempted only for big assemblies.

Television in Future Theatres

There is no reason to believe that motion-picture audiences in the future will not be entertained by direct television in the theatre. Distant events will be thrown on the screen before the audience while they are actually happening. Just as the motion-picture news reels are flashed on the screen today, though days and weeks after they have happened, it is conceivable that, in the future, when a big event is occurring, the projectionist will interrupt for a minute or two the picture that is being shown, in order to throw on the television screen the climax of an important contest in some other part of the country, a gathering of great dignitaries, or some other scene of the greatest public interest.

What the ultimate size of the television image will be is impossible to foretell. We will have very large images, in the open, where thousands of people can see the image at the same time; and television images may even be projected on passing clouds, for stunt purposes; but it is probable the largest image for general purposes will not exceed 10 feet square.

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THE NEXT ISSUE COMES OUT DECEMBER 15TH

THE PROMISE

By MERLIN H. AYLESWORTH
President, National Broadcasting Co.

Mr. Merlin H. Aylesworth, President of the National Broadcasting Co., who presents in the accompanying article, his views on the present and future commercial development and sale of television to the radio public. Mr. Aylesworth discusses such interesting phases of the television problem, as research and development: the importance of cooperation by "radio amateurs" and "television experimenters": the type of programs to be presented, and the many details that have yet to be worked out by experimenters and engineers.

TELEVISION can no longer be side-stepped. It is a great question of the moment, not only to the radio industry seeking fresh impetus at this time, but to a world at large seeking new activities whereby to put surplus capital, facilities and personnel to profitable work. Therefore, an inventory of the new art, and a frank appraisal of its immediate and future value to industry and home, are quite in order at this time.

Television Defined

By television, of course, we refer to the instantaneous flashing of animated pictures through space. Qualifying the term still further, we mean the broadcasting of pictures and their reception, by simple, practical, relatively inexpensive equipment for lay use, in the average home. More elaborate qualification is necessary with regard to the exact nature of the television service—whether it is pure experimentation or whether it attempts genuine entertainment; but since such qualification here would steal my speech, it is conserved for the major theme of the remarks that follow.

The controversy that rages over the commercial readiness of television revolves mainly about the question of what constitutes "television service." One school of television thought believes the art to be still in the purely experimental stage, so that any attempt at genuine entertainment service is decidedly in poor taste at this time. The other believes the art ready to provide genuine entertainment service and is consequently promoting television on a commercial basis. Fortunately, there is a common ground in the undeniable achievement of flashing recognizable pictures through space. The progress of the past year, and particularly the last six months, has served to narrow the gap between the two contending schools of thought. Further progress may now serve to bring about a mutual agreement as to television entertainment, with one admitting the possibilities while the other concedes the limitations of the new art form.

Nipkow's Dream Comes True

Television is not new. As an idea, it dates back to 1884, when one German experimenter, Paul Nipkow, described in his patent how images might be broken down; translated into electrical terms; flashed over a suitable medium; translated back into light terms; and reassembled into a replica of the original. His method of analyzing the image, strip by strip, and translating the varying lights and shadows into electrical terms, with the reverse process at the receiving end, is the familiar scanning system of present-day television. Nipkow's fond dream of a practical application of his idea has been realized because of the advent of the necessary tools with which to perform the delicate work. Modern photoelectric cells make possible the accurate and rapid translation of light values into corresponding electrical terms. The vacuum-tube amplifier permits of amplifying the electrical terms to any required degree at both transmitting and receiving ends. The neon lamp is capable of translating delicate electrical variations into corresponding light terms which, arranged in proper order by a scanning system, serve to weave a replica of the transmitted image.

The degree of perfection attained by present television systems rests mainly on refinements and improvements, since the basic principle remains the same. Striking departures from the basic principle have not as yet left the secret confines of the laboratory.

Research and Development

Crude as the basic television principle may seem, engineers and experimenters have achieved results far beyond original expectations. Actually, the commonplace technique is not unlike attempting to design a wrist watch with locomotive parts. The means are obviously crude with regard to the delicate purpose; yet in the absence of any immediately available technique that can compare in simplicity, low cost and practicability with mechanical scanning, the only course lies in further refinement and improvement of components and assembly. If the present scanning system is to remain as the basic technique, then the future of the art rests on intensive research and engineering. The vast laboratories of the radio industry must be heavily drawn upon in evolving a more refined version of the existing technique. Each step in the television process must receive specialized attention, for the television chain of functions can be no stronger than its weakest link. As each function is notably improved, the other functions must be brought up to the same level of efficiency, if progress is to be realized in terms of ultimate

Mr. Aylesworth, as President of the famous National Broadcasting Co., has an excellent grasp on the present and future status of television. The "experimenter" will find his views, expressed herewith, very interesting and valuable, for the research and development, as well as marketing of television apparatus are discussed.

Of Television

results. Television—an old idea gone modern—is an ideal subject for research and engineering development.

If there be any novelty to television, it is in our everyday speech. Five years ago, the word was quite without meaning to the "Man in the Street". Today everyone knows the word. There is much talk about television. It is a term to conjure with. The less that is shown of television, the more is said about it. So far, the most successful television reputations have been built up on the imagination of the laity. Demonstrations have unsold rather than sold television. It is, in effect, the radio three-shell game, with Mr. Public always convinced that he knows the game best.

For a fair appraisal of present-day television, it is necessary to draw a comparison with the pre-broadcasting days of radio.

Comparison with Pre-Broadcasting Era

It may be recalled that the radio-telephone was by no means a novelty when the public at large became radio conscious. The idea of transmitting sounds via radio was at least 15 years old when the present broadcasting era began in 1920. From 1915 until 1920, many experimenters were on the air with radio telephone transmitters, for the most part engaged in point-to-point telephone conversations and, in a few instances, actually attempting mass communication or broadcasting. Entertainment programs were essayed in some instances. However, in the absence of a definitely established program service, covering a sufficiently large area, the efforts could not entice the public to invest money in the necessary receiving equipment. Radio remained an experiment, appealing to radio amateurs and experimenters interested solely in the technical means and not the end. It remained for the inauguration of a positive program service aiming at genuine entertainment and enlightenment of the public, by Station KDKA of the Westinghouse organization at Pittsburgh, to bring about the present broadcasting era.

Technically and commercially, television today compares well with the pre-broadcasting days of sound broadcasting. It is just as experimental, just as crude, yet just as promising as the feeble attempts at propagating entertainment via radio telephony prior to 1920. Technically, it compares with the crystal detector and earphone stage of radio reception. Commercially, it enjoys about the same status as early telephone stations which catered to a handful of listeners possessed of infinite patience, courage and insatiable curiosity. Artistically, television again compares with pre-broadcasting efforts, in that whatever is lost in detail is willingly supplied by the imagination of the audience. The thrill of receiving programs flashed through space largely compensates for shortcomings in artistry.

Interesting Angles on Present-Day Television Problems, as Mr. Aylesworth Sees Them.

¶ Television can no longer be sidestepped!

¶ Crude as the basic television principle may seem, engineers and experimenters have achieved results far beyond original expectations!

¶ Technically and commercially, television today compares well with the pre-broadcasting days of sound broadcasting!

¶ The present limitations imposed on television presentations are no greater than those imposed on early broadcast presentations!

¶ The limitations of television are simply a challenge to the ingenuity of the broadcasters!

¶ Television technique offers unlimited opportunities for experimentation. Its present status is simply a repetition of early broadcasting history, when there was more pleasure in the never-ending building and tearing down of home-made radio sets, with which to intercept the feeble radio signals. Indeed, through the efforts of practical testing of transmitting and receiving ideas in the field; with laboratory research workers and development engineers receiving the hearty cooperation of "radio amateurs" and "experimenters"; it is to be hoped that television progress may be materially accelerated.

¶ Out of a vast amount of experimentation, there has slowly but surely emerged a system which, in further refined and improved form, will become the basis of future home television.

¶ The transmission is being developed step-by-step with reception developments, thereby building up to a complete television system, which will soon be introduced to the public as a vehicle of "practical home entertainment", rather than as an experiment. A reasonably stabilized technique will justify the mass production of television receivers, so that television equipment will sell at prices within reach of the average purse. And a sufficiently numerous and enthusiastic audience will justify attractive television programs, which will then be forthcoming.

¶ Television will not interfere with sound broadcasting, although it will no doubt supplement the latter in an altogether pleasing manner. Television will not replace the existing broadcast receiver, but rather will work independently of or in conjunction with the latter, depending on the program service.

¶ The radio buyer will not delay buying a broadcast receiver in the hopes of obtaining a "combination model", for the television receiver will be a "separate and distinct unit for a long while to come", on the basis of sound engineering and sane merchandising.

¶ That day will come when television is capable of flashing complete scenes over the air. Sporting events, parades, news events, ceremonies, plays, pageants—such subjects may eventually be handled by television, both in the studio and out in the field, at which time the "pictorial" presentation will surpass the "sound" presentation in importance.

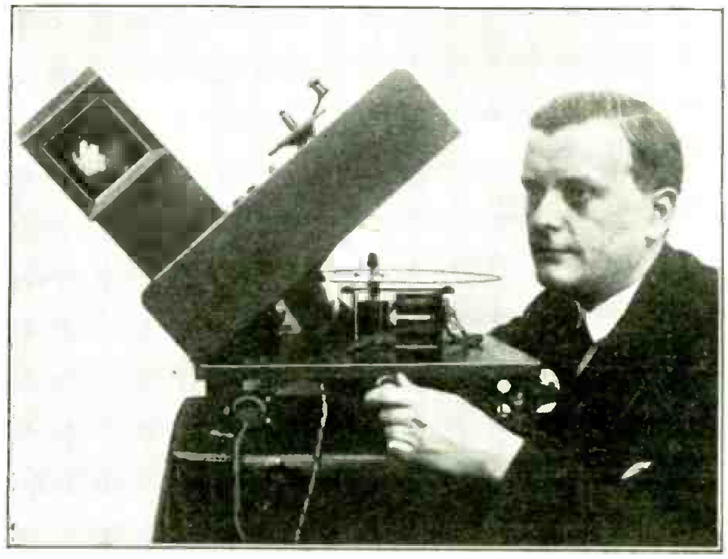
The present limitations imposed on television presentations are no greater than those imposed on early broadcast presentations. Not always has it been possible to broadcast an entire symphony orchestra with every assurance that the reproduction would be successful. In the early days full orchestras were avoided by broadcasters with reputations to maintain. Instead, a few musicians were selected to render the selections in the name of the full orchestra. To go beyond a few pieces was to court disaster. Those who attempted full orchestras presented their audiences with a radio version of the Tower of Babel.

Present Limitations

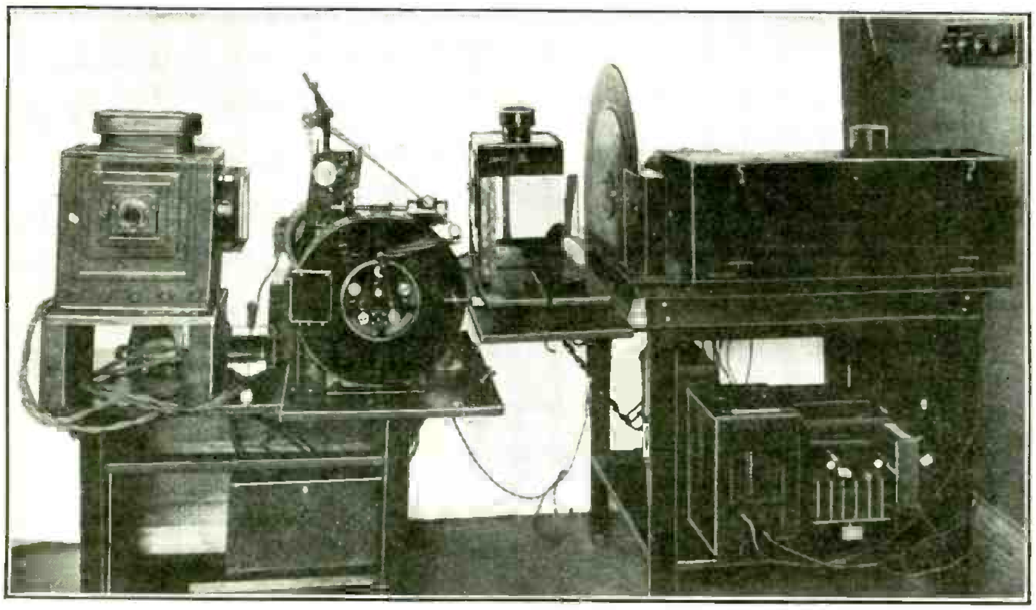
The existing television systems have their limitations. Only a modest amount of detail is available. With just so many light elements at hand with which to weave the reproduced images, it is necessary either to work with large figures or close-ups, or to sacrifice detail in obtaining a larger field of vision. Thus it is possible to reproduce good close-ups of personalities, with the facial features readily discernible, so that immediate identification imposes no severe strain on the imagination of the audience. Half-length pictures result in a marked loss of detail. Facial features are insufficiently distinct to permit of ready identification. However, a greater range of action may make up for loss of detail. Lastly, full-length pictures or so-called long shots possess very little detail, so that action alone must

(Continued on page 395)

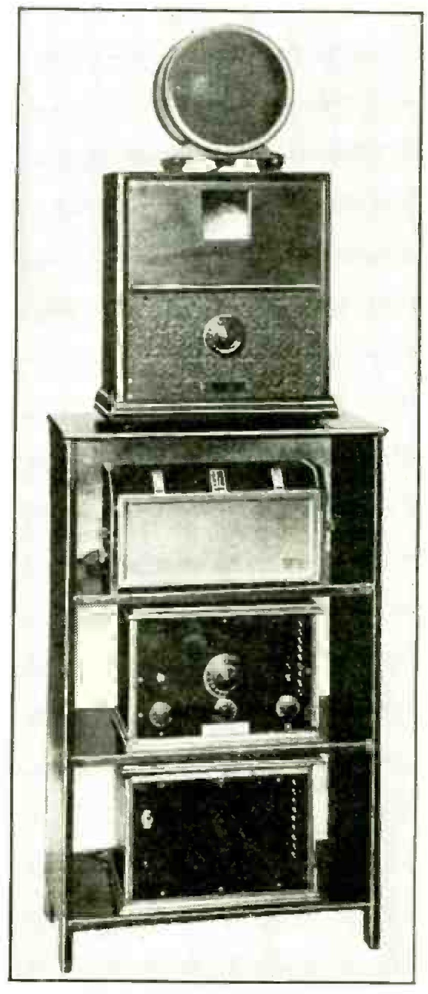
VON MIHALY *Television* SYSTEM *Used* at German Station



DENIS VON MIHALY appears in the photo above, with one of the many models of television receivers conceived by his brilliant mind. As will be seen, a horizontal scanning disc is here rotated by a large phonic wheel motor, the image being observed through the lens on top.

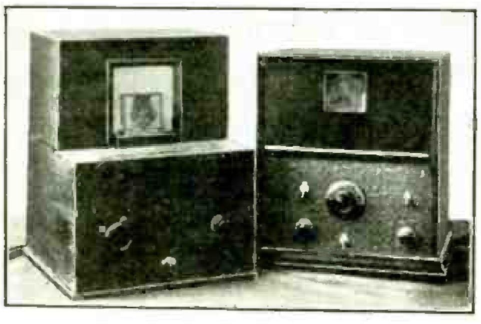


BELOW we have an elaborate model of the Von Mihaly (German) television receiver, with loud speaker and "image scanner" on top and below the voice receiver and power supply.



THE elaborate television apparatus shown in the large picture above, is the Von Mihaly photo-film television transmitter. A powerful light is housed in the box at the left; the film moves continuously through a lens system. The film images are projected through a diaphragm onto a scanning disc and fall onto a photocell, the minute currents from which are amplified several million times.

THE Von Mihaly television apparatus shown below comprises a television transmitter and receiver of minimum range, used either for teaching or demonstrating.

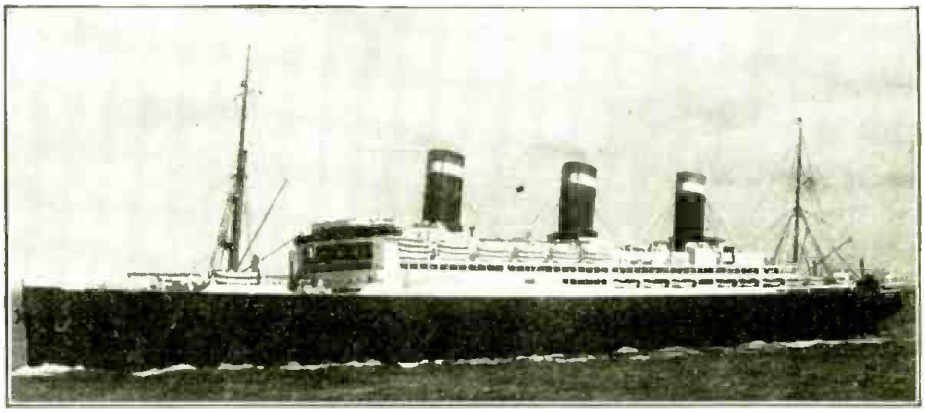


ABOVE—Another version of the Von Mihaly television receiving apparatus, the "image scanner" appearing at the left; the apparatus at the right comprises a loud speaker on top of the cabinet, while below we have the voice receiver or "tuner", and below that the short wave "image tuner" with audio amplifier. Von Mihaly is an eminent expert.

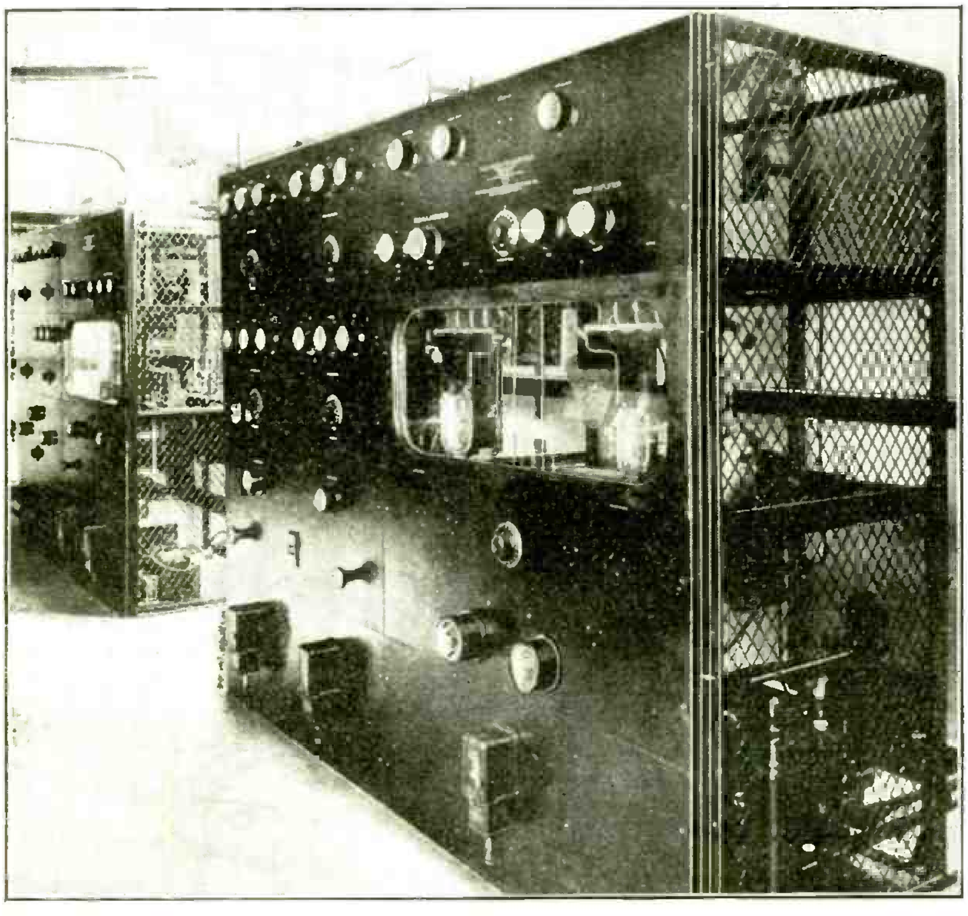
TELEVISION IMAGES *CAUGHT* AT SEA

Above: Shortwave & Television Corp. image receiver on board the S.S. "Leviathan", which apparatus successfully picked up several television programs from shore.

ANOTHER page in television history was written, when (under terrific static) the S.S. *Leviathan*, more than 350 miles out at sea, successfully picked up, on her television receiver, images sent out by 2XAB, NBC, 2XR, 3XK, and W1XAV, the last-named being the famous Boston pioneer television broadcaster, Shortwave & Television Corp. Mr. J. Everett Nestell and Marshall P. Wilder of this corporation were in charge and provided thrills for the thousand passengers who eagerly sought opportunities to peer at the television screen. Many of these folks were viewing, for the first time, television images—certainly the first images transmitted to a steamship over 350 miles out at sea. The Shortwave & Television Corp., of Boston, radiated a special program.



← S.S. "Leviathan" on which the television reception successfully took place when she was more than 350 miles at sea.



Television transmitting station of the Shortwave & Television Corp., at Boston, which sent the "images" to the "Leviathan" while at sea.

Mayor James M. Curley of Boston (left) and George Bancroft, Paramount Publix movie star, who took part in the special program transmitted to the "Leviathan" at sea.

In The TELEVISION EYE

Pantomime a La-Television

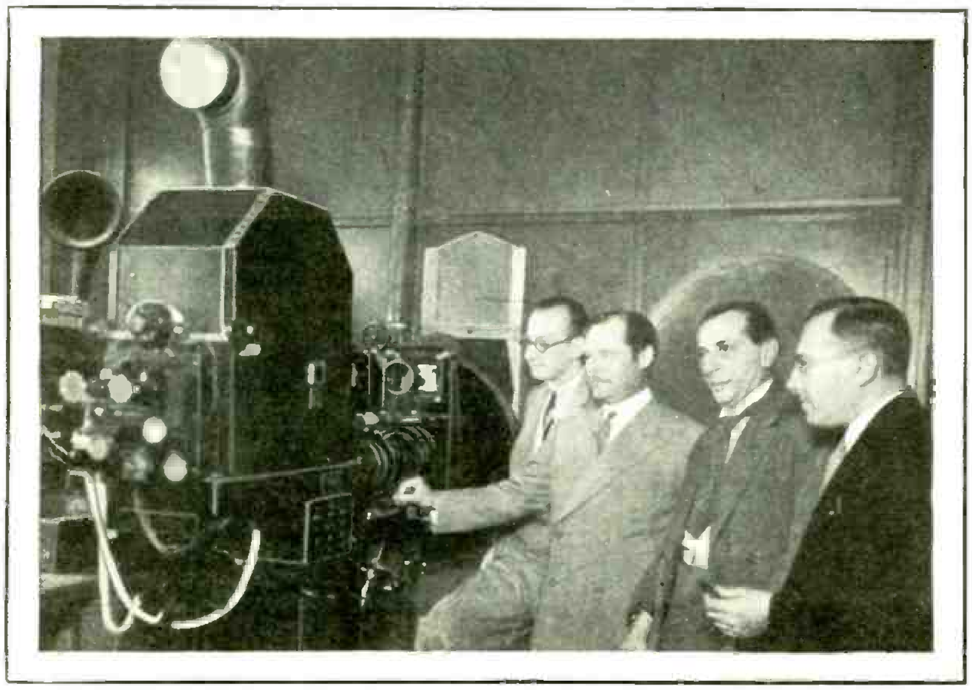
Miss Grace Voss, pantomime artist before the Columbia Television Transmitter.

AN ideal performer before the "flying spot" of television station W2XAB is Grace Voss, pantomimic artist, who is shown at left as she appears before the photo-electric cell bank, each Tuesday night at 7:45 P. M. Animated gestures and vivid facial expression are the only media she employs to tell a story. A special "long-shot" lens picks up the image.

Newspaper "Radioed" to Sea

A MINIATURE copy of the Schenectady "Union-Star" is shown being sent by radio to a ship at sea from General Electric's short-wave station, with facsimile apparatus developed by Dr. E. F. W. Alexanderson. A beam of light travelling over the newsprint is reflected into a photo-electric cell, changing the light variations into electric vibrations, which are transmitted like any radio broadcast signal.

Miniature copy of the Schenectady "Union-Star" ready to be radioed to ship at sea, from short-wave station over facsimile apparatus developed by Dr. Alexanderson.



Germans Inspect Alexanderson Televisor

DR. E. F. W. Alexanderson, well-known engineer of the General Electric Company at Schenectady, N. Y., who exhibited large size television images in theatres at Schenectady, about two years ago, is shown explaining his latest giant television projector to visitors from Germany. Dr. Alexanderson is the second from the left in the photograph and the gentleman at his right is Dr. Walter Reichardt, engineer of the Hamburg Division of the Germany Broadcasting Company. The second gentleman from the right is Dr. Walter Schaeffer, engineer of the German Broadcasting Company. Mr. C. W. Horn, short wave expert and engineer of the National Broadcasting Company, is at the extreme right. The Alexanderson television projector involves the use of a scanning disc and the Kerr cell, the source of light being a powerful arc.

Our artist's picture reproduced above from a photograph appearing in a Japanese magazine, shows that they are wide-awake indeed on television in Japan, for we have not reached the stage in America where we are televising ball-games, although the technical equipment available here is capable of doing so. We predict that by next summer we shall see ball games televised over more than one television system in this country.

STRIKE ONE! GREETS JAPANESE VISUALISTS

By H. WINFIELD SECOR

Recently a Japanese magazine contained a photograph showing a baseball game being televised. The recent television broadcast of the English Derby, coupled with the televising of fistic encounters in America, demonstrates that television is steadily marching forward.

JAPAN is wide-awake when it comes to the latest advances in television, as the accompanying picture clearly demonstrates. This illustration was made by our staff artist from a photograph, showing a baseball game being televised in Japan. In the illustration shown on our front cover, the apparatus has been somewhat modernized by placing the televisor on gimbals, so that it can be quickly pointed, in any direction, by the operator. Judging by the original photograph, which appeared in a Japanese magazine, the televisor utilized for picking up the baseball game was a stationary affair, and it evidently was focused across the home plate. In the last issue of TELEVISION NEWS, we showed how the Baird experts, in conjunction with the British Broadcasting Company, recently televised the famous English "Derby", so that the present instance affords another link in the chain of evidence that television is indeed marching forward.

Public Anxious to "See" Sporting Events

American *visualists*, by the tens-of-thousands, are waiting for the day when prizefights and other athletic events will come to their homes via the television screen. Probably this coming winter will see the first prizefight shown via television—that is actual prize matches in such large places as Madison Square Garden, New York City. As a matter of actual fact, the Columbia Broadcasting System have shown several "prize ring" scenes over their television station, W2XAB (107 meters) accompanied by voice over W2XE (49 meters). Mr. William Schudt, director of television programs for the Columbia Broadcasting System, and his staff, especially arranged these "studio" boxing scenes between well-known exponents of the fistic art.

About three years ago, the writer saw what was probably the first demonstration, in America, of an "outdoor" pick-up as given by the Bell Telephone Laboratories. At that time a man going through various motions with a tennis racket, was shown on the television screen, which utilized a 60-line scanner. Public demonstrations by the Bell Telephone Laboratories, since then, have been practically all confined to "close-ups" such

(*Continued on page* 392)

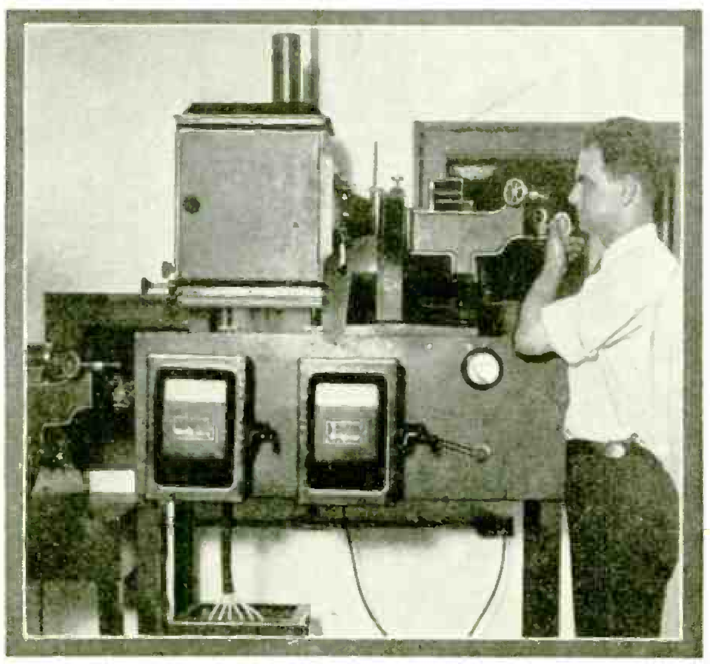
Left: Miss Speed Freeman adjusting the television tuner control on latest model, vertical cabinet receiver. This receiver comprises two distinct radio sets, one tuning in the "image" signal, and the other the "voice" signal, which is heard on a loud speaker placed at the bottom of the cabinet. The new Garner high-intensity neon tube, throws an enlarged image on the screen at the top of the cabinet.
—Photo courtesy of Western Television Corporation.

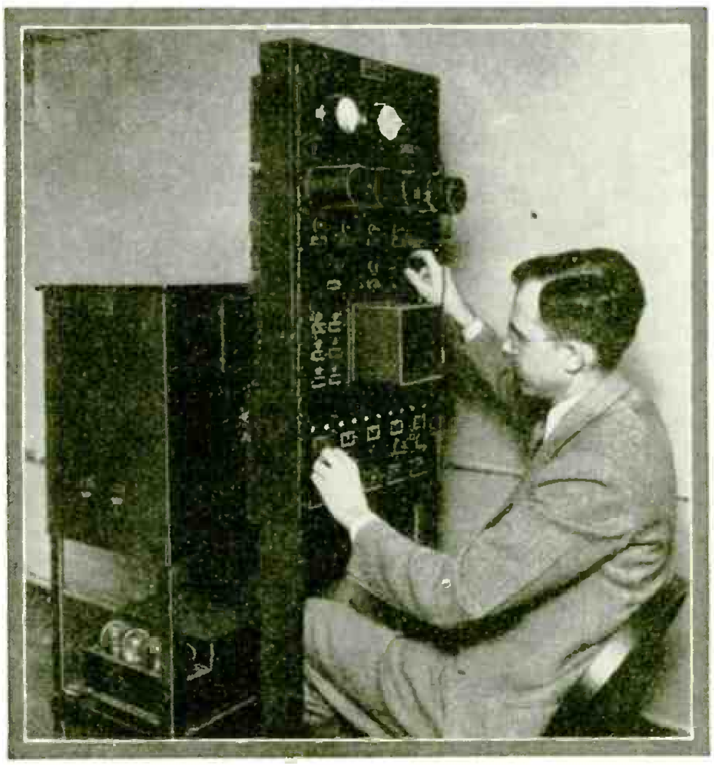
Right: Again we have Miss Freeman, artist of W9XAO and W9XAP, adjusting the image control of another model television receiver designed by the Western Television Corp.

Chicago Steps Ahead in Television

Right: Chicago television broadcasting is becoming very "ambitious"; here we see two artists presenting a "fencing bout" in front of the long-range television pick-up at W9XAO, Chicago.

Below: Mr. William N. Parker, General Chief Broadcast Engineer, Western Television Corporation, Chicago, at the controls of the scanner at W9XAP, "Chicago Daily News" Station.





Above: Dr. Lloyd P. Garner, research engineer of the Western Television Corp., operating the controls of television monitor at station W9XAP, operated by "Chicago Dail News".

THE photos reproduced on this page give some idea of television activities in Chicago. The two television receivers, suitable for home use and illustrated at the top of the page, have several points of interest to "Television Fans". The tall cabinet contains two radio receivers, one for tuning in the "voice" and the other for the reception of the "image" signals. A new high intensity neon tube developed by Dr. L. P. Garner is used to project a large picture on the screen at the top of the large cabinet. A switch enables the operator to "hear" the image signal, if desired for tuning purposes.

WHAT WILL The *RADIOVISOR of TOMORROW* BE LIKE?

Answered by

D. E. REPLOGLE*

Peep-hole stage sure to be abandoned shortly for the projector type equipment due to accelerated engineering efforts.

WITH the television broadcast programs becoming more and more interesting every day especially with the early prospect of picking up fights, world series baseball games, special plays and stage effects, Mr. John General Public is, of course, quite interested in what is happening in the development of receiving equipment that he can use in his home. All of the various types of receiving equipment available for the home have been described in these pages; and circuit constants have been given, so that the average man can build or buy a suitable television receiver, together with a radiovisor.

In the pages of newspapers and magazines, however, the average man reads of large, projected television pictures of good quality and has been wondering why he cannot use this equipment in his home. The answer has been that this equipment is too costly and too complicated. Indeed, the development in the laboratories on receiving equipment in which he is interested has been along the lines of simplifying, cheapening and making more efficient projection equipment for home use that can be sold at a reasonable price.

Equipment already on the market is pretty much of the peep-show type, giving clear pictures to be sure, but requiring a dimly lighted room and requiring the observers or radiovisionists to occupy a position directly in line with the axis of the lenses employed to magnify the images. We have been glad to use such equipment, because it did give results; but, just as we wanted to discard the headphones for something of higher efficiency and comfort, so the radiovisionists want to discard the peep-show type of radiovisor and substitute for it television equipment equivalent to the well-known loudspeaker. In brief, we now want a large projected picture that can readily be observed from almost any angle in the room, and possessing sufficient brilliancy so that it can be seen clearly with the customary floor lamps lit. In this way the observer may sit in comfort in any portion of the room, read his magazine under the lamp and yet look up and observe the pictorial image which the sound accompaniment indicates is of interest to him.

Such receiving equipment is now being developed in the laboratories of several highly responsible companies. The new equipment, which will be introduced this fall, will probably possess the following advantages:

(1) Silent operation;
(2) Translucent-screen projection, which can be observed from a wide angle;
(3) Greater picture-brilliance than hitherto obtained;
(4) Larger size of image;
(5) Choice between orange color or black-and-white;
(6) Compactness—

and all at a price no higher than now asked for present equipment. This is what constant research, good engineering and production facilities can promise for the winter of 1931 and 1932. Couple this with the rapid development of much better and more efficient transmitting equipment, and the winter of 1931 and 1932 looks like a real television year for the experimenter; with little excuse for him to sit back and say: "I guess I'll wait until they have better equipment before I buy."

It must be recognized, however, that radio television is a new art, while sound radio is highly developed. Also, it must be kept in mind that some eleven million homes now have excellent radio receivers. For this reason, the new television receiving equipment will probably be manufactured separately in the majority of cases without the sound receivers; since any sound receiver can be used to tune in the synchronized sound for the picture tuned in on the television set. Thus the combined sight-and-sound reception in the home gives the radiovisionists true radio-talkies.

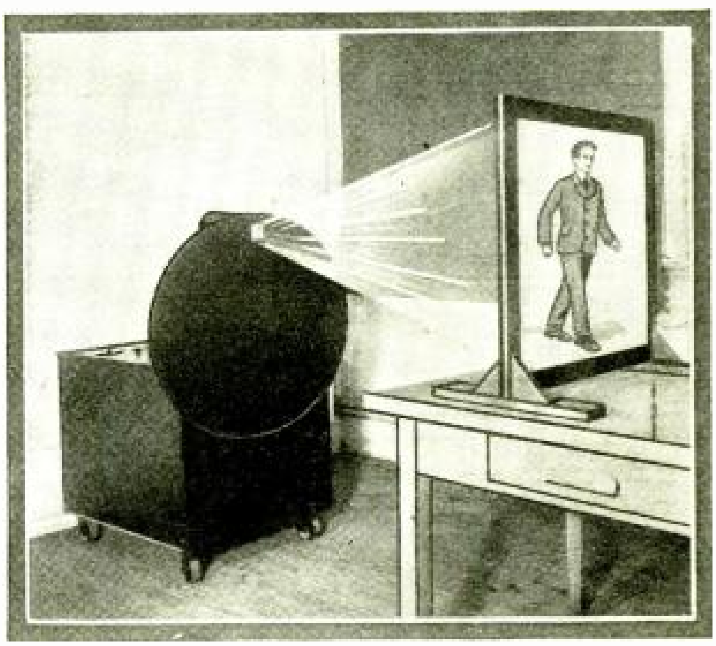
As the television receiving equipment proves itself satisfactory in the hands of Mr. John General Public, the sound and sight will be combined in a single cabinet; because of economies that can be effected in the equipment when sound and sight are together. There is danger, however, in effecting this marriage too quickly; due to the facts pointed out above, namely, that the television receiving equipment will undoubtedly go through much development in the future seasons, as did sound broadcasting.

In any event, the future of television reception as seen by Mr. John General Public, while full of many challenging problems, looks very bright. We have every reason to believe in, and to expect the development of, more and more satisfactory television broadcasting and reception during the coming radio season.

* Vice-President, Jenkins Television Corp.; Chief Engineer, De Forest Radio Co.

New 3 by 3 ft. Image Projector

THIS newest projector is built on a portable steel truck enabling one to move it from place to place without difficulty. Everything required for the operation of the large projector is mounted in the cabinet, the complete power supply, amplifiers and power controls taking up most of the space.



Latest exhibition model Jenkins Projector.

The controls on the projector are, in the order of their importance — gain control, light control and, of course, the switches required to start and stop the motor and amplifier. The amplifier within the projector cabinet will operate from the

(*Continued on page* 382)

TELEVISION at the German Radio Exposition

By DR. FRITZ NOACK (Berlin)

Several new designs of television scanners and receivers were shown at the famous German Radio Exposition and these are interestingly described by Dr. Noack, in the accompanying article. Some of the newest television inventions exhibited included a new "mirror-screw" scanner; the new von Ardenne "cathode ray scanner" for transmitting and receiving; also a new line of television kits.

ALTHOUGH television at present is carried on in Germany over broadcast channels (*i. e.*, ordinary long waves) and even there only experimentally—and even though we cannot count on the introduction of "ultra-short wave television" before next year, or the year thereafter—still it was highly commendable that the German Reichspost (Post Office Department) decided to institute a television display at this year's radio exposition. This step is welcome, because it is necessary to call to the attention of the public that in Germany, research is still being actively carried on in the field of television and, indeed, with great success. The radio exposition unquestionably proved that; for the television pictures shown this time were of surprising pictorial sharpness and of unusual brightness. Furthermore, television models were displayed which, in contrast with previous radio expositions, may be described as absolutely new in design.

Sets were displayed by the German Reichspost, the Fernseh Co., the Tekade-Telehor Co., and the D. S. Loewe Radio Co. (M. von Ardenne).

The television section was the center of interest this year. The quality of the pictures obtained won the public's unanimous approval. Foreign visitors, including experts from England, freely admitted that what is being done in Germany today in the field of television, promises distinct success and in many respects surpasses what other European countries have to offer in this field.

Films Show Relative Scanning Efficiency

First, the Reichspost showed a series of films, which had been scanned with different numbers of pictorial elements. Thus they demonstrated the varying degree of pictorial sharpness with different numbers of pictorial elements. The films were projected in the ordinary way (*i.e.*, not through televisors); but it could be determined, as in the case of regular television pictures, that for reproducing sharp pictures of two persons, at least 5,000 picture elements are necessary; and for scenes with more than two persons, at least 10,000 elements. The Reichspost furthermore exhibited some television receivers, built for itself, of the type

The new 84 line "mirror-screw" scanner, with synchronous motor, exhibited at the German Radio Exhibition by the Tekade-Telehor Co.

for 5,000 pictorial elements. One receiver was shown with a Nipkow disc, and another with a Braun tube scanner; both types of receivers furnished very good pictures.

Disc and Tube Scanners Shown

Much more significant, however, were the demonstrations of the Fernseh Co., which exhibited one receiver with a Nipkow disc and one with a Braun tube. It is well known that the Fernseh Co. is working with the optical firm of Zeiss, which possesses highly efficient and precise apparatus for making optically exact Nipkow discs. While formerly, in disc reception, one usually saw so-called "streaks" on the pictorial surface, today these have entirely disappeared. This represents a marked advance, if we consider that even the Fernseh Co.'s receiver operates with 5,000 picture elements; so that the Nipkow disc is provided with very tiny little holes. It is furthermore very important, in the case of the Fernseh apparatus, that the pictorial brightness was perfectly satisfactory; indeed, so far advanced, that one can clearly observe the images, even in an undarkened room — a thing hitherto quite impossible. The Fernseh design employs a new kind of high-power glow-lamp, possessing unusually great surface brightness. To be sure, this lamp requires considerable exciting power, which can only be given with an extra amplifier. It is to be noted that the new Fernseh set ran almost noiselessly; this will mean a great deal, in view of the simultaneous sound transmission which is, of course, absolutely necessary. Hitherto it has always been felt as a disadvantage of all rotating televisors that, unlike the Braun tube, they did not operate silently. Besides, with the Fernseh receiver, a film was not presented. Instead, a living subject was reproduced, who at the same time spoke into a microphone; the voice being reproduced by a loud speaker. Thus the public was able actually to see how future "sound-television" broadcasts will take place.

"Mirror-Screw" a Novelty

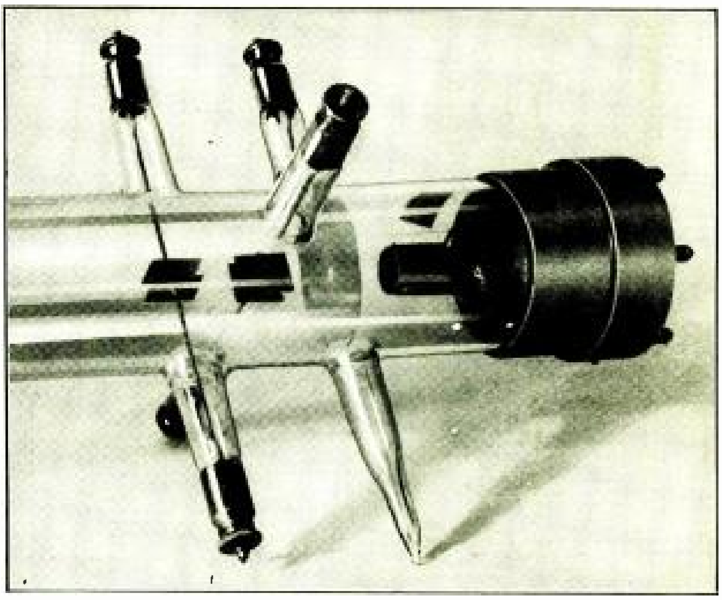
The new "mirrow-screw" televisor of the Tekade-Telehor Co. appears very promising. This televisor was evolved by Okolicsanyi and Wickenhauser of the Telehor Co. (not by Von Mihaly who, moreover, has not been associated with the Telehor Co. for a long time and therefore also has nothing more to do with the television developments of this firm and of Tekade). The '"mirror-screw", of which a description has previously been given, and the manufacture of which is naturally not at all simple, has been so perfected that the quality of the television pictures is perfectly satisfactory.

During the exposition, pictures were presented with 5,000 elements, with an original size about 8 x 11 cm. (about 3 x 4 inches). The screw had 84 individual mirrors; and one can easily imagine how narrow the individual mirror strips were. Furthermore, if it is considered that the individual mirror surfaces must be very exactly adjusted, it is easy to imagine the great difficulties of manufacture; suitable means have, however, been found to make the adjustment more easy.

A brief description of the system may be justified. On a vertically-revolving shaft, thin metal plates are arranged, in order, in the form of a winding staircase. The narrow perpendicular edges of the "steps" are polished most brilliantly, so that they act as "mirrors". Each of these edges reflects a small bit of the filament of a special glow-lamp, which is fed by the television currents, and gives, with the rotation of the mirror screw, a line of light across the frame. Since the mirrors are arranged at equal angles to one another, the light lines are produced in regular succession. The advantage of the mirror screw lies in the size of the original pictures obtainable with small dimensions of the whole television set, which is due to the fact that the size of the set is quite independent of the number of mirrors or pictorial lines.

A further advantage is the efficient utilization of the light of the glow tube; so that one conveniently gets along with glow-tubes which can be fed by normal power output tubes, hence requiring no additional amplifier. The pictorial brightness shown at the exposition was so great, that one could observe the pictures comfortably in a lighted room.

As compared with the Nipkow disc, the "mirrow-screw" set has the advantage that one is not obliged to look at the picture from any definite direction; for there is no need of an enlarging lens, such as the Nipkow discs require.



A close-up view of the "neck" of the von Ardenne cathode ray scanner tube for television, which was exhibited at the German Radio Exhibition. Note the space-charge cylinder at the extreme right; in front of this the anode, followed by the two condenser systems used for horizontal and vertical deflection of the electron stream.

Cathode Ray Receiver and Transmitter

Furthermore, there was great interest in the television receiver of the D. S. Loewe Radio Co., developed by Baron Manfred von Ardenne. As is well-known, this receiver operates with the Braun cathode-ray tube as a scanner. In contrast to all other Braun tube scanners, the apparatus devised by von Ardenne possesses enormous image brilliancy, coupled with great clarity of the reproduced pictures; due principally to a suitable luminous layer and also to the very high anode potential of 4,000 volts, and to the very smooth operating control of the pictorial elements' intensity.

TELEVISION
at the
New York Radio Show
In the Next Issue

It is especially noteworthy that M. von Ardenne likewise exhibited and used as a television transmitter, one utilizing a Braun (cathode-ray) tube, probably the first of this kind. The advantage of this new type of transmitter lies especially in the fact that it is extraordinarily simple, and particularly suits the Braun-tube receiver, with regard to the synchronization between pictorial-line frequency and pictorial-alternation frequency.

The von Ardenne cathode-ray transmitter operates as follows: on the luminous surface of a Braun tube are described horizontal lines of light, whose number and frequency must agree with those at the receiving end. These lines of light are projected upon the film to be transmitted, by means of an optical (lens) system. The number of "frames" of the film must, of course, agree absolutely with the number of pictorial changes of the light lines on the Braun tube. This is effected by an electric contact on the film projector. The light penetrating the film is directed upon a photo-cell, whose currents are amplified by an amplifier which is distortionless up to one million cycles.

How von Ardenne Improved Braun Tube

The receiving tube of von Ardenne differs from the transmitting tube, in that the electron stream, illuminating the luminous screen, is still influenced in its intensity by the television currents which come from the transmitter. Modulating the electron stream in its strength has caused many headaches for television inventors experimenting with the Braun tube. M. von Ardenne has solved the problem by surrounding the filament of the Braun tube with a cylinder, applying a negative potential to this cylinder, and conducting the television signal voltages on the one hand to the filament, on the other to the cylinder.

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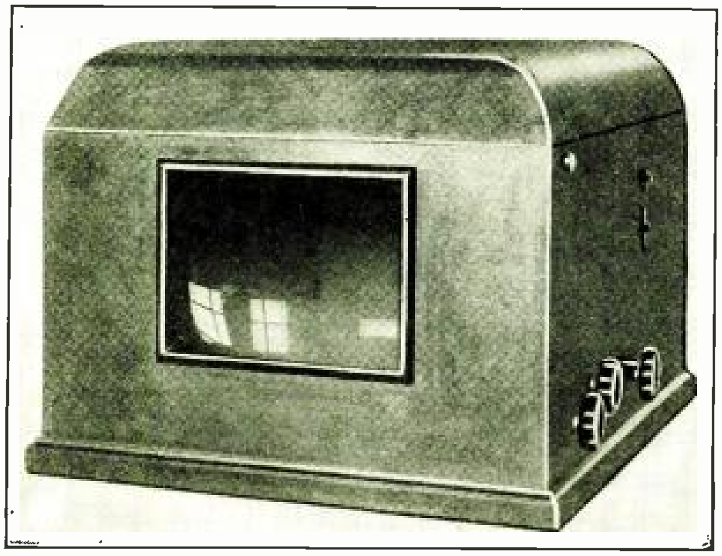


Braun tube television receiver complete, as developed by von Ardenne. The knobs at the side are turned to adjust the image sharpness and the pictorial change frequency, which are produced by adjusting the voltages applied to the apparatus.

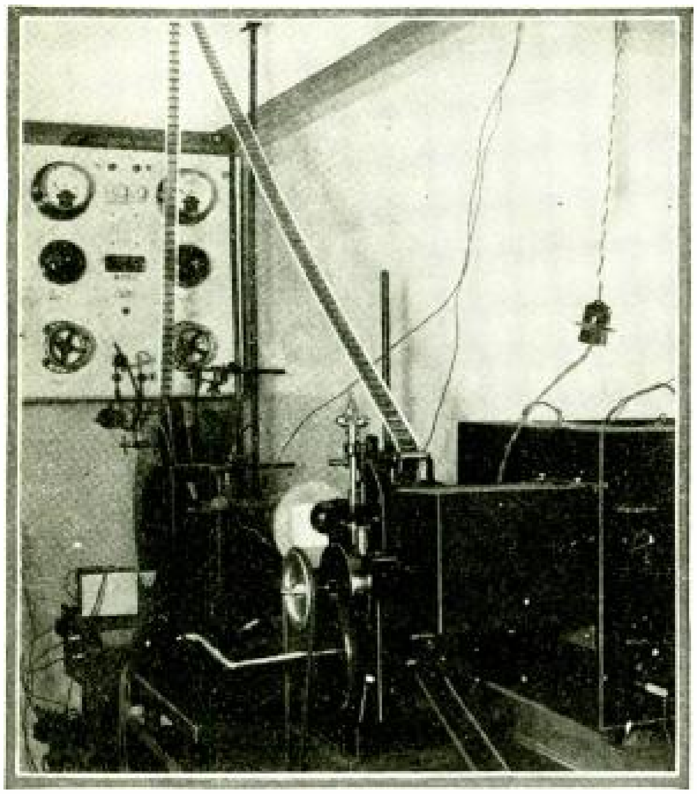


Fig. 1—Cathode ray tube set up for the transmission of "movie" film images.

YES—Europe Sees Images *With* Cathode Ray Tubes!

By BARON MANFRED VON ARDENNE

Europe has taken the lead in the development and demonstration of cathode ray tube scanners for both transmitting and receiving television images, due principally to the researches of Baron von Ardenne. Cathode ray scanners were shown at the Berlin radio show.

IN a former article in this publication the writer reported on successful transmissions by television, in which both transmitter and receiver operated with cathode ray tubes. In a scientific study of this subject published in the interim,* the essential details of the method has been presented and discussed at length. By new work, especially energetically carried on and performed with the assistance of the Loewe Radio Co. (Germany), it has been possible to realize further essential improvements in the quality of the pictures transmitted.

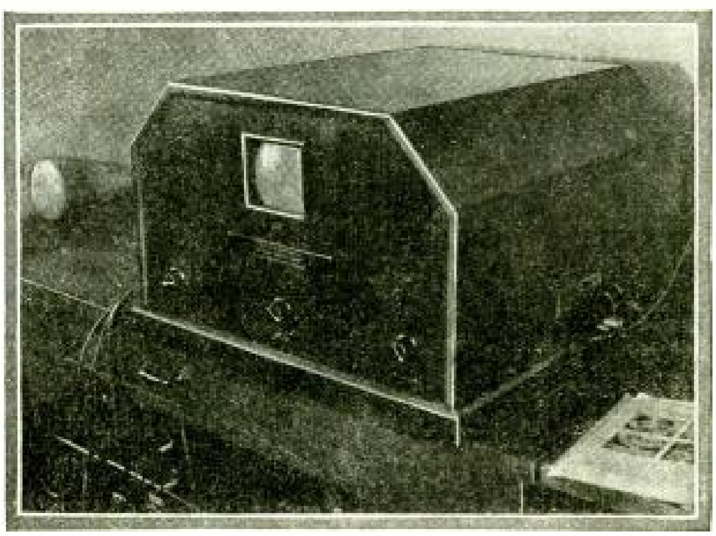
Improvements Attained

The progress attained, which appears most clearly from a comparison of the photographic copies of the fluorescent screen pictures, is the result of a great number of individual items of progress: improvements in the transmitting tube and, in particular, a further reduction of the inertia of the screen; improvements in the optical apparatus; the use of more sensitive photo-cells; and finally the design of amplifiers of still higher frequency-range, enter into the collective progress at the sending end.

Progress at the receiving end is centered mainly in further improvement of the light modulation, which now operates in a practically ideal manner. The need of the improvements mentioned and the degree of improvement attained was determined and judged almost exclusively by measurements. Without going further into the details of the advances, which would be of interest only to specialists in this field, I shall take up the picture qualities attained and attainable.

Fig. 3 — Excellent photograph of a typical image as reproduced on the target of German cathode ray scanner.

Fig. 2—Cathode ray tube scanner for reception of television images, as built by the Loewe Radio Co., of Germany, and exhibited at the recent radio show in Berlin.



The Transmitter

The transmitting apparatus, which is arranged at will for sending continuous films or stationary film pictures, is shown in Fig. 1. At the left in the background is the Braun (cathode-ray) tube arranged with its associated apparatus. On the fluorescent screen, photographed in operation, may be recognized the luminous rectangle, which is sharply reproduced on the film, via the optical system. Behind the mechanical apparatus for carrying the film, in the extreme foreground, may be recognized the box for the photo-cell and the first stage of amplification, which is fastened to the main amplifier.

From the transmitting end, the different frequencies for "synchronizing" and "light modulation" reach the

* M. von Ardenne: Ueber neue Fernsehsender und Fernsehempfänger mit Kathodenstrahlröhren—"New Television Senders and Receivers With Cathode Ray Tubes"—published in "*Fernsehen*", No. 2, 1931.

receiver over wires. At any rate, with the use of ultra-short waves as carriers, there is no difficulty confronting us in the transmission of these frequencies; so that it is perfectly sufficient to perform the television experiments in the laboratory in the manner indicated.

The Cathode Ray Receiver

The receiver used today is represented in Fig. 2. In an opening of the housing the fluorescent screen of the cathode-ray tube is to be seen. At this point the picture appears and, with this arrangement, it is, of course, viewed from the outside. The pictures reproduced herewith were obtained by photographing the screen picture from the outside. The different parts for operating the tube are inside the box which, with its evident size, offers also space enough to receive the television amplifier (for reception) and the sound receiver, with even the loud speaker and transformer connections, if desired.

Pictures of Images Received

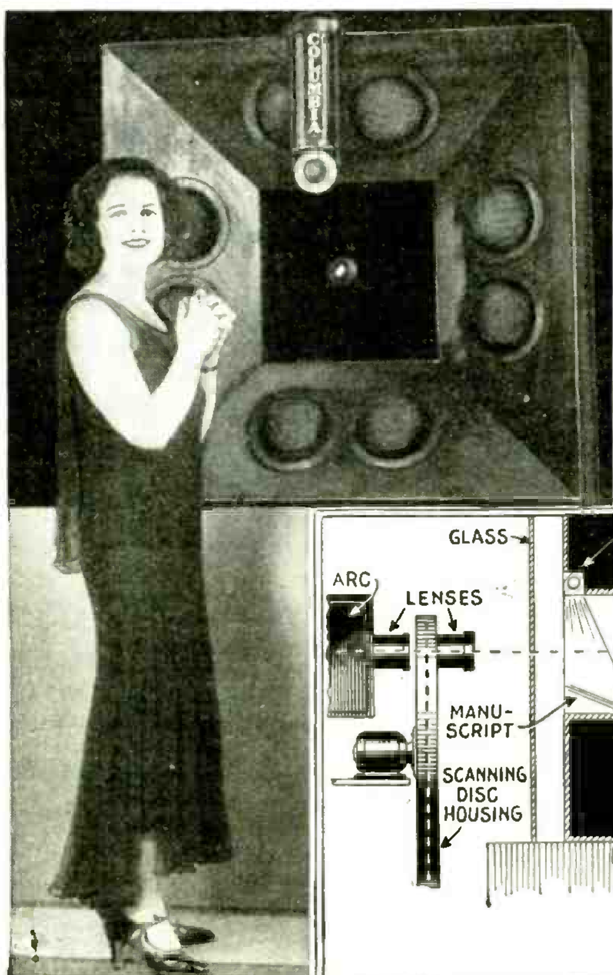
Two recent pictures, obtained with the illustrated apparatus in the laboratory of the writer, are shown in Figs. 3 and 4. Of course these pictures are not retouched. If one compares the reproduced images with ordinary pictures, it will be recognized that they possess a richness of detail corresponding to about 9,000 pictorial elements. In Braun-tube television, with changeability of line and picture frequency, and the possibility of mutual covering of the controlled light points, practically nothing but a comparison with ordinary pictures seems suitable as a basis of judgment. In both (on the original prints) pictures one can plainly see under the eye of the right head the familiar beauty spot (court plaster). The pictorial quality actually present when the photographs were taken was, with the continuously-adjusted framing rate of 26, considerably better than appears in the pictures; *i.e.*, it amounted to about 10,000 to 12,000 pictorial elements per picture. The difference is due to the fact that, in the course of the illumination, through disturbances in the power-packs, the A.C. heating, etc., small distortions of the pictures set in. These, however, do not disturb the eye, so long as they do not exceed the size of one pictorial element diameter. In the process of photographic fixation, on the other hand, even the above mentioned small distortion suffices to reduce the sharpness considerably.

Fig. 4—Another photo of a television image as built up on the target end of a cathode ray scanner, as perfected by the author.

Present Limitations

Today the limitation of the pictorial quality, in the cathode ray televisor, lies chiefly at the transmitting end. The receiving end, which also furnished the Braun-tube "image pictures" 3 and 4, is today so far developed that, right now, 20,000 to 30,000 pictorial elements per picture would be possible, if a transmitter were available with this frequency-range, which is only a matter of time.

"Behind the Scenes" in a Television Studio



THE three accompanying pictures are interesting in that they show several angles of television broadcasting, with which the public is not familiar. The photo at the left shows Miss Helen Choat, popular Broadway actress, who recently gave a series of dramatic readings over the Columbia station W2XAB (voice broadcast) over W2XE. Note how the microphone is placed above the speaker; in actual use it is folded back against the sloping photo-cell panel. The center picture shows how speakers read their talks while being televised. The manuscript is placed at such an angle that the speaker's

Scenes herewith show television studio of Columbia Broadcasting System: Left—Miss Helen Choat, Broadway actress. Below—How speakers and singers perform in television studio.

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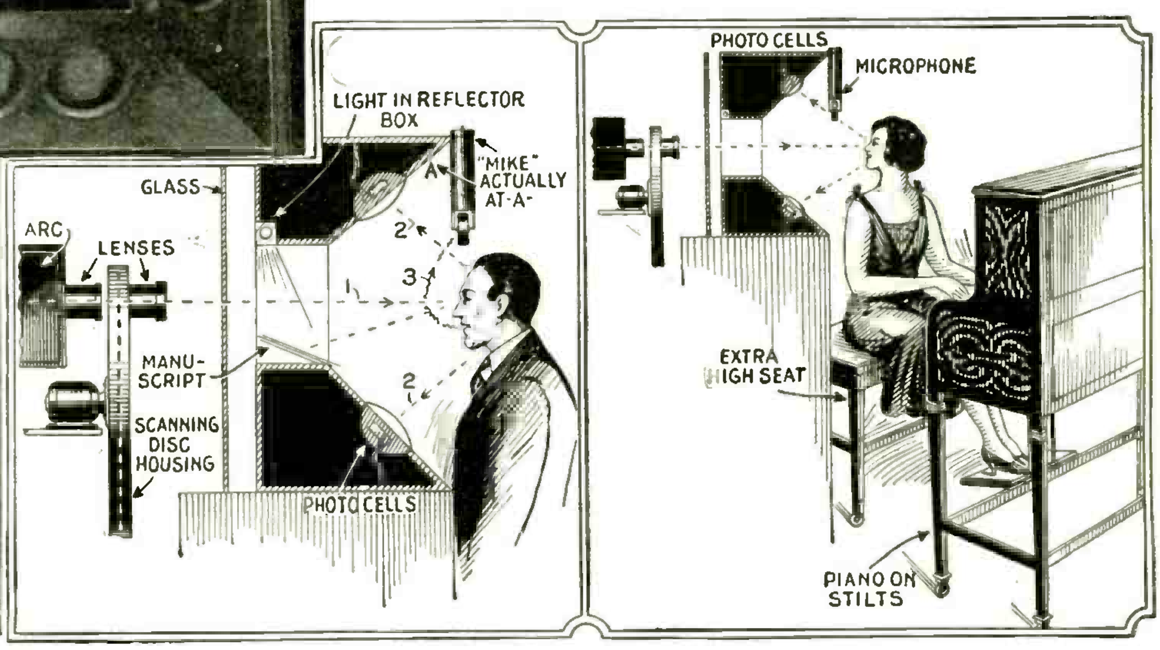
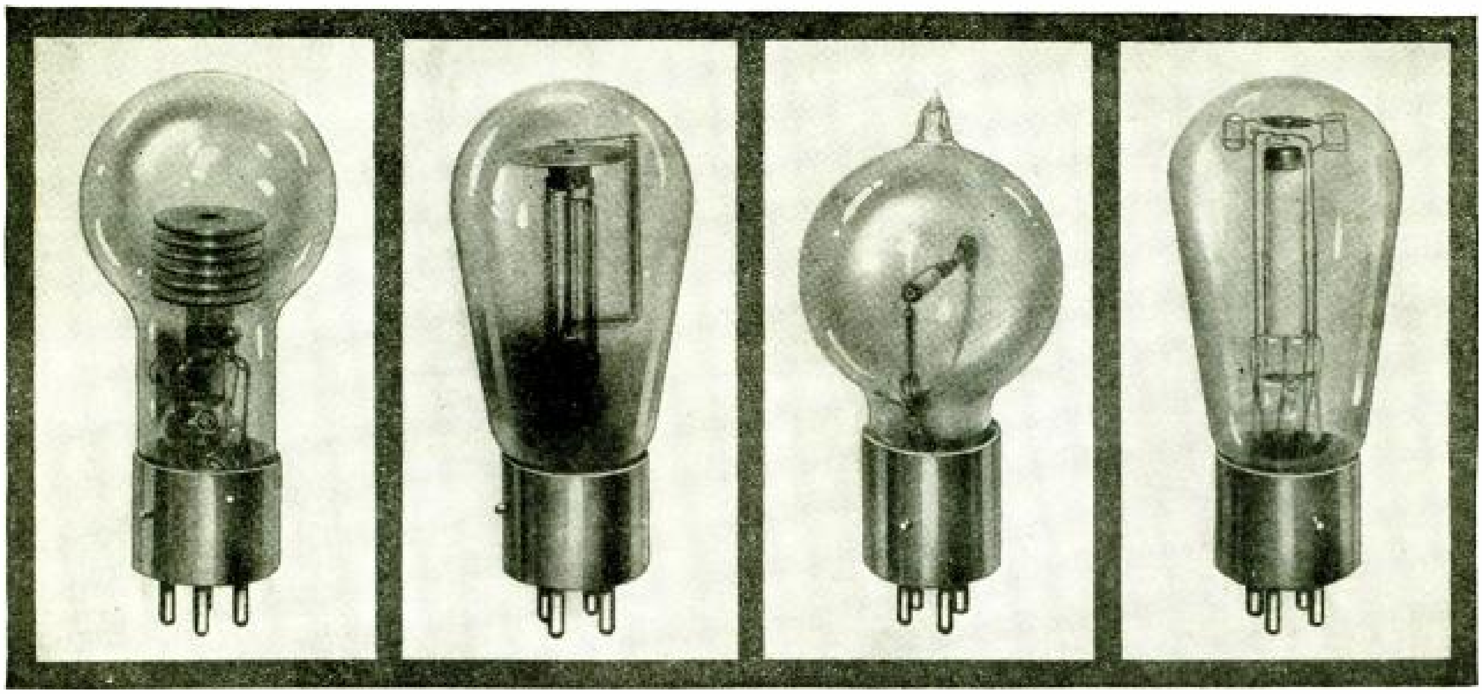




The photograph above shows several different styles of "neon crater" tubes: Fig. 2 at the extreme left shows an air-cooled crater tube, with fins on the cathode to help dissipate the heat: the tube next to that has a large cathode plate and is viewed end-on; the third crater tube shown is viewed from the side, while the tube at the extreme right is viewed from the end. The feature of all crater tubes is to obtain a highly concentrated discharge in a small area, so as to have a bright point of light, instead of a widely diffused light.

THE CRATER TUBE

By D. E. REPLOGLE*

Specially Prepared for TELEVISION NEWS

What is a crater tube? How does it differ from the usual flat-plate neon tube? How much current is required to operate a crater tube? These and other vital questions on the newest television scanner tube are here answered by an eminent authority.

EARLY in the development of television, it became apparent that the light source is the "bottle neck" through which the results of a television receiver must pass. Since the very beginnings of the art, we have been searching for a light-source that will respond to the high frequencies that light transmission demands, and at the same time give sufficient illumination for the production of pictures. Until just recently, the best that the lamp art had to offer was the so-called *flat-plate neon glow-lamp*, which is now well known to the television experimenter. While the present glow-lamp works well for the purposes of the amateur enthusiast, who is satisfied with the very thought of actually reproducing living images by radio, we must realize that the ultimate judge of the television image will be Mr. Layman, a hundred million strong, who is interested in "entertainment"; and the Mr. Layman will require that his sight reception be at least comparable with the early motion pictures. That ultimate criticism sooner or later standing in our path, it is apparent that we must develop a better light-source as the next step in improving the television image. Why the flat-plate glow-lamp will not lend itself to our requirements can be easily explained.

* *Vice-President, Jenkins Television Corp.*

Inefficiency of Flat-Plate Neon Tube

It is obvious that, if we are transmitting square elements at a frame ratio of 5 by 6, only 1/4,320 of the light available on the neon lamp is observable at any instant. In film scanning, and in our later "direct film pick-up", however, the assumption of square elements is incorrect, since our *horizontal resolution* may be from three to five times as great as our *vertical resolution*. Therefore, only 1/17,280 of the actual light on the plate is usable! And even this calculation is based on the assumption that we are covering the whole of the plate with the scanned area.

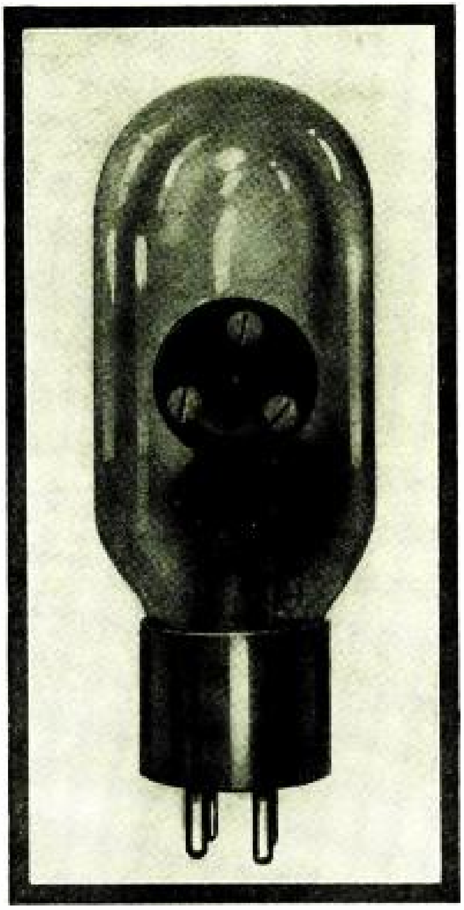
We can readily deduce, from the above situation, that any method which can be devised to utilize the whole glow, of a gaseous source, will result in an enormous increase in illumination of the picture. By its means we could use a projected image thrown on to a translucent screen; we could increase the number of lines per frame for better detail—in short, we would transfer the "bottle neck" of television from the light source, to some other factor in the chain, with a consequent improvement in the resulting pictures. To be more concise, if we could concentrate the light, which we now spread out over the entire surface of the square plate, we could use *all* of it at each hole of the scanner, instead of the very small fraction that now finds its way through the lens.

These facts and their natural deductions have led engineers (who know that in most gaseous types of tube the illumination is, roughly, proportional to the current through the tube) to attempt to develop a tube in which a highly-brilliant, concentrated point of light can be obtained, with a reasonable amount of current, such as from 30 to 150 milliamperes. It was important to preserve the linear increase in illumination with current, that has been developed in the plate type of lamp. The characteristics necessary are that each small increase in current shall provide a constant increase in illumination with faithfulness of modulation; *i.e.*, that the rapidly varying current necessary to television, which may be as high as 40,000 cycles, shall produce no distortion. This last characteristic (*i.e.*, response to high frequencies) has limited our television mostly to gas-discharge devices.

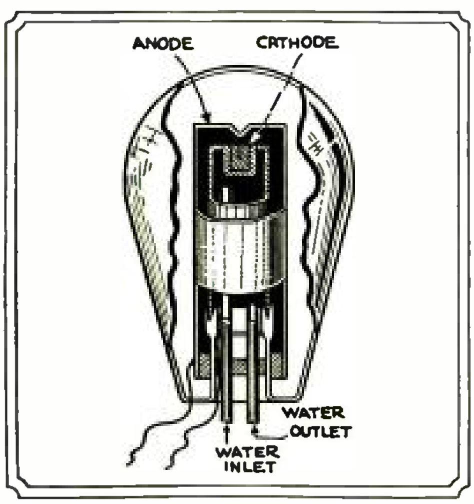
A great number of possibilities for securing a bright projected picture present themselves, the minute we have developed a satisfactory "point source" of light, which can be modulated without distortion. By the use of a scanning disc, we may use each hole of the disc as a "pin-hole" camera; and, by the use of suitable lenses, this brilliant point of light can be projected and caused to scan the picture on the screen. It is also possible to use vibrating mirrors to reflect the image of this source in a scanning cycle. It is also possible to use prismatic discs, such as were first used by C. Francis Jenkins, in his early motion-picture projectors. Resort may also be taken to mirror drums, mirror discs, and mechanisms of various forms to cause the light to be projected in a scanning cycle on a screen, translucent shade or what not.

However, thus far, the most simple and satisfactory method to be developed is to use a disc which, instead of the usual pinholes in its periphery, has lenses correctly designed and of proper focal length to fit into the desired system. With this "lens-disc" and the latest, most efficient and successful "point-source" of light, it has already been possible to scan with good illumination a received image of ten square feet!

The neon lamp glows because, in the presence of a sufficient potential gradient, the atoms of gas break down and give up one or more electrons, which travel against the potential and cause the current flow. In their migration through the atoms of the gas, they collide with other atoms and cause those to vibrate at light frequencies. This collision is strongest near the plate and causes what we will term a "glow discharge" in the gas.



Latest type of neon crater tube.



Sectional view of water-cooled neon crater tube.

It has been found that, by increasing the number of molecules in the tube (or, in other words, increasing the gas pressure), this discharge is made to cling closer to the negative electrode; although the potential gradient necessary for "ionization", which the above process is called, must be created.

Another important fact, which enters into the design of the tube, is the point where ionization occurs. The potential drop at that point in the gas, or the resistance to the flow of current, is much less; which tends to concentrate the flow through the gas at the point of least resistance. Still another interesting fact about gas-discharge devices is that, wherever a gas is confined by solid boundaries, such as a crack or crevice in an electrode, ionization will become much more intense; and the light will be much more intense if the discharge can be confined to that part of the electrode.

With these facts in mind, the early experimenters set out to produce a "point-source" of light from a gas-discharge tube. The early work took the form of a small hole bored in the negative electrode of the tube, with an anode surrounding this hole; so that the potential gradient would be even all around the hole. It was possible then to concentrate the flow of current through the electrode, through the gas in the hole, and a very intense light was achieved. This was transformed into heat with the result that, where light was brightest, the heat was greatest; which led to the melting or sputtering of the metallic electrode. This darkened the tube and shortened its useful life considerably.

All this led the experimenters to enlarge the negative electrode for better absorbing the heat, and reradiating it through the walls of the tube.

Figure No. 2 shows this early type of tube. In this will be noted the ring anode which is positive, and the large metallic negative electrode, with its radiating fins to dissipate heat. In the center can be seen the small hole in which the intense glow occurs. If all the voltage gradients are symmetrical in the tube, and the material in the electrodes is homogeneous, the discharge will concentrate itself in the small hole. These factors, however, are difficult to keep constant in production; and other means have been developed to insure the concentration on the discharge at the proper point.

It has been found that oxides of barium, strontium, calcium and the like have the property of emitting electrons, even at comparatively low temperatures. So the next step was to coat the inside of the small hole with a proper mixture of these oxides. This made the concentration of the discharge extremely simple, and permitted the research men to concentrate their efforts on the dissipation of the heat from the enlarged negative electrode (cathode).

The next step was to make a "water-cooled" electrode, and various types of these tubes have been developed. It was then found possible to put very high current through these tubes, without destroying them, and to secure an extremely intense light. The water-cooled arrangement has, however, proved impractical, and it is

(*Continued on page* 391)

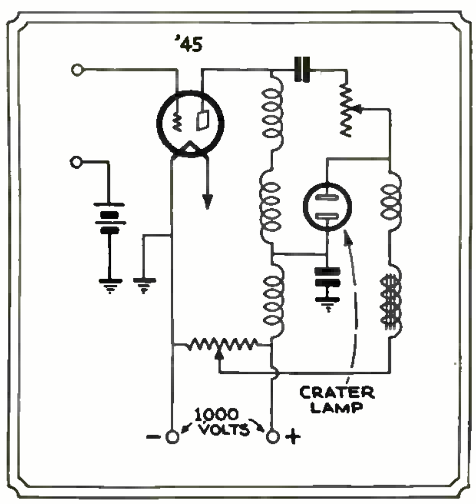


Diagram of connections used with crater tube.

THIS OUTFIT RECEIVES RADIO MOVIES 1000 Miles

By RAYMOND STEPHENS

The author describes a simple and inexpensive television receiver, which enabled him to pick up Washington, D. C., images at Davenport, Ia.

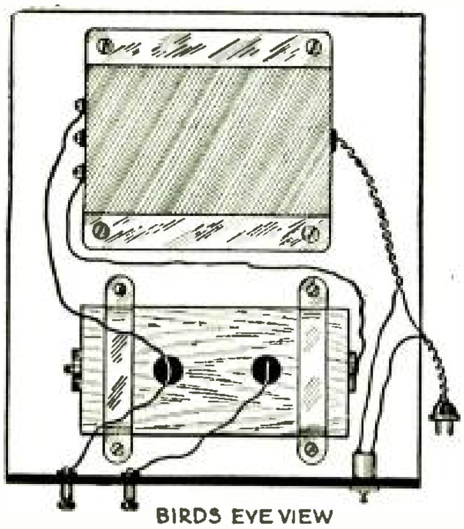


Fig. 3 above shows top view of Ford spark coil and step-down transformer.

THE attachment that I used on my one-tube short wave receiver for seeing pictures from Washington, D. C., is very simple. The pictures received at Davenport, Iowa, by using that small piece of apparatus are fairly good. Now, here's the dope:

Parts Needed for the Attachment:

One filament transformer (Sec. voltage 2.5—3)	$3.00
One Ford spark coil	1.15
One A.C. switch	.25
One 3x7-inch hard rubber panel.	.15
One 7x10-inch wooden baseboard	.10
Eight ½-inch wood-screws (brass preferred)	.05
Two ¾-inch wood-screws (brass preferred)	.01
Two binding posts (brass, nickel-plated)	.05
TOTAL	$4.76

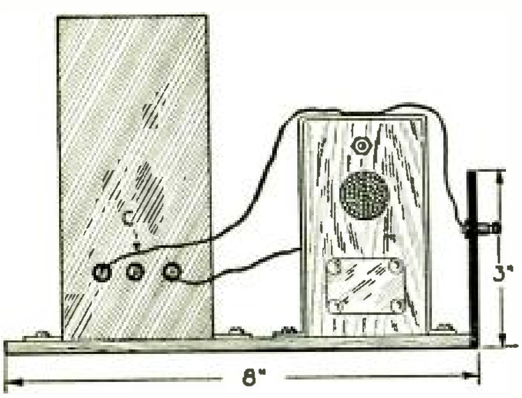


Fig. 2 above end view of Ford spark coil and transformer assembly.

The cost is only approximate; the experimenter may have a few or all of these parts in his work-shop.

The hook-up of the attachment is shown in Fig. 1 at the right.

The hook up of the short wave receiver used appears at the left. The parts used are as follows:

One 3-circuit tuner form, rewound for short wave reception
One .0005-mf. variable condenser
One UY tube socket

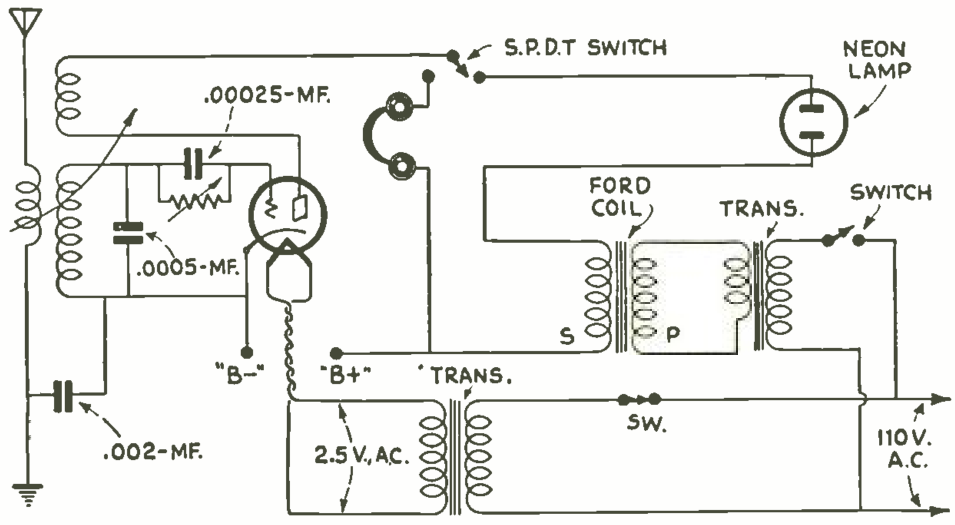


Fig. 1—Wiring diagram of Mr. Stephens simple television receiving circuit, with which he claims to have received television images transmitted from Washington, D. C. "W3XK," at his station in Davenport, Ia.

One 7" x 14" panel
One 8" x 13" baseboard
Two Pilot art dials
One Bradley grid leak (variable)
One .00025-mf. grid condenser
Two cord tip-jacks for phones
Four binding posts
One binding post strip, with four holes
One S.P.D.T. switch
One A.C. switch
One 227 detector tube
Two 45-volt "B" batteries
One .002-mf. fixed condenser

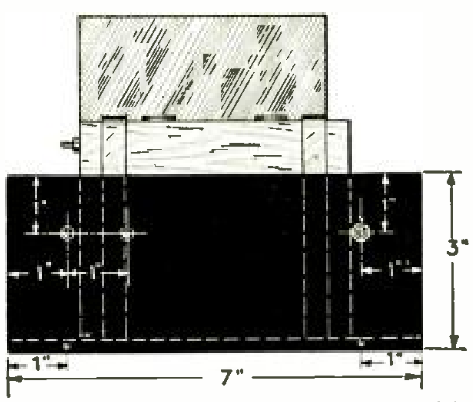


Fig. 4, above, shows terminal panel with Ford coil and transformer behind it.

The coil of the short wave receiver is wound as follows: Primary, 6 turns No. 18 D. C. C. wire; secondary, 10 turns, No. 18 D. C. C. wire; tickler, 8 turns, No. 18 D. C. C. wire.

Assembly of the Televisor

Now back to the construction of the attachment:

Take off the Ford spark coil vibrator. Mount the coil on the baseboard, using strips of aluminum or brass 3/8"x1/16"x10". The coil is mounted on the baseboard, 1 inch from the panel and running parallel with it. (See Fig. 2.) The filament transformer is mounted in back of this in any convenient position. Mount the panel on the baseboard, using the two ¾" wood screws to hold it in place. At the front, left side, mount the two binding posts, one inch from the top edge and side. On the right side, mount the A.C. switch one inch from each edge (top and side).

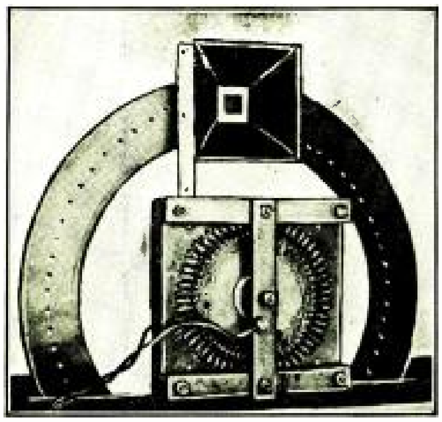
The wiring is now to be started. It is best to use No. 18 or No. 14 D.C. wire. From the 2.5-volt terminals of the filament transformer, run one lead to the bottom terminal of

(*Continued on page* 390)

BUILDING A 1200 Cycle SYNCHRONOUS MOTOR

By KENNETH E. SHERMAN

Complete instructions are here given so that any one in the least familiar with mechanical or electrical work can build for themselves a 1,200-cycle synchronous motor. The field winding is supplied with direct current from a 6-volt storage-battery or other source.



1,200-cycle synchronous motor is here shown driving Mr. Sherman's scanning disc, the image visor being seen at the top of the picture.

IN localities where a synchronous scanning disc motor cannot be operated from the 110-volt lighting circuit, synchronizing the receiving scanner is something of a problem. Even where alternating current of the same frequency as that used at the transmitter is available, it is only when the transmitter and receiver are supplied by the same power company (or companies whose lines are interconnected), that this system of synchronizing is satisfactory. After trying various mechanical and electrical speed controlling devices, the following system was worked out.

A small universal motor (A.C. and D.C. 110-volt type; usually series-wound), operated from the 110-volt lighting circuit, is belted to the scanning disc's shaft, and furnishes the power for driving the disc. A synchronous motor, having 120 poles, is coupled directly to the shaft, and supplied with about 15 watts of A.C. from a 1200-cycle oscillator. When the scanning disc attains a speed of 1200 R.P.M., the synchronous motor "falls in step" with the oscillator and holds the disc at this speed; thus insuring the proper initial scanning speed. The oscillator is coupled to the image amplifier in such a way that, during reception, the oscillator falls in step with the 1200-cycle component of the transmitted signal. In this way "automatic synchronization" is maintained.

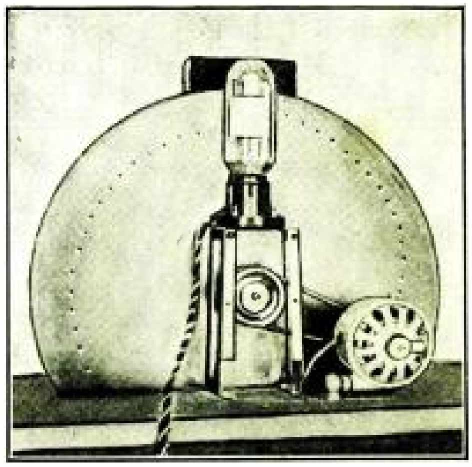
The 1,200-Cycle Oscillator

The details of the oscillator and its associated amplifier are shown in Fig. 1. This type of oscillator, known as the *dynatron*, was chosen for its inherent stability. The only thing that will seriously affect the frequency of this oscillator (assuming constant capacity and inductance) is a change in plate or screen-grid voltage. For this reason we must have a nearly constant voltage at the points marked "+ 22" and "+ 67." In the writer's opinion, there is nothing better suited to this purpose than a good fresh dry "B" battery.

The dynatron characteristic of '24 tubes varies somewhat; that is, different tubes may require slightly different plate or screen-grid voltages to maintain stable oscillation. This is easily provided for by connecting one or two 4½-volt "C" batteries, in the plate or the screen-grid lead, as may be required.

The coil L1 and the condensers C1 and C2 form the oscillating circuit. L1 is the secondary of a Ford spark coil, with the primary and the core removed. These coils vary somewhat but, when shunted with a capacity of .06-mf., they resonate somewhere near 1200 cycles. The one used oscillated at about 1220 cycles, when shunted with a capacity of .06-mf., C2 in Fig. 1. C1 is a .0005-mf. variable condenser and adjusts the circuit to the exact frequency. L2 is a small filter choke of the kind used in "B" supplies. The amount of inductance used here is not critical, but the choke should resonate somewhere near 1200 cycles.

T1 is an ordinary push-pull audio transformer. Probably greater grid excitation could be obtained for the output stage by using a resonant circuit here, but still larger tubes would be necessary to gain anything by it. '10s were used in the push-pull stage for reasons of convenience, but '45s could be used as well.



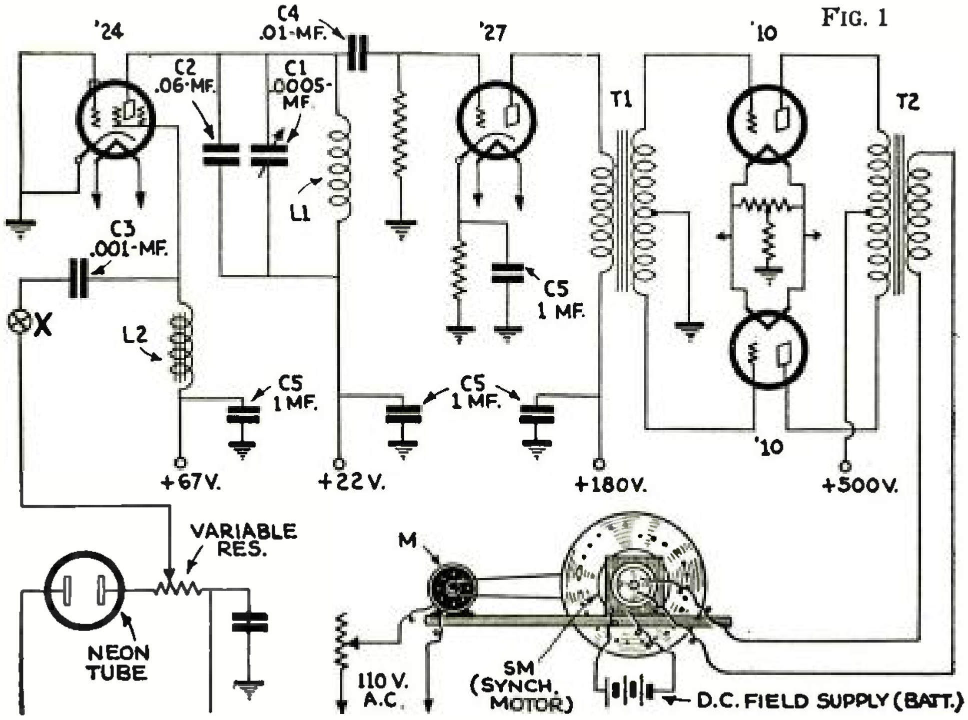
Rear view of Mr. Sherman's scanner, showing universal "power" motor driving scanning disc.

The transformer T2 is similar to the choke L2, with the addition of a center tap and a secondary of 75 turns of No. 12 D.C.C. magnet wire wound over the outside of the original winding.

The 1,200-Cycle Synchronous Motor

The synchronous motor (details of which are shown in Fig. 2 and 3) is similar in some respects to a phonic wheel. The armature has 120 slots, in which is the 1200-cycle winding. The field has the same number of slots, and is supplied with direct current from a storage battery. The armature and the field member are built up of thin pieces of soft iron. It is not necessary for the stator piece to be laminated in this case, as its winding carries only direct current; but this construction was convenient. The iron was first cut into pieces 7 inches square, enough to make a stack about ⅝-inch high. Each piece was

FIG. 1



Wiring diagram of 1,200-cycle oscillator, used with synchronous motor designed and built by Mr. Sherman.

then carefully centered and screwed to a face plate in a lathe; using a fine sharp tool, a 5 1/16-inch circular piece was cut out of each, using care not to make the cut too wide.

The stator pieces, B, were then drilled for small rivets and riveted securely together; after which the inside surface was filed down smooth. The circular pieces A for the rotor were bolted together temporarily with three bolts near the outside edge, and drilled through the center for a ⅜-inch shaft.

Truing Up Rotor and Cutting Slots

The assembled rotor was then placed in a lathe and trimmed down just enough to remove the sharp edges and to insure its being perfectly round and free from humps. The lathe used happened to be equipped with a large circular pattern, marked out in degrees; which was very convenient for marking the location of the slots on both the rotor and stator. The slots were sawed with a power saw, using a blade 1/16-inch thick, to a depth of ¼-inch in the rotor and ½-inch in the stator. This leaves the teeth slightly over 1/16-inch thick. The exact thickness of the teeth and slots is not important; *but they must be accurately spaced and of the correct number,* 120.

Motor Windings

Both the stator and rotor are wound with No. 21 D.C.C. magnet wire. The slots are insulated with varnished cambric, to prevent the sharp corners cutting through the insulation on the wire. The winding is put on in zigzag fashion—that is, over in one slot and back in the next, and so on around until the slots are filled. There are 6 turns in each slot on the rotor and 12 on the stator.

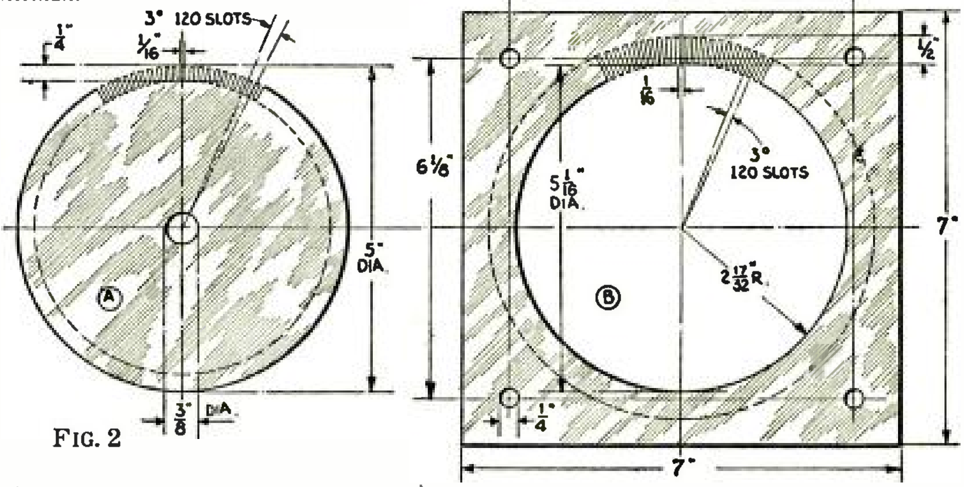


FIG. 2

Details and dimensions of 1,200-cycle synchronous motor, stator and rotor.

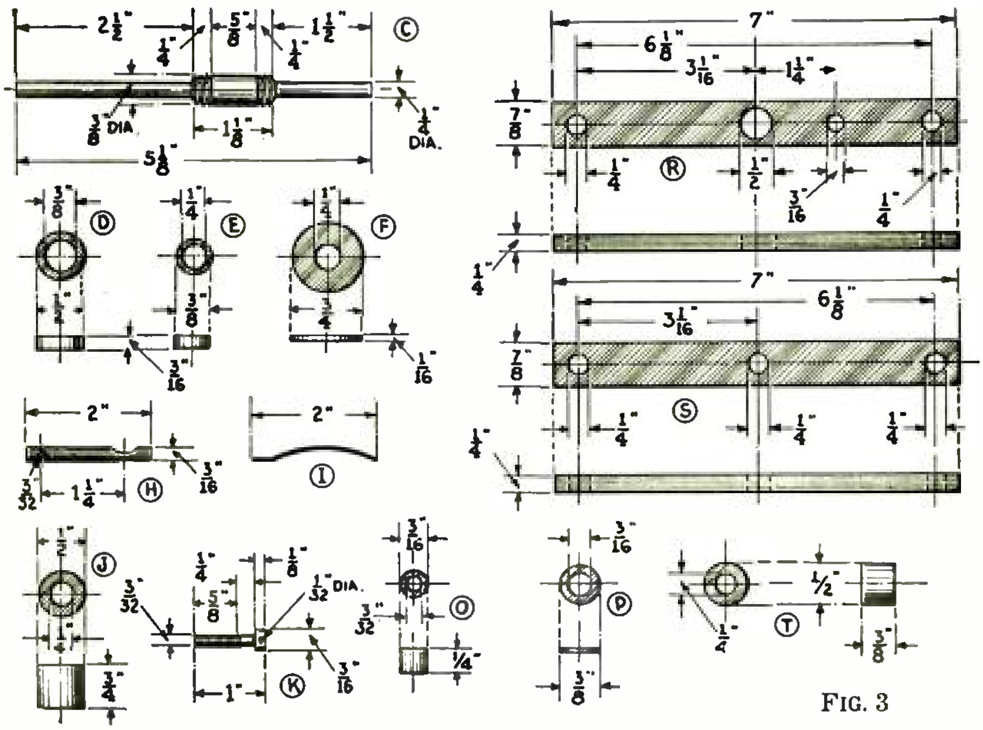


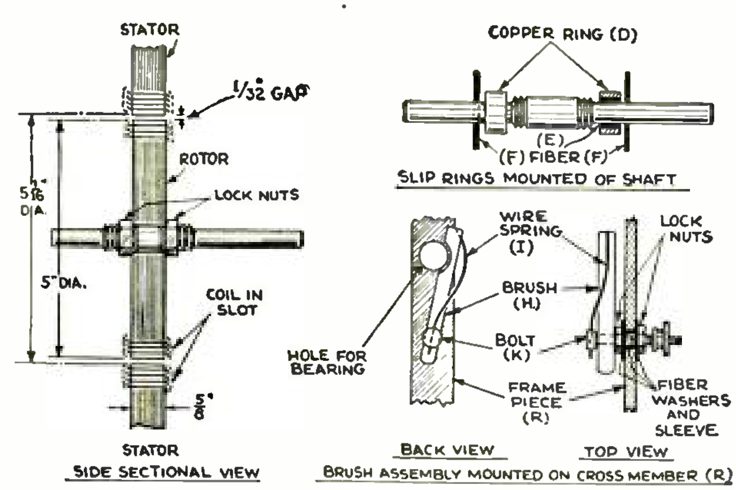
FIG. 3

Details of 1,200-cycle synchronous motor here described by Mr. Sherman.

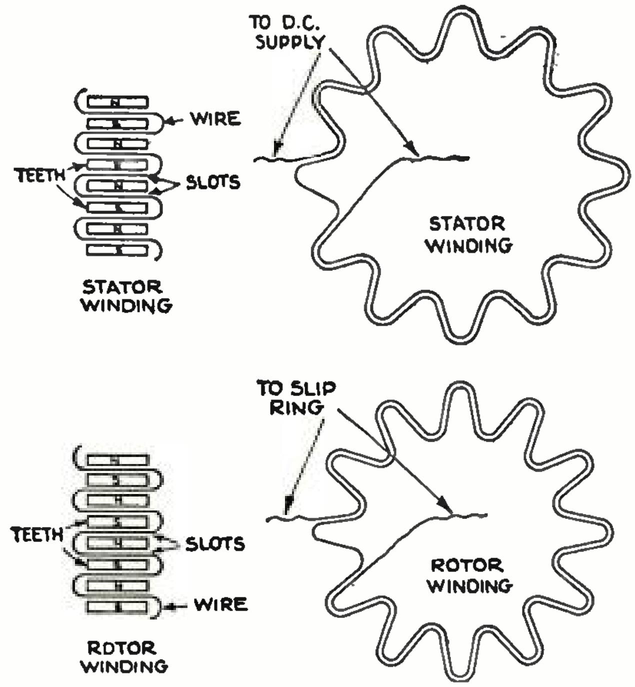
The shaft C was turned out of a piece of cold rolled steel. The rotor is held in place between the threaded portions of the shaft by means of two ordinary ⅜-inch hex nuts.

The copper ring D is driven over the fiber insulator E, and the whole driven on the shaft, nearly up to the ⅜-inch shoulder; followed by the fiber washer F. There are two of these assemblies, one on each side of the rotor.

There are four of the frame pieces S, mounted two on each side of the stator, with one of the spacers T under each end of each piece. The two cross members R support the rotor assembly by means of the brass bushings shown at J. These bushings are carefully fitted to the shaft and are made to drive loosely into the cross-members, to allow for any slight error in alignment.



Above: Side view of rotor and stator, showing position of rotor laminations on shaft; also details of brush construction.



Right: Wiring diagram showing, in simplified fashion, how rotor and stator coils are wound in slots.

Brush Assembly

The cross-members also hold the brush assemblies. The brush is held in place by the bolt K, which goes through the 3/16-inch hole in the cross member. The bolt is insulated from the cross member by means of the fiber sleeve O, and two fiber washers, P. Two nuts on this bolt, one on each side of the cross member, serve to adjust the position of the brush. The brushes, H in Fig. 3, are copper bars with a groove cut across one end to fit the slip rings. Opposite this groove on the same end is a small groove cut lengthwise in which rests the curved end of the wire spring I; the straight end of this spring goes through the small hole in the head of the bolt K. The slight tension required to hold the brush against the slip ring is obtained by turning the bolt until the brush is in place and the spring is bent slightly from the tension.

The field winding is supplied with direct current from a 6-volt storage battery. The resistance of this winding is slightly over one ohm; making the current drain about 5 amperes, which is not excessive for a medium sized battery.

The armature is fed with 1200-cycle current from the secondary of the transformer T2, shown in Fig. 1.

Operation Hints

To establish synchronism, for the first time, between the oscillator and synchronous motor, the connection marked X in Fig. 1 is connected temporarily to the grid of the first tube in the image amplifier. This produces a strong 1200-cycle modulation in the neon lamp, which shows in the viewing aperture (when synchronism is approached) as two vertical bands, one "dark" and one "light."

If the synchronous motor is functioning, these bands are very easily brought to rest by adjusting the control rheostat on the driving motor. "Hunting" is sometimes present in the synchronous motor, and causes the vertical bands to swing violently back and forth in the aperture. This is overcome by advancing the control rheostat until the driving motor takes the "slack" out of the synchronous motor. When the proper adjustment has been found, the control rheostat may be left permanently in this position.

To get the oscillator adjusted to 1200 cycles, the connection X is removed from the image amplifier and left free. A picture is tuned in and synchronized, using the oscillator tuning condenser C1 as the speed control. (The condenser must not be turned too quickly, for this would throw the synchronous motor out of step.) When the oscillator is adjusted so that the image drifts not more than one or two frames per second, the connection X may be made permanently to the output of the image amplifier, as shown in Fig. 1. After this about the only manual operation required is to frame the image vertically, at the beginning of reception and perhaps, adjust the oscillator tuning condenser slightly, after the tubes have become thoroughly warmed up.

An arrangement for rotating the frame of the synchronous motor could be easily worked out, and would considerably facilitate the framing operation.

A six-volt pilot lamp, connected across the brushes of the synchronous motor, indicates synchronism between the motor and oscillator. As synchronism is approached, the lamp blinks violently. The blinking gradually slows down until the motor falls in step; at which time the light brightens up and remains steady.

Another way in which this apparatus

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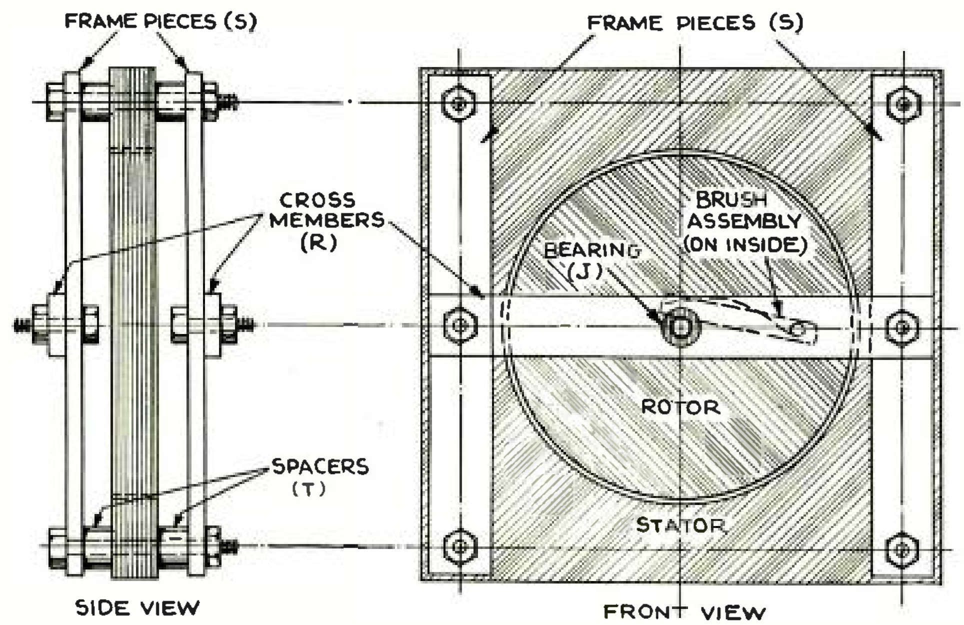


Assembly view of bearing brackets and brushes of 1,200-cycle synchronous motor.

The author in his home television laboratory. Here's the kind of photos we are looking for, so rush 'em along, all you Visualists! Pronto!

GETTING STARTED in TELEVISION

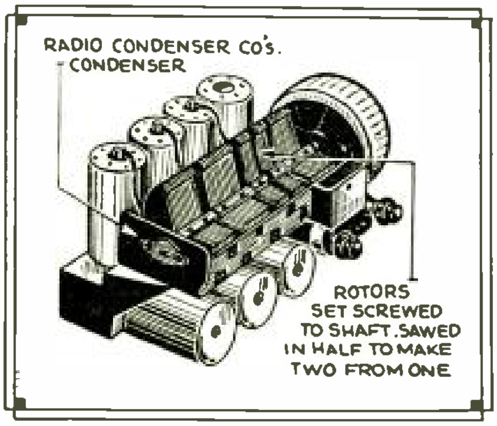
By EDWIN J. BACHMAN

Pleasant surprises experienced by a dyed-in-the-wool television experimenter. If you do not rush out and buy a television outfit after reading Mr. Bachman's article—we miss our guess!

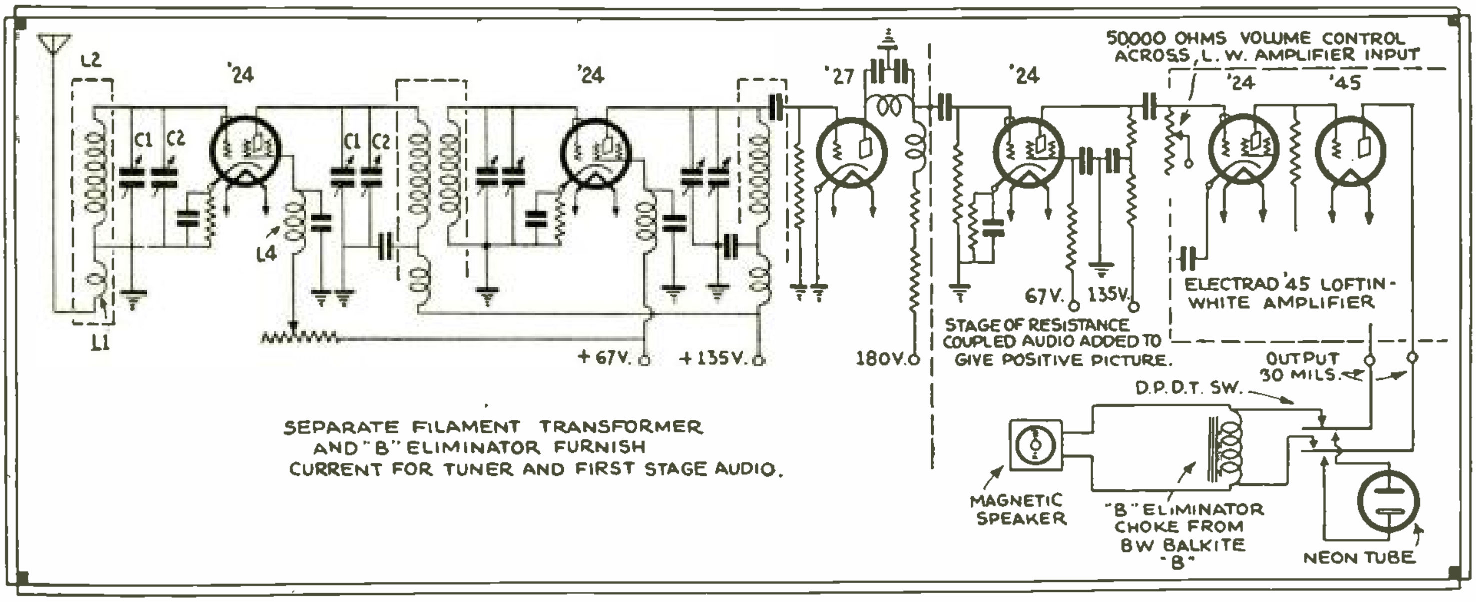
SOME day I will tell of my wild dream of seeing at a distance in 1912 when selenium was the retina and the tantalum or tungsten filament incandescent bulb, which lit and extinguished instantaneously (so we thought after years of association with carbon filaments) was our hope for modulated light. It did not materialize and nothing happened until 1930.

The Challenge—"Look In"!

Those signals that would almost "knock your ears off," coming in on a short-wave headphone set, with announcements ending up with "look in," became the challenge that made me do something about it.



Dismantling perfectly good electric fans; making scanning discs out of aluminum pie plates; adding a resistance-coupled amplifier to my regenerative short-wave receiver; discarding a 65-cent neon lamp for a regular Kino lamp; adding a stage of radio-frequency amplification to the short-wave receiver—and still not enough power to modulate the neon tube. Then two stages of radio-frequency amplification were used, and yet no pictures!



Wiring diagram of Mr. Bachman's television tuner and amplifier.

At this time I had a receiver with four individually tuned circuits, a panel on the front of the baseboard and one on the back with two variable condensers on each, and still I —well the signals were (or so it seemed) weaker than those heard on my first small headphone set. They were stronger, really, but they seemed weaker on the loud speaker than with headphones. Up to now I had in the way of television pictures the sum total of nothing. All that work done and nothing to show for it! If I had put larger dials on the condensers I would, at least, have had a little wagon.

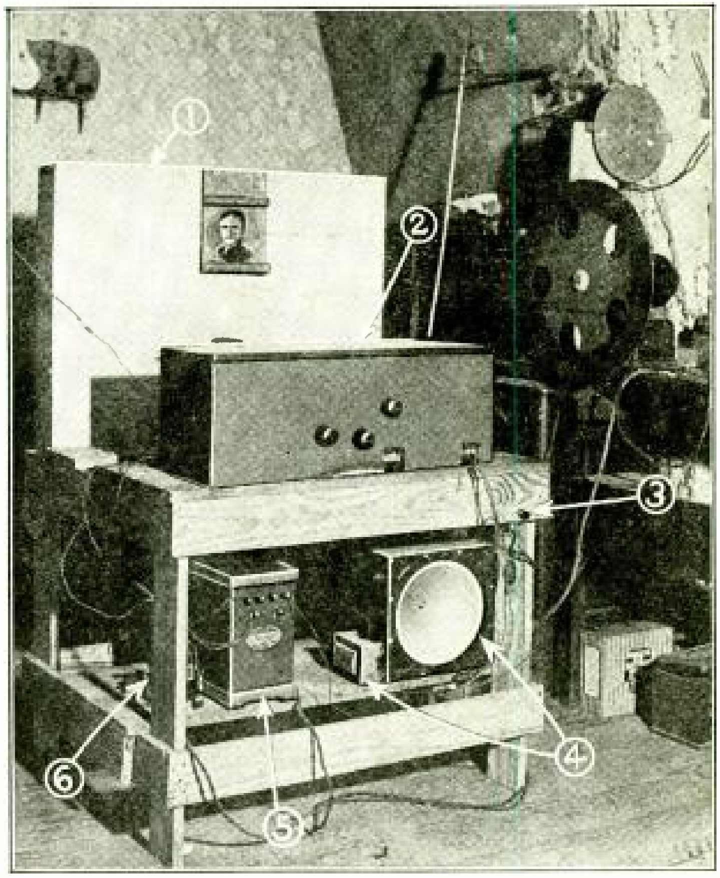
I Get Beautiful "Music" Patterns

I came to believe that, if one lived near enough to a television station, the receiver would have worked; for I could get beautiful geometric patterns on my televisor on the sound signal when I tuned in our local radio station, but they were not broadcasting television. Also, the television laboratories would have a larger market than they could supply for some time to come, right in the thickly-populated districts where they were located and serving strong signals to; so they did not need to bother about us "out here in the sticks."

I proceeded to cut down a compact four-condenser broadcast tuner to serve as my television receiver. I decided to make an A.C. set, in spite of advice to the contrary by writers on the subject; "B" batteries were too expensive. By the time I apparently had everything ready for a good test, the batteries had weakened so that their combined voltage was lower than the striking point of the neon tube.

What I Did for Condensers

I took the four-condenser gang apart and with a hacksaw cut two of them down to half their size. Two twelve-plate rotors were cut in half, giving me four six-plate rotors. The stators were treated the same way; only removing the center plate made two five-plate stators out of one eleven-plate assembly. The rotors originally had two set screws, leaving one in each half after they were cut. The cut-down stators were recentered in their respective compartments, and these were fastened without having to drill any holes. The coils were wound after specifications given by the Jenkins Laboratory for an A.C. tuner, and consisted of a tuned antenna coil, tuned plate of first R.F. coupled to the tuned grid of the second R.F., and a tuned impedance to a grid leak-condenser detector. R.F. tubes are '24s and the detector is a '27. Transformers are taboo in television low-frequency amplification, where halftones are desired, and I never could make much of resistance-coupled audio; so I tried my "new love" in sound amplification — the Loftin-White direct-coupled amplifier.



Here is another view of Mr. Bachman's television receiver and scanner—and look at the "Lab.!" My! My! A veritable "Experimenter's Paradise" — with plenty of batteries, scanning discs, and just "oodles" of other radio paraphernalia lying handy.

I had read in the original article (January, 1930, *Radio News*) that the frequency range of amplification was a great deal larger than is necessary for television.*

Hooray! I "See" Pres. Hoover; But He's Black!

On the night of Nov. 21, 1930, I was successful in picking up a signal announced as a portrait of President Hoover. Manipulating the motor's speed control I finally got a picture of good definition but alas, the Hon. President's face was black; in other words I had a negative.

I now added, or rather, interposed a stage of resistance-coupled amplification between the detector and the Loftin-White outfit; using another screen-grid tube. So much for the receiver. Signals are powerful and consistent, as my list at the end of the article will show.

*The audio amplifier for television should pass frequencies up to 40,000 cycles per second; the ordinary Loftin-White amplifier, not especially designed for television, passes up to about one-half this frequency.—Editor.

How I Checked Up Speed With Stroboscope

I sent away to a mail-order house for a Daven two-foot, 48-hole scanning disc; went to a chain store, where they sold machine shops on the installment plan, and bought me a polishing head or emery wheel stand to mount the disc on. A 1/4-HP. washing machine motor, mounted on a sponge rubber mat, is used to drive it through round belting. A 25-cent kneeling pad is used to absorb vibration and to provide a flexible motor mount. Keeping the picture in frame is accomplished by a slight pressure on the motor frame to tighten or loosen the belt.

The standard speed of the 48-line pictures is 15 per second; 900 a minute. Unless you have a 900 R.P.M. synchronous motor, make a paper disc with sixteen spaces alternately black and white, and illuminate this with a miniature (neon) night-lamp connected to the 60-cycle, 110-volt supply. When the disc (which should be mounted on the shaft with the scanning disc) has reached the 900 R.P.M., the black spokes seem to be

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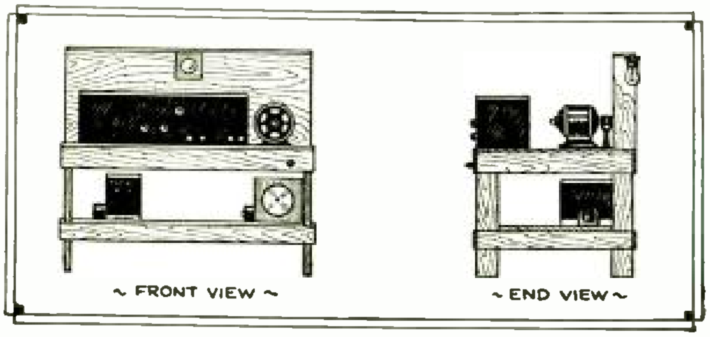
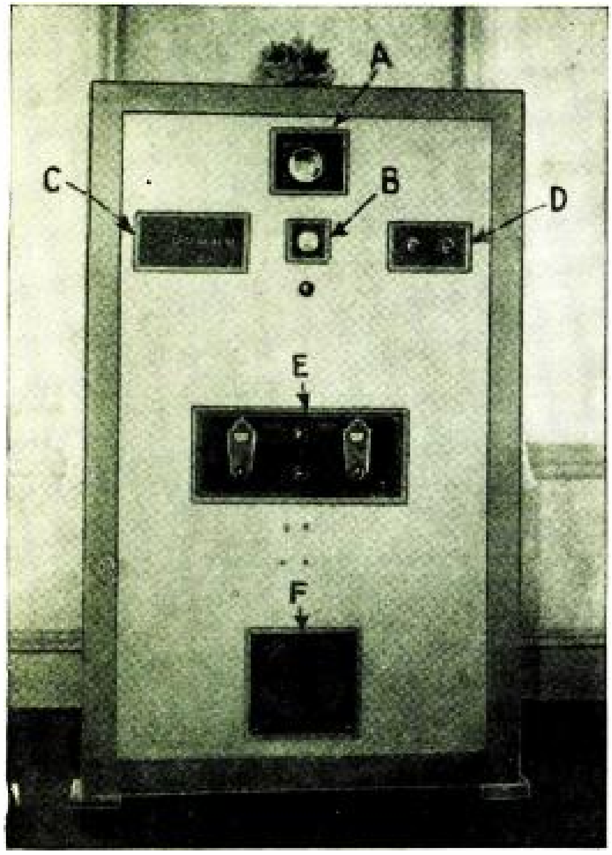


Front and side views of Mr. Bachman's television scanner and receiver bench.

HOW I BUILT MY HOME *Radiovisor*

By EDMOND DEANE, Jr.

Mr. Deane gives the "Television Fans" some sound information on how he built his own television receiver.



Appearance of Mr. Deane's television receiver cabinet: (A) lens; (B) milliammeter; (C) inductance jacks; (D) motor speed regulators; (E) short wave tuner; (F) loud speaker.

THIS radiovisor which I am about to describe was constructed and built by myself last year, at the age of sixteen. I am pleased to say that I met with much success and feel confident that there should be no reason whatsoever, why anyone interested cannot construct and build one with equal success.

My First Experience

My first experience with radiovision dates back to two and one-half years ago. At that time, for the reception of the earlier radio pictures, I built what is now commonly termed a "bread-board" outfit. Since then there have been many changes and much improvement in reception. In these eariler stages one was obliged to be contented with a black (silhouette), rather distorted image. It then grew and became more interesting with half-tone films; and today its popularity has increased greatly with our present stage of halftone "direct pick-ups" of persons and objects.

People today are not so inclined to give as much of their interest and attention to radiovision, as was their custom in the earlier stages of the now greatly-perfected art. They deem it advisable to wait till it meets with more perfection. This, to my way of thinking, seems somewhat discouraging; for radiovision will never be perfected until people in general become interested and express their support by experimenting with its principles.

My advice, to all those interested and working on radiovision, is to keep at it; do much to advertise its value of enjoyment; and partake of all the knowledge contained in the various magazines and recent books on the subject. TELEVISION NEWS has been of much value to me, and I consider it in many ways superior to other magazines; as it keeps up to date with all new methods of hookups, etc. So fellow amateurs, come on and enjoy some novel experiments and thereby help to better the field of radiovision.

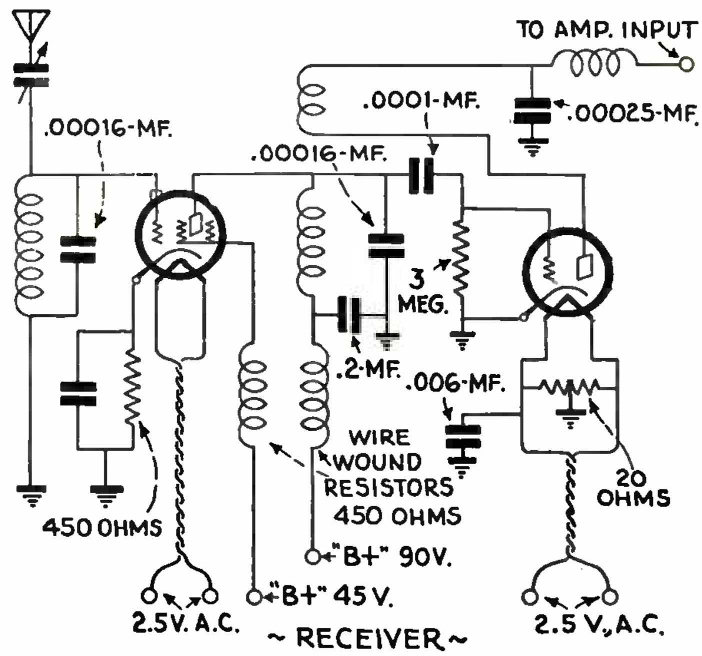
How I Built the Cabinet

The photograph will give you some idea of how my television receiving outfit looks. The cabinet is made of three-ply veneer board of three-eighths-inch material, with pine strips, 2¼ x ¾-inch, used for border trim and legs. The cabinet stands five feet in height, measuring three feet in width, with a depth of two feet.

To permit of immediate access, when in search of trouble, the rear of the cabinet remains uncovered. On the front panel, and under full control, you will note how conveniently the practical parts are arranged.

In constructing the receiver, be sure to place the shadow-box first. Space the shadow-box opening the desired distance down from the top, but be sure and allow ample freedom for the revolving scanning disc. This opening should reach its widest point at the panel front; then taper to a narrower opening 1½x2¼ inches, directly in front of the disc.

If you care for pictures of a larger size, it is necessary to place a good magnifying lens within the shadow



Short wave tuner used by Mr. Deane: note—the two .00016 mf. condensers across the inductances are variable. as is also the .00025 mf. condenser connected from one side of the tickler to "ground".

box. For clearer reception the lens can be omitted; but the picture becomes smaller, in accordance with the size of the neon tube's plate.

Should you dislike the somewhat severe glare from the tube, as many do, it can be overcome by placing a piece of ground glass just back of the disc. Be sure to have the magnifying lens in exact line with the tube; with proper focus there will be no diffusion of the picture surface.

The Scanning Disc

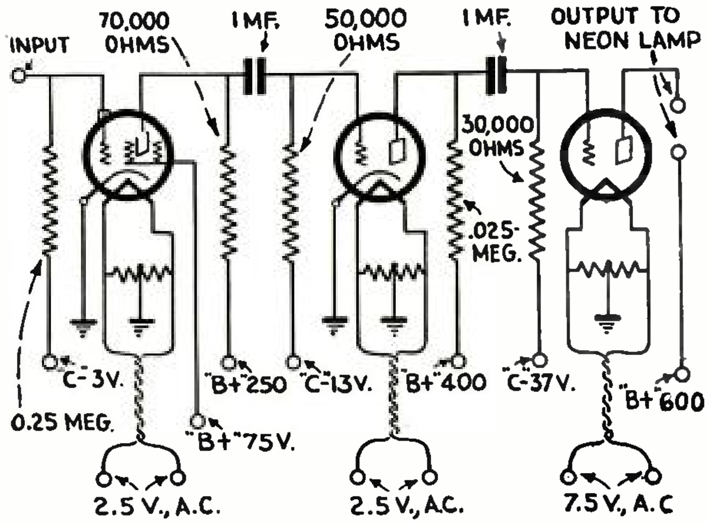
On the scanning disc, placed behind the shadow box, depends the size of your picture. The one contained in my cabinet is of aluminum, with a twenty-four inch diameter and a thickness of 1/32-inch. The holes in the disc are square, thereby producing a better and more distinct picture than with round holes. However, both are practical.

In my experience with discs, I find that a thin one is of more practical value on account of its steadiness in running and lightness for the motor; thus making it more serviceable and easier for synchronization, whether by rheostat; or automatically with a magnetic field and poles.

The Motor

The motor, which can be automatically synchronized by the amateur, is any good 1800-R.P.M. non-sparking brush motor, which can be varied to the speed of stations now broadcasting (1,200 R.P.M.)

In arranging the motor-bed, be sure to have as much support and anchorage as is possible. Motor variations, which might cause some distortion in the field, are greatly lessened by the use of rubber cushions.



Mr. Deane's resistance-coupled television amplifier. A suitable variable resistance should be connected in series with the neon tube to protect it.

The Tuner

Our next consideration is the receiver. The selection should be made with great care; for with an inferior receiving set you will never obtain good pictures. The Pilot set (which you will notice, from the picture, is used in my set) produces pictures that are "perfect" and bright. It utilizes regeneration; which works as well as the band-pass set, providing a resistance is placed in the "B +" lead of the detector tube. This will regulate the pitch of regeneration, by eliminating the sharpness and producing a much brighter picture. If you contemplate building the receiver yourself, be sure it is shielded with aluminum or copper, and thoroughly grounded; to a water pipe if possible.

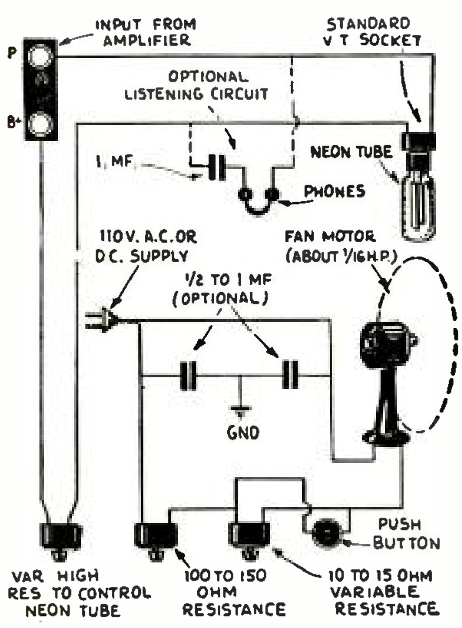
The amplifier, simple in design, must be matched with the receiver in order to function properly. I use a separate power-pack for the amplifier, in addition to that used on the receiver. When buying a power-pack, select one with no less than six hundred and fifty volts output.

For convenience it is advisable to have a speaker located in the bottom of the cabinet, with a double-throw switch to cut in the neon lamp. When the speaker is used connect a one-mf., condenser in series with the plate and "B +" lead; to avoid "blowing" the speaker field. When trying out the amplifier, if it is not of a standard make, adjust the "C" biasing voltage to match tubes.

I trust my few remarks may prove of interest to many, and of practical value to all interested in radiovision. I am sure you will find much enjoyment and feel well satisfied in attempting to build a home-made television receiving outfit such as here described.

Motor and Neon Tube Hook-up

THE accompanying circuit shows one method of hooking up a neon tube, with a variable protective resistance, to the terminals of the last amplifier tube in your television receiver. An optional "listening-in" circuit utilizes either a pair of phones or loud speaker with a 1-mf. condenser in series. By-pass condensers connected across the motor are desirable with commutator motors in order to minimize effects on the image of any sparking at the brushes. The scanning disc motor is adjusted to slightly below synchronous speed, say 1,175 R.P.M. By periodically pushing the short-circuiting button, the motor is speeded up and kept at a fairly constant speed.

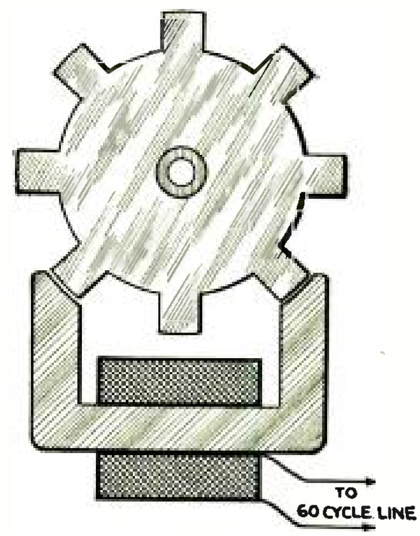


Neon tube and scanning motor hook-up.

A 60-CYCLE PHONIC WHEEL

THERE is a novel method for maintaining synchronism which may be of interest to some readers. This makes use of the 60-cycle current for synchronizing, and is recommended for those who have a 60-cycle supply, but do not have the necessary 60-cycle synchronous driving motor. By using an ordinary induction or universal motor on the A.C. line, and a small home-made 60-cycle "phonic motor", perfect synchronism is easily maintained with transmitting stations *operating from the same power line source.* (*Cont'd on page* 385)

A 60-Cycle Phonic Wheel



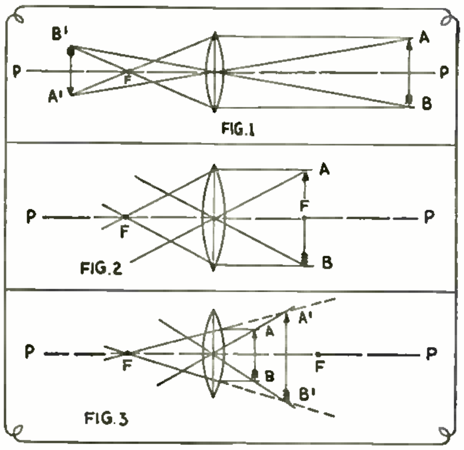
A 60-cycle "phonic wheel", the rotor having six teeth instead of the eight shown.

A SHORT COURSE IN *TELEVISION*

Advanced Television Optics

By C. H. W. NASON
Television Engineer

LESSON 5



Optical diagrams showing focal relations in the case of a double-convex lens.

IN our last lesson we discussed certain properties of optical systems, without much regard for their practical aspects. This time we will deal with lenses in their more practical forms and uses, and later give an arithmetical example of the use of what we have learned. If you will remember, we noted the effects of refraction in lenses and the fact that images could be formed. Since thick lenses require special and advanced treatment, we will deal here only with relatively thin lenses.

In all the figures, the line *PP* is the axis of the lens; *O* is the optical center; *F* is the focal point of the lens; and *f* is the focal length, which is measured from *F* to the lens.

(*A*) As shown in Fig. *1*, it may be seen that, in the case of a convex lens, if the object is an infinite distance from the lens, the rays will lie in such lines that the image will be a point and will lie at the focal point *F*. From a consideration of the figure it will be seen that this is true; and that, as the object moves further and further away from the lens, the image moves toward the focal point, becoming smaller and smaller.

(*B*) In the same figure it will be seen that, if the object lies outside the focal point of the lens, the image is inverted and also lies outside the focal length of the lens. The object and the image are said to be at *conjugate* foci, for, if they were to be interchanged, the image would lie at the point originally occupied by the object, and *vice versa*.

(*C*) We have noted that the image is located by the intersections of the rays; and it can be seen from Fig. *2*, that, if the object is placed at the focal point, the image is at an infinite distance; for the rays beyond the lens would be parallel lines and they would intersect (theoretically) only at infinity.

(*D*) If the object is located inside the focal length, as shown in Fig. *3*, it may be seen that the image will be on the same side of the lens as the object; and that it will be upright and larger than the object. It is located by the reverse continuation of the rays, as shown; since the rays on the other side of the lens are divergent and never meet. This leads us to the differentiation between *real* and *virtual* images: and we may say that *real* images are formed by the actual intersection of the rays, and that they are *always inverted*. In the reverse sense we say that *virtual* images are formed by the continuation of the rays and are always upright.

(*E*) With a concave lens the image is always *virtual*, always upright and always smaller than the object, as shown in Fig. *4*.

DO YOU ENJOY
Mr. Nason's Television Lessons?
What subjects would you like to have explained in these course lessons?
Write to Mr. Nason in care of this magazine.

Location of the Image

In order to locate the position of the image we may use the equation

$$1/q - 1/p = 1/f$$

where p is the distance from the object to the lens, q the distance from the image to the lens and f the focal length. If, therefore, we desire to place an object at one position and the image at another, we need to vary only the distances and the focal length of the lens. How this is done we shall see later. In the meantime we wish to see how the equation applies to the cases noted above. (All distances measured on the object side are *positive*, and those measured on the image side of the lens are *negative*.)

(*A*) In the first case we have p equal to infinity, and $1/p$ is equal to zero. The equation is thus

$$1/q = 1/f$$

(*B*) In the second case, we must remember that the distances on the object side are *positive* and those on the image side *negative*. We thus have $-q$, $+p$ and $-f$. The equation is in this case

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

(*C*) Here p is equal to f, and the equation reduces to $1/q = 0$ and we have q equal to infinity.

(*D*) Here we have positive values for q and p and a negative value for f. The equation then is

$$1/q - 1/p = -1/f$$

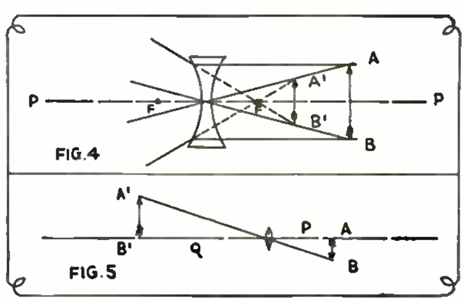
(*E*) In the last case we have positive values for q and f, but a negative value for p. The equation is then

$$1/q - 1/p = 1/f$$

Size of the Image

By a proposition in geometry (having to do with the relative sizes of the vertical sides in similar triangles) we may from Fig. *5*, evolve the proportional relation:

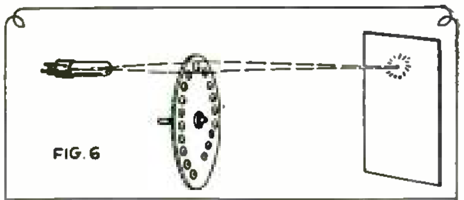
$$AB : A^1B^1 = p:q$$

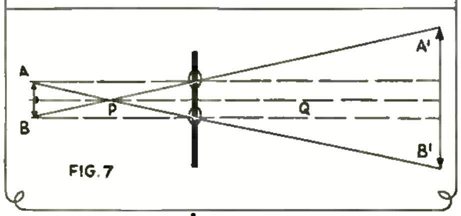


With a concave lens, the image is always "virtual", always "upright", and always "smaller" than the object, as shown in Fig. 4 above.

The Design of a Jenkins Lens Disc

The Jenkins lens disc is an adaptation of the Nipkow disc, in which the layout for the apertures will serve to locate the axes of sixty small lenses. The advantage over the normal disc is due to the fact that a projected image is possible; and also to the fact that the light efficiency may approach the maximum or ideal value by a close approximation.





Diagrams above are referred to by the author in the text, with relation to the design of a Jenkins "lens" scanning disc. How to calculate the focal relations of such a lens disc is explained by the author.

If we assume a light source as shown in Fig. 6, situated at a distance from a disc carrying sixty lenses, having four-inch focal lengths, and desire to project an image on a screen 120 inches away from the disc, we can find from the basic equations (Case B) that

$$1/p = 1/f - 1/q$$
$$\text{or } 1/p = 1/4 - 1/120$$
$$\text{whence } p = 4.13 \text{ inches}$$

We may easily compute the size of the image if we realize that the source is fixed, but the axis of the lens moves in respect to the source; and we further consider that the source may be considered as merely a point on an object. This is shown graphically in Fig. 7, for the first and last lenses in a system in which the difference between the radii of the first and last lenses is 1.2 inches. This enables us to use the same layout of the scanning disc as that described in Lesson 2, of this course, for our lens disc. The points locating the apertures are used for the centers of the sixty lenses. But, to return to Fig. 7, we find that, if we consider the light source as a point, there is no difference between holding the source steady and moving the axis through a range of 1.2 inches, and considering the lenses fixed and the source as an object having a height of 1.2 inches. Then, from the equation for the size of the image, we find that

$$AB : A^1B^1 = p:q$$

or, substituting and expressing the quantity algebraically, we have

$$1.2/X = 4.13/120$$
$$\text{or } 1.2/X = .0344$$
$$X = 34.8 \text{ inches (approximately)}$$

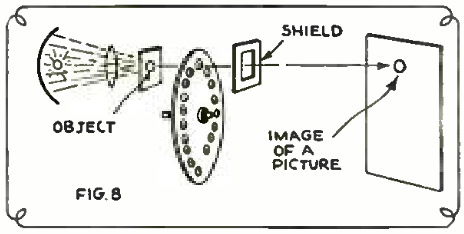
The width of the image will then be 41.76 inches. It should be realized that, in order to attain an image of these proportions, a light-source of relatively high intensity is needed. The intensity of the source may be increased by utilizing for the actual object of the system a diaphragm in a blackened card, upon which the rays are roughly focused by a condenser lens having a relatively large diameter. Another diaphragm, close to the lens disc, serves to localize the light in such a manner that those lenses not actually in position will receive no light; this is shown in Fig. 8. By scaling down the dimensions listed, till we have a less ambitious image, we may arrive at an image size such that an ordinary neon crater lamp will serve to provide the desired illumination intensity.

In this case we may assume the distances $f = 4$ and $q = 20$ inches; in which case we have

$$1/p = 1/4 - 1/20$$
$$1/p = 0.20$$
$$p = 5 \text{ inches.}$$

And, from the equations giving the size of the object, we have:

$$1.2/X = 5/20 = 0.25$$
$$X = 4.8 \text{ inches}$$



Optical train utilizing a neon crater (high intensity, point of light, type neon tube), with lens disc, shield or diaphragm and projection screen.

The width of the image will be 1.2 x 4.8 inches (as the aspect ratio of a 60 by 72-element image is 1.2).

An image of this size, projected upon a ground-glass screen and viewed through the screen, is nothing to be sneezed at, and is quite practicable for the amateur constructor.

In the next issue of TELEVISION NEWS we will describe the calculations involved in the design of a mirror-wheel system which is far more compact than the lens disc, although of not much greater efficiency. Do not be too anxious for the arrival of this data; the Weiller wheel is more interesting in its theoretical considerations than in its construction. Indeed, it is about the toughest proposition you could hand to any but the most experienced tool-makers.

In Our Next Issue

EXPERIMENTS WITH A KERR CELL—THE "HOW AND WHY" OF THESE LIGHT MODULATING DEVICES.

LENS DISC SCANNERS AND CRATER TUBES—HOW TO USE THEM TO OBTAIN LARGE IMAGES.

THE LORA CATHODE RAY TUBE, **Described and Illustrated by Its Inventor, Luis A. Lora.**

A DRUM SCANNER—HOW TO MAKE IT, **by Milton Trenhaft.**

CATHODE RAY SCANNERS—LATEST INFORMATION ON THEIR THEORY AND OPERATION, INCLUDING LATEST NEWS FROM EUROPE ON THESE TUBES.

FARNSWORTH'S PRINCIPLES OF SIDE-BAND COMPRESSION, **by C. H. W. Nason.**

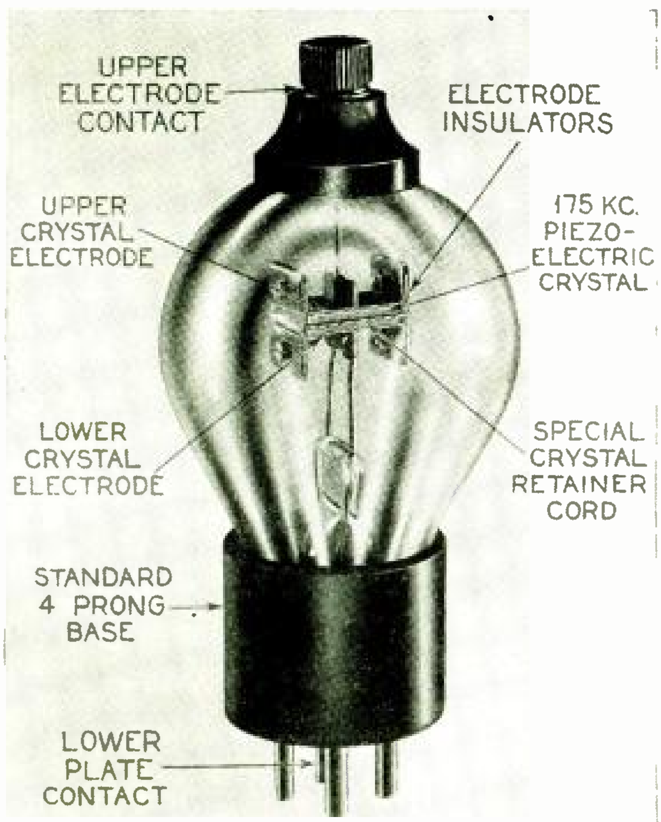
DETECTION IN TELEVISION—THE CHOICE OF DETECTORS AND WHY GRID-LEAK AND PLATE RECTIFICATION ARE USED FOR CERTAIN REQUIREMENTS.

HOW I BUILT A DEMONSTRATION TELEVISION AMPLIFIER—INCLUDING DIAGRAMS AND COMPLETE DATA, **by H. P. Austin.**

ALSO PHOTOS AND DESCRIPTIONS OF ALL THE LATEST TELEVISION RECEIVERS, AS WELL AS TRANSMITTERS; **including the Latest Crater Tube and Lens Disc Projectors.**

STENODE

Is the sharp selectivity of "Stenode" quartz-crystal tuning an advantage in receiving television images? "Yes" — says Mr. Bouck, and he here explains why.



Quartz-crystal used in the input circuit to the second detector in Fig. 3. This crystal is principal factor in a super-selectivity feature of the Stenode.

THE problems of television transmission and reception are both mechanical and electrical. Mechanical considerations involve the methods of resolving and integrating the image by means of scanning mirrors, prisms, lenses or discs; while the electrical considerations deal with the manner of transmission and reception of the signal itself. (It is reasonably possible that the mechanical side of television will, in the future, be confined to the transmitter, by the substitution of a modified cathode-ray tube for more clumsy integrating machinery.)

While these two phases of television development are distinct and separate, their interdependence is intimate; and the possible extent of mechanical development is limited, not only by its innate difficulties, but by the electrical limitations of the television system. Regardless of a variance in opinion as to the present degree of perfection attained in the scanning mechanism, refinements here making possible the transmission of better pictures (images containing more detail) are without practical use until methods of receiving and amplifying the higher frequencies necessarily accompanying such transmission are developed.

How Image Is Built Up

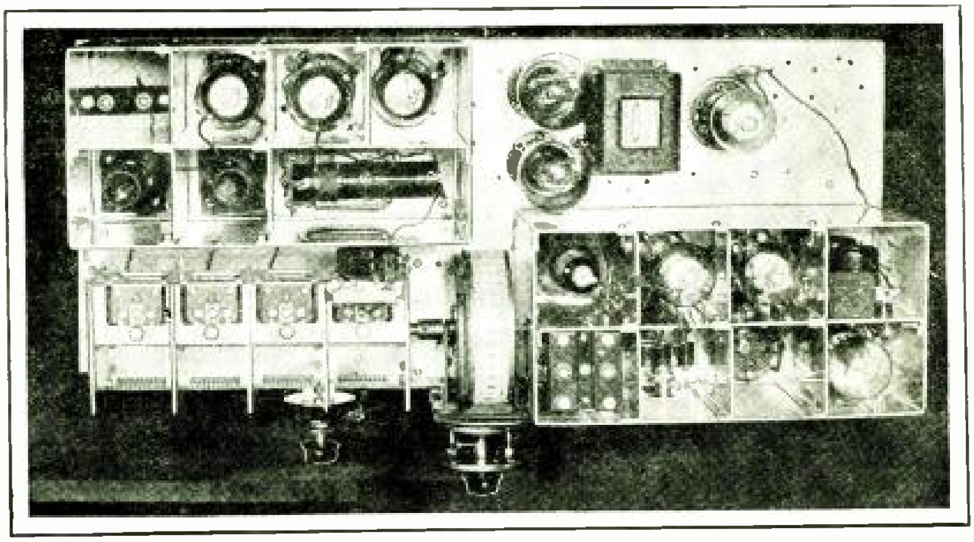
Present-day developments in both mechanical and electrical phases of television are such that it is possible to transmit a good picture of a head in sixty horizontal lines; each line being broken up, *theoretically*, into seventy-two elements. These seventy-two elements are hypothetical—they do not actually exist, as do the sixty horizontal lines—and are considered merely because they provide an easy basis of calculating the fineness of detail.

In Next Issue!
HOW TO CONSTRUCT A "STENODE" *Television* Receiver
By ZEH BOUCK

The horizontal resolving power of the apparatus is really a function of the aperture's characteristics and the frequency-response of the system. With the present frequency limitations and aperture design, the finest picture that can be transmitted is the equivalent of a picture made up of sixty vertical elements or dots and seventy-two horizontal elements or dots. This compares to an ordinary square newspaper halftone, 1.3 inches on a side. In such a halftone, the head and shoulders would be quite satisfactorily defined, and the definition would be constant no matter how much we magnified the picture; providing we moved farther away from it as we made it larger. This applies equally to television; and the image loses nothing in detail if thrown on a screen, so long as we are not too close to the screen.

80,000 Elements a Second!

This is the present status of television. Since the picture is transmitted twenty times a second, the system must be capable of handling 72 x 60 x 20 (approximately 80,000) elements a second. It is rare that this number of elements is actually transmitted each second; because large areas of the same degree of shade will be transmitted as lower-frequency impulses. But the system must be capable of the higher-frequency transmission which may be transmitted,



Specially designed television tuner-amplifier, using the Stenode principle.

Applied to TELEVISION

By ZEH BOUCK

when the scanning beam crosses (for instance) the rims of glasses or the pupils of the eyes.

Considerations of aperture and frequency cut-off distortion determine the required frequency-band encompassed in a television signal, describing a picture of a given number of elements. These calculations result in a compromise, which indicates that little is gained by transmitting a frequency (in cycles) higher than one-half the number of theoretical picture elements to be transmitted in one second. Thus, in the more or less standard 72 x 60 television image, the modulation frequencies may be as high as 40,000; which, extending on each side of the carrier in all existing systems of transmission and reception, *with the exception of the Stenode*, require a frequency band 80,000 cycles wide; (or extending over 8—10 k.c. channels).

The transmission of these sidebands, as well as the reception, imposes severe engineering difficulties on the designers of television apparatus, not to mention the concomitant natural limitations if an effort is made to transmit images of larger scenes, without loss in detail.

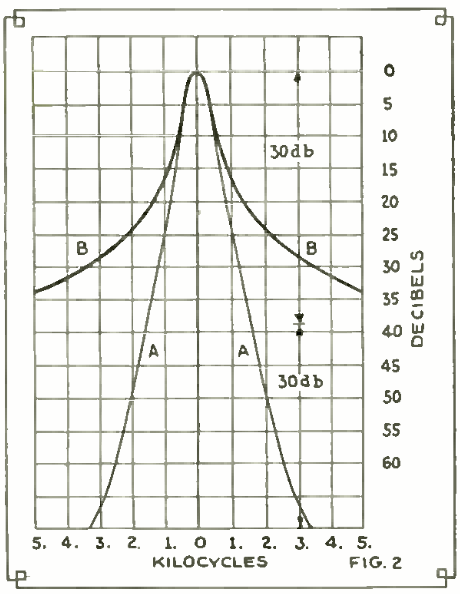


Fig. 2—Curve "A" shows the response characteristic of the Stenode as the frequency is varied from resonance; curve "B" shows the frequency-attenuation characteristic—showing the discrepancy between the Stenode resonance and tone curves, accounting for the tone selectivity gain attained with the Stenode.

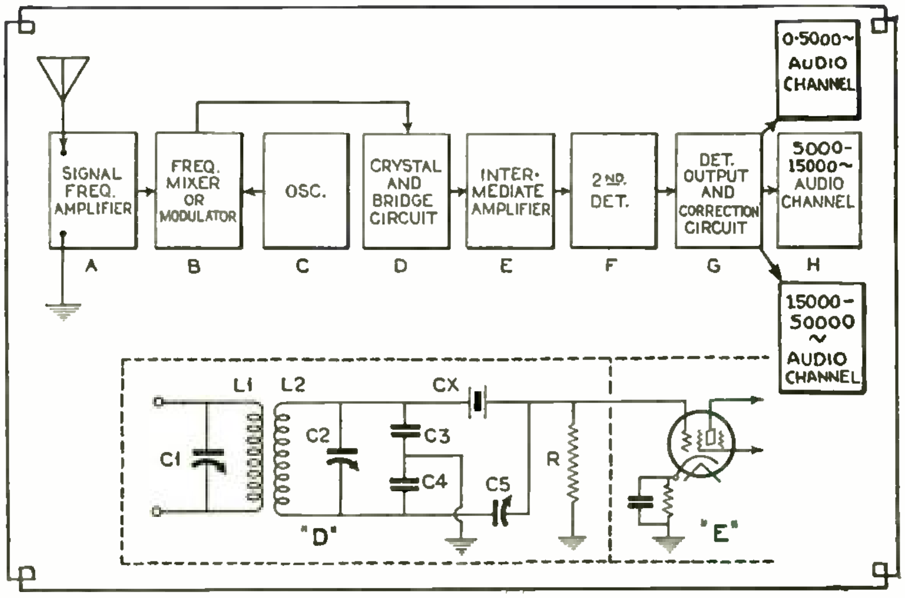


Fig. 3—Above illustrates schematic line-up of a practical Stenode television receiver. The output of the three different amplifiers can be recombined in either a single neon tube, or several individual tubes, operated in an optical system of "transparent" mirrors.

Good Image May Require 875,000 Cycles

Reverting to our newspaper analogy, one obviously could not show a "good" picture of the Do-X alighting in New York harbor on a 1.3-inch x 1.3-inch cut. We should require a 5-inch x 7-inch picture of the same screen—in other words about 87,500 elements (based on 50-screen), equivalent to twenty of the smaller pictures. If we attempted to transmit such a scene with equal detail over television, we should have to transmit this number of elements twenty times a second, or 1,750,000 elements a second. Assuming that the same element-to-frequency ratio will hold true (and this ratio will probably approach unity when the time comes actually to broadcast a picture in such detail), a modulation frequency of 875,000 cycles will be required. Broadcasting at 100 meters, this would spread all the way from 78 meters to 140 meters!

Should we endeavor to transmit the image within the broadcast band (where television rightfully belongs) —say at 400 meters—the signal would blanket everything from 190 to 2400 meters!

This of course assumes that the sidebands are transmitted—and the vast majority of radio engineers will tell you that this is necessary.

Side-Band Transmission and Reception Unnecessary

It is the purpose of this article to show that the *transmission* and *reception* of these sidebands *is not at all essential to the reproduction of these high frequencies*—that the loss in the high frequencies attending "sideband cutting" in a receiver, can be fully compensated without tracing a vicious circle that would bring up interference and all the undesirable characteristics of the "broadly-tuned" system to the original degree experienced in a "sideband-admitting" receiver.

As usual, in discussing the Stenode, we find that, automatically, we have become embroiled in an argument regarding "sidebands"! This is not my fault, nor the fault of any engineer intimately acquainted with the Stenode theories as propounded by its inventor, Dr. Robinson.

Stenode engineers have said next to nothing about sidebands (let alone denying their existence!), and the entire "smoke-screen" has been laid by others who persist in misinterpreting the theory with a fervor that at times approaches the obtuseness of the "fundamentalist." As a matter of fact they find themselves in much the same boat with those who scoff at Darwinism because "Darwin declares we are the descendants of the apes." But Darwin never declared anything of the kind! Darwin merely maintained that man and the apes were descended from a common ancestor—which is indeed an entirely different proposition!

Stenode engineers have merely declared that, regardless of how sharply a receiver may be made to tune, it is possible *to bring back the high frequencies, without killing selectivity;*

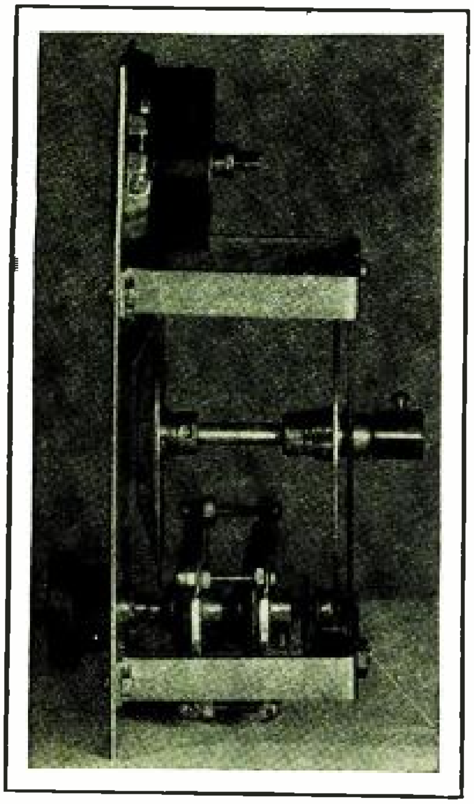


Fig. 6—The special dial developed for tuning the Stenode. A single knob controls the five-to-one-ratio for rough tuning, and the three-hundred-to-one ratio for final adjustment.

and they have proceeded to demonstrate this fact by making several hundred such receivers. The existence of these frequencies in a receiving circuit is not *prima facie* evidence that the sidebands also exist; and the *Fourier series* upon which opposing engineers place so much reliance, does not prove their existence.

The Fourier expansion merely asserts that, if we want to obtain an analysis of the wave-form, existing in the circuit, which is mathematically convenient to handle, we can consider this resulting wave as being built up of many sine waves, including those of the sidebands. These hypothetical frequencies, however, do not necessarily exist. The Fourier series was applied in electrical engineering—before the days of modulated radio frequencies—to analyze complex periodic curves, when there was no question of their being composed of any such component frequencies.

Simple Sideband Analogy

Any force applied in a given direction can be considered as the resultant of several component forces, but this does not mean that the component forces necessarily exist. The component forces may be imaginary, or, in many instances, real. An automobile being hauled by a rope extending in the direction of motion is propelled by a single force, acting in a single direction. But, for some obscure reason of analysis, this force may be considered as the resultant of two imaginary forces pushing the car from an angle on each side. However, when two men are actually moving the car forward, one pushing on the right fender and the other on the left fender, these imaginary forces become real. The fact that a mathematical quantity is useful is no evidence of its reality! Imaginary quantities are among the most useful of all mathematical tools—and, like the Fourier series, they often have a physical meaning. For instance, an exponential function with an imaginary exponent can be expressed as a real trigonometric function.

Resonance Curve for Stenode Analyzed

Fig. 1 shows the resonance curve of a typical Stenode receiver compared with similar curves of the sharpest band-pass and ordinary superheterodyne receivers. It is obvious that the sidebands must be severely and rapidly attenuated in the Stenode, with an attending loss in the high modulation frequencies. And it will be maintained by most engineers that this loss cannot be compensated without bringing the selectivity back to its original broad state. Their argument is based upon consideration of the *sideband theory alone*, and as such is logical and correct.

Looking at it from their point of view, let us consider a receiver the resonance curve of which is down 6 db. (decibels), or fifty per cent at 3 kc. (kilocycles) off resonance. This, by the way, represents a very sharp receiver. Now if this receiver is tuned to a transmitter modulated by a constant frequency of 3 kc., the sideband representing this frequency will be attenuated at 6 db. below normal; precisely as an interfering carrier 3 kc. off resonance would be attenuated. To bring the 3-kc. modulation up to normal, the amplification at 3 kc. off resonance will have to be 6 db. higher than that of the very low frequencies. But this will, in turn, bring up the interfering carrier the same amount, and apparently nothing will have been gained in making the receiver sharp in the first place.

Carrier Modulation versus Sidebands

However, this is only true if we neglect the effect of amplitude variations in the desired carrier, which become relatively more important as the receiver is made sharper. Many engineers have apparently forgotten that the "sidebands" exist in the transmitter only because they have been set up by amplitude or strength variation in the carrier itself. The fact that sidebands exist is *prima facie* evidence that the amplitude of the carrier is varying at the modulation frequencies. Cutting off the sidebands has little effect on the amplitude variations of the carrier in the receiver and, while these amplitude variations decrease in depth with the increase in the modulation frequency, it is possible (with quartz-crystal tuning) so

(*Continued on page* 384)

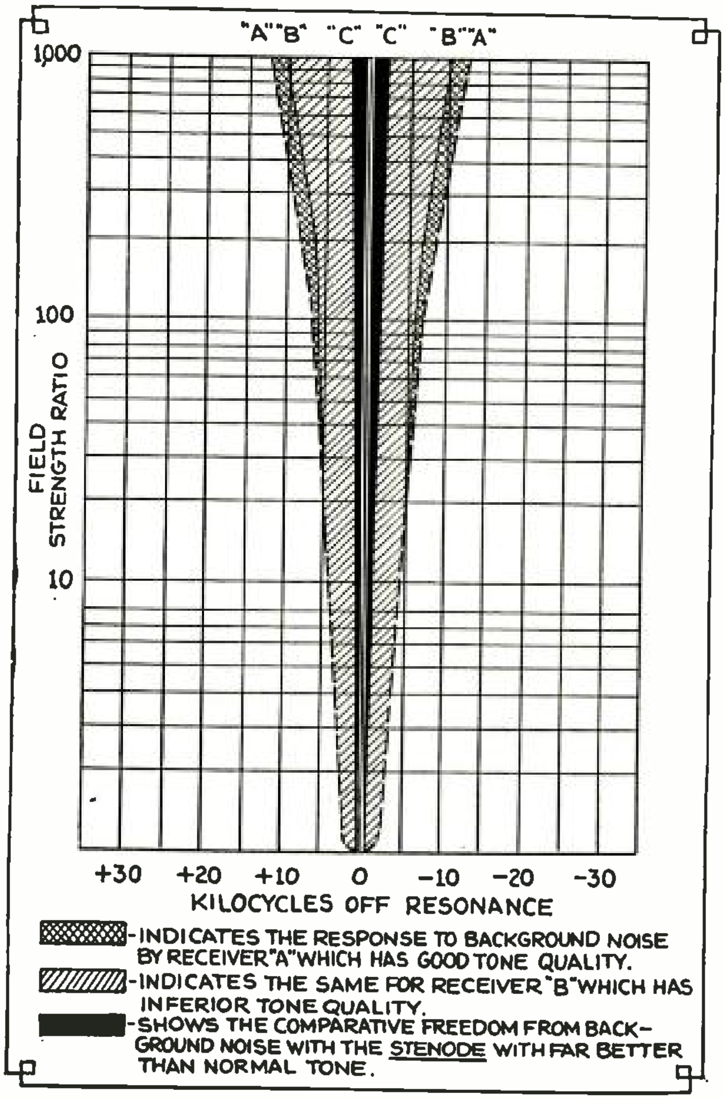
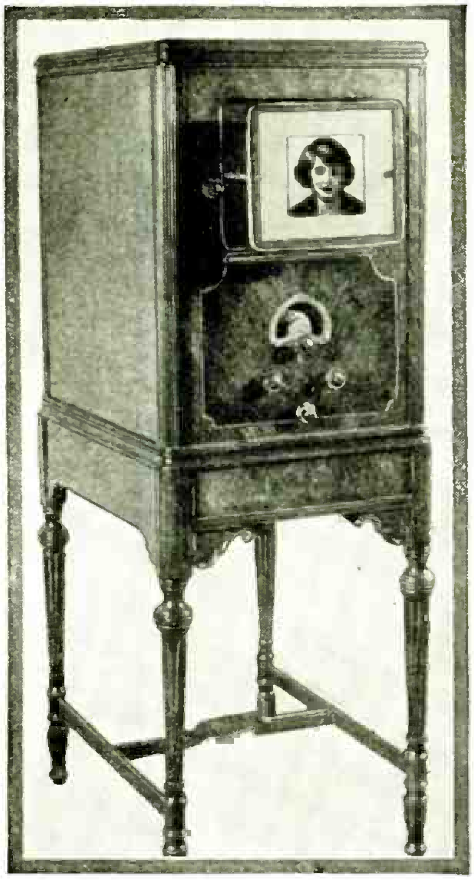


Fig. 1—Shows the resonance curve at "C" for a typical Stenode receiver, compared with that for one of the best "band selector" receivers (A), and again at "B" for a "sharp" super-heterodyne receiver. The reduction in background noise makes for cleaner television images.

JENKINS NEW HOME PROJECTOR GIVES LARGE IMAGE



New Jenkins large image console.

Crater tube plus lens disc gives large brilliant image.

PROVIDING a large, brilliant, undistorted screen image that may be viewed by the largest home group, as contrasted with the peep-hole image and the handful of lookers-in of previous equipment, the latest Jenkins Projector Radiovisor marks an important step forward.

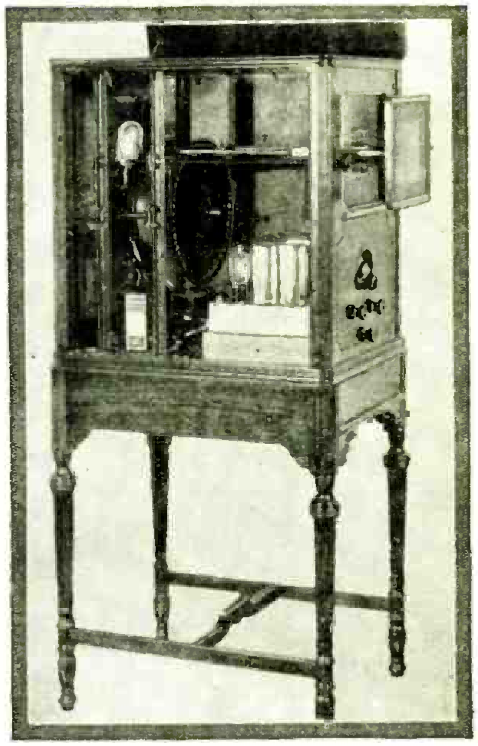
The new projector radiovisor comprises a lens scanning disc, DeForest spot-source neon crater tube, translucent screen, driving motor, focusing adjustment, framing handle and motor controls, mounted in neat and compact chassis form.

The unique feature of this radiovisor is the 12-inch scanning disc with 60 lenses, each of 7/16-inch diameter. The intense spot of light provided by the crater neon tube is focused, by means of a condensing lens, on to the lens scanning disc, which in turn throws a flying spot on the reverse side of a ground glass screen, to weave the picture. The scanning disc is rotated by the driving motor which is synchronized with the intercepted television signal, either by using a common A.C. power system or by the carrier beat of 1200 cycles.

The DeForest crater neon tube is an entirely new and startling development, aimed at producing a highly responsive and concentrated light source for projected television pictures. The screen picture may be adjusted and focussed for any size from 3 x 3½ inches up to 8⅜ x 10 inches. The focusing control is on the front of the radiovisor chassis, as is also the small handle for framing the pictures.

The driving motor is of unique design, assuring constant speed and silent operation. It offers no interference for the television receiver, which may be placed in close proximity for compactness of the entire television set.

The projector radiovisor is available in chassis form or mounted, in combination with the receiver, in a handsome walnut console cabinet for living-room use.

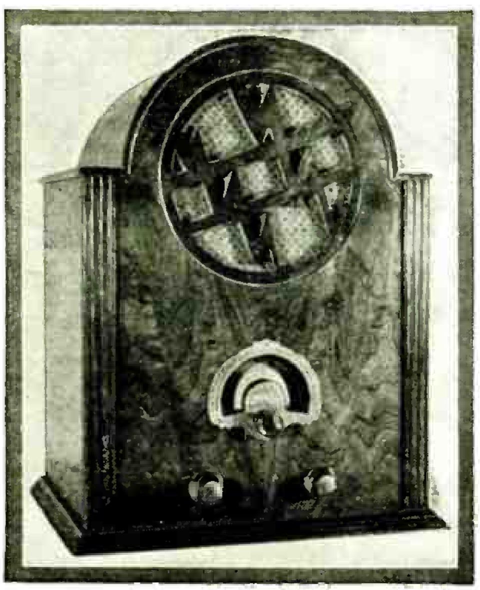


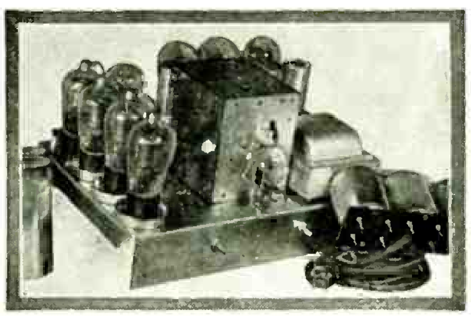
Side-view of new home projector with Crater lamp and lens disc.

New Dual Range Television Receiver

MEETING the first prerequisite of an ideal television tuner and amplifier, the new Jenkins Model JD-30 receiver in addition serves as a com-

(*Continued on page* 380)

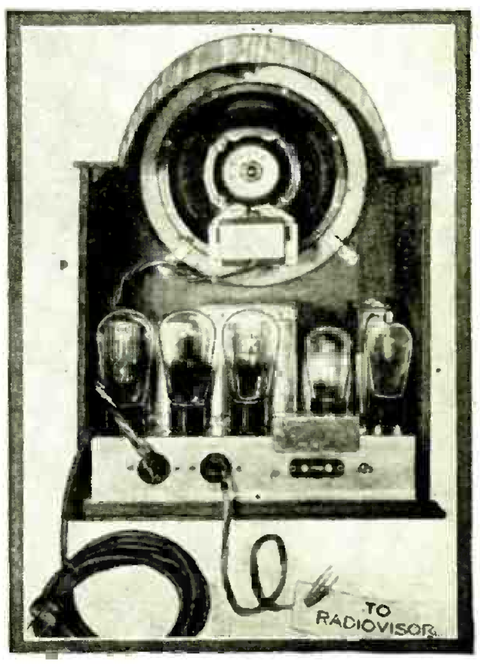




Above—Chassis of "Dual-Range" television and short wave receiver.

Left—Front of "Dual Range" television receiver.

Rear of receiver showing loud speaker and television terminals.



Hints on Using A Braun Tube as A Scanner

By DR. ERNST BUSSE

One of the principal problems met with in adapting the cathode ray tube for television scanning, is the development of suitable oscillators to produce control currents of "saw-tooth" wave form, which are here discussed by Dr. Busse.

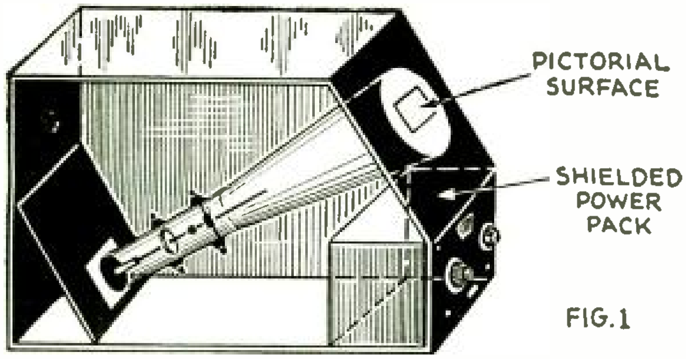


FIG. 1

Braun Tube in cabinet.

RECENTLY we have read frequent proposals, or reports, concerning the employment of a Braun tube for television. In fact the extraordinary ease with which the Braun (cathode-ray) tube can be adjusted to various scanning systems justifies the cost, which is at present still relatively high. Quite apart from that fact, one also possesses in the Braun tube, an extraordinarily interesting indicating device for many kinds of electrical tests.

How to Set Up Braun Tube

Today the Braun tube is obtainable commercially in a form indicated by Baron Manfred von Ardenne, frequently described in the technical press. In this type of construction it has eight connections; three of which end at the socket of a Loewe triple tube, while the remainder lead to terminals on side (electrode) arms of the tube. In setting up the tube in a holder it is advisable to make the fluorescent screen stand obliquely; in this way it is more agreeable to the observer. Fig. 1 serves as an example of this set-up. The expensive tube is thus protected as far as possible from mechanical injuries; in the casing one can put the accessory apparatus (under shields sheet iron, on account of the magnetic effect). One must not forget a magnet, by which the pictorial field can later be moved to a proper place on the screen.

Three Operating Voltages Required

For operating the tube three voltages are required: a low heating potential; a variable bias for the concentration cylinder (Wehnelt cylinder), and a high plate potential. To obtain great brightness it is advisable to use plate potentials of between 1,000 and 3,000 volts; but with a stationary spot of light, avoid too high plate potentials, in order to spare the fluorescent screen.

A house-current power connection, especially constructed for this type of tube, is likewise commercially obtainable*. One can, however, take the operating voltages from a home-made power pack. Fig. 2 gives the hook-up for this. Here alternating current is used for heating; which is an advantage of the Ardenne tube. Switch A serves for setting to different plate potentials, while resistance R serves for adjusting the cylinder bias. That one must take the high operating potentials into account in selecting the parts, is self-evident. The currents required are very slight; they are fractions of a milliampere.

Fig. 2—110 volt A.C. supply transformer, with rectifier and voltage regulator, including low-voltage heater terminals H.

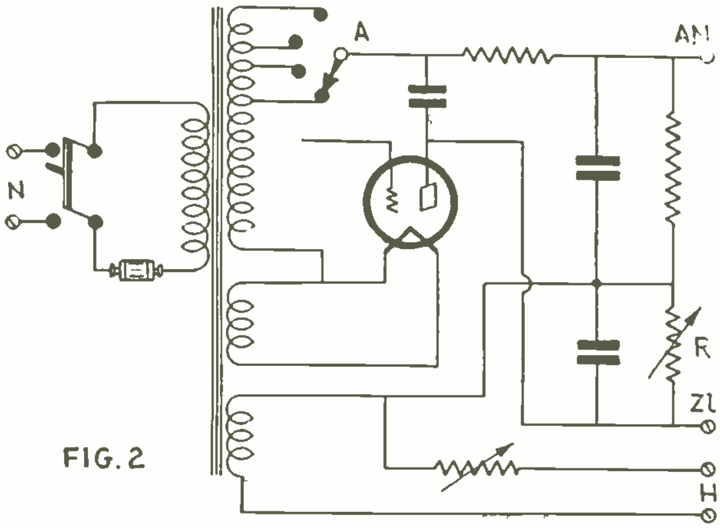


FIG. 2

By regulating the heater current and the cylinder bias one gets an extraordinarily fine cathode ray, and thereby a small, sharply limited, spot of light on the fluorescent screen. It is most satisfactory, according to the manufacturer, to regulate the brightness of the fluorescent spot by changing the cylinder potential. Therefore one connects into the wire leading to the cylinder the secondary winding of a transformer, whose primary winding has the receiver current flowing through it. Better results are obtained by coupling through condensers and resistances.

* General Radio Co., Cambridge, Mass.

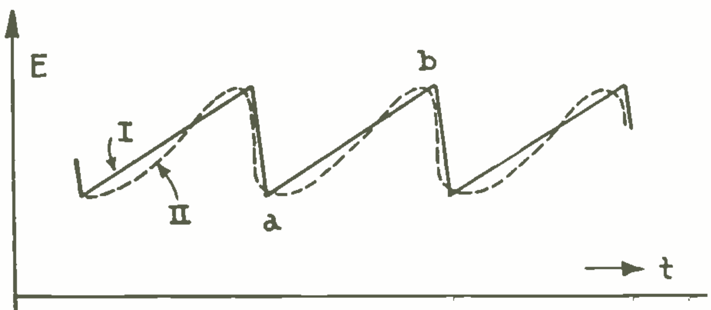


FIG. 3

Fig. 3—Where cathode ray tube scanners are to be used for television, the control oscillator currents must have a "saw-tooth" wave form, as shown by the graph at the left.

How Cathode Ray Is Deflected

The cathode-ray is diverted from its usual direction by electric or magnetic fields. Therefore one can move the spot on the luminous screen by applying various potentials to the pairs of deflection plates. For pictorial reception, the spot must execute the same movements as the scanning dot makes at the transmitter. In German television, the scanning dot executes a uniform movement from left to right across the pictorial field, 375 times per second (line frequency) or 1,200 times per second in America. At the same time the dot moves 12½ times (20 times in America) from top to bottom in a direction perpendicular to this (*i. e.*, to the other motion) (pictorial frequency). Accordingly corresponding potentials must be applied to the two pairs of deflection plates.

Saw-Tooth Form of Deflecting Current

In the application of sinusoidal potentials to the plates, the dot, since its deflection is proportional to the potential, would hurry back and forth with correspondingly varying velocity. Therefore such potentials are not suitable for use in television. Rather, for the correct scanning motion the potential must rise evenly in point of time, from an initial value to a final value, then suddenly jump back to the initial value and again rise evenly—saw-tooth fashion. A periodic course of potential of the desired kind (see Fig. 3-I) is shown by definite relaxation oscillations, designated as switch oscillations. The best known way to produce switch oscillations is the periodic discharge of a condenser through a glow tube.

In Fig. 4 is drawn a serviceable glow tube buzzer hook-up, suggested by Dr. Geffcken. The condenser C is charged by the saturation current of the tube E, up to the ignition potential of the (neon) glow tube G. At the moment when ignition potential is reached, the discharge takes place via the glow tube, which lasts until the condenser C is discharged down to the extinguishing potential of the glow tube. The frequency of the switch or saw-tooth oscillation is dependent upon the size of condenser C and the magnitude of the saturation current of tube E.

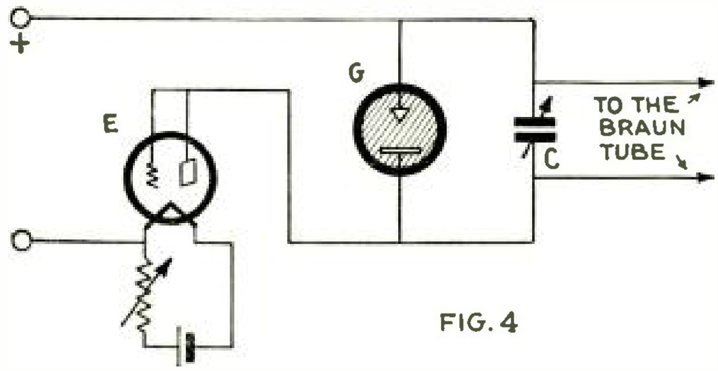


FIG. 4

Fig. 4—One of the special "saw-tooth" wave oscillators used as "control" supply source in cathode ray scanners, utilizing a neon glow tube "G," shunted by a condenser "C"; this combination causing periodical discharges having a "saw-tooth" wave form.

This arrangement furnishes switch oscillations which have a certain course in point of time, as indicated by curve II in Fig. 3. The deviation at b is insignificant and can generally be neglected. Much less pleasant is the deviation at a, which is caused by the extinguising process in the glow tube. In practice it causes in the picture a distortion of the left edge of the picture and can be avoided only by the use of specially built glow tubes. Furthermore, the slight difference between ignition and extinguishing potentials, commonly shown by commercial tubes, is a disadvantage, since the diversion potentials at condenser C, are too small and therefore have to be amplified once more. For these reasons it is advisable to use a tube switcher (oscillator).

Separate Tube Oscillator

The hook-up of the separate oscillator tube is shown in Fig. 5. In principle it is similar to the Flewelling hook-up. The block condenser C is very quickly charged by the oscillations of the tube I, which is very stiffly back-coupled, to so high a value that the oscillations break off. The discharging of the condenser takes place via the saturation current of tube II, until the oscillations set in again. The course of potentials is approximately that of the ideal curve I in Fig. 3. For practical purposes it is to be noted that the back-coupling must be made as stiff or tight as possible, hence the smallest possible condenser in the oscillation circuit and the largest grid circuit coil.

The frequency is roughly adjusted by interchanging condenser C. It changes with the plate potential and with the saturation current of tube II. At the same time the amplitude of the saw-tooth oscillation is influenced by the plate potential. The frequency is slightly dependent on the heating of tube I, and on the size of the oscillation circuit condenser. Therefore one should undertake the adjustment of the amplitude by changing the plate potential, the rough adjustment of the frequency by changing the heating of tube II, and the fine adjustment by the heating of tube I.

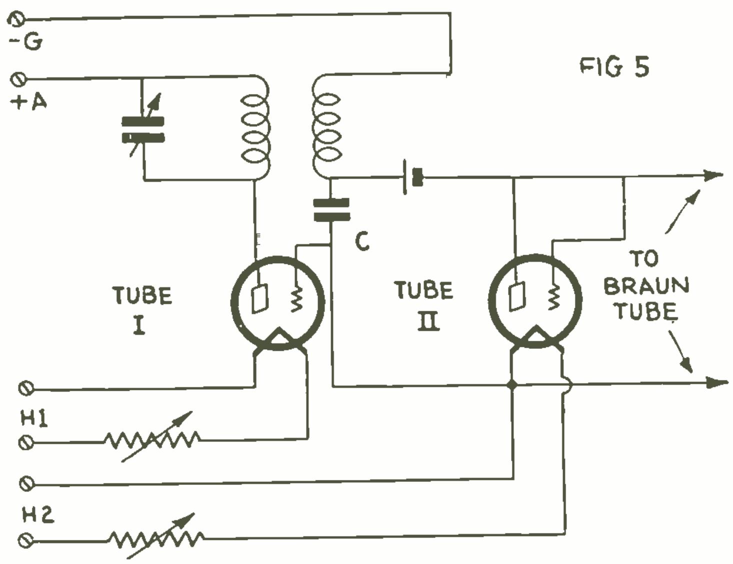


FIG 5

Fig. 5 — Diagram at left shows another form of oscillator devised as a source of supply for "saw-tooth" wave form control currents, suitable for use with cathode ray scanners, and which is described in the accompanying article by Dr. Busse.

Adjusting Pictorial and Line Frequency

In order not to spend too long a time in adjusting pictorial and line frequency during image reception, it is advisable to attend to the adjustment beforehand. As an aid for adjustment of the correct frequencies, it is most advantageous to use the 60-cycle alternating current. If one

(*Continued on page* 386)

Fig. 6 — at right, shows path of cathode ray as it oscillates over the target screen at the end of the tube, with an applied control frequency. Fig. 7 shows path followed by cathode ray with applied "saw-tooth" control frequency of 350 to 400 cycles.

FIG. 6

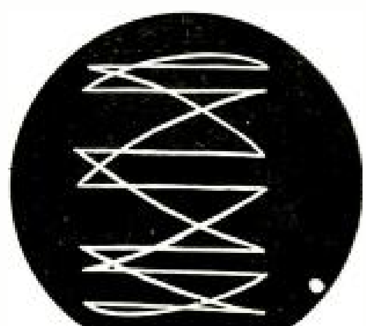


FIG. 7

How to Build an Automatic Synchronizing Brake

Which Will Hold Your Image Steady

By W. MANSFIELD

The author provides a new and interesting design of brake, which is automatically applied and released by the scanning line current, so as to hold the image steady. All of the parts can be easily made by the experimenter.

SYNCHRONIZATION is a difficult point for the average television amateur, unless he familiarizes himself with the problem and its solution. In this periodical a number of very serviceable devices have already been described, but many of them have certain disadvantages. It is fairly practicable to brake the disc, in some sets with the hand, but then one cannot leave the set, to make any experiments. (This inconvenience can be avoided if one does the braking by an electrically-operated brake, and provides an extension cable with a push button for the brake-magnet; then he can work the brake from any desired point.) In other sets, the 60-cycle A.C. is used to run a La Cour (phonic) wheel; yet I have seldom found A.C. suitable for satisfactory synchronization (the picture wanders back and forth!).

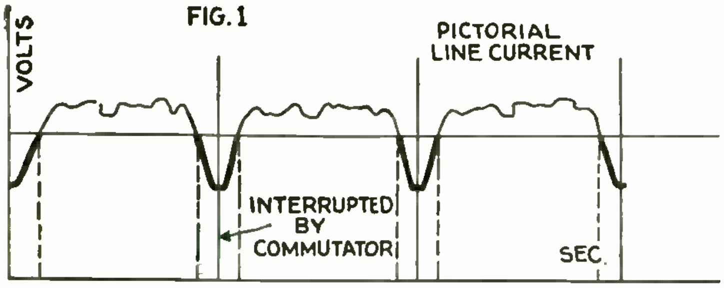


Fig. 1. Graph showing pictorial (image) line current, interrupted by the "brake" commutator.

The apparatus to be described here is easy to make; it was built according to a proposal to use the 60-cycle A.C. line-frequency for synchronizing.

The television broadcasts taking place at present have a line frequency of 1200 cycles, which is produced by a current impulse occurring at the end of each pictorial line. That is to say, 60 (lines) × 20 (pictures per second), equals 1200 (cycles).

The "Black-Streak" Current

These current impulses appear in the television picture as a horizontal black streak (presupposing that we receive a positive picture!) The intensity curve of the received pictorial-line signal would look like Fig. 1. At the points marked in a heavy line, the potential sinks below the average and the neon glow-tube is extinguished. Since this process is repeated after each line, we see in the picture a black streak. Now, if we switch in, between the current source and the glow-tube, a commutator mounted on the axle of the disc, and join in parallel to it a relay (Fig. 2), the glow tube's current goes either via the short-circuited commutator or, in case this circuit is interrupted by the commutator, through the relay. If one uses a commutator with 60 segments, the current is interrupted 60 times. Now, if the commutator is so adjusted that the interruptions coincide with the picture streak, then the entire pictorial-line current goes via the commutator, and only the "picture streak" over the relay. The latter ("picture streak" current) has, according to Fig. 1, a lower potential than the closed-circuit current. The relay armature is adjusted by a spring or the like; so that it is just attracted at the potential of the closed-circuit current, but must at once spring back on reduction of same. Therefore the relay is not closed by a picture-streak current passing through.

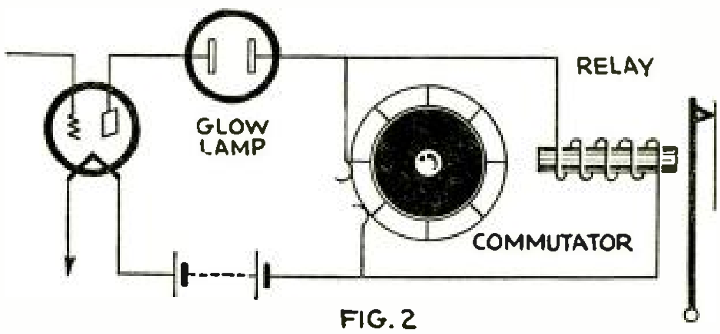


FIG. 2

Fig. 2. Showing author's arrangement of the commutator and relay used in operating scanning disc brake here described.

How "Streak Current" Works Brake

But this is only the case when transmitter disc and receiver disc run "evenly." If the receiver disc runs faster, of course the commutator's interruptions likewise take place somewhat too soon, at any rate, not in the periods in which picture-streak current is flowing. In Fig. 3, we see in the heavy line of the curve (section represented at "R"), that part of the picture-current which goes through the relay and closes the armature cir-

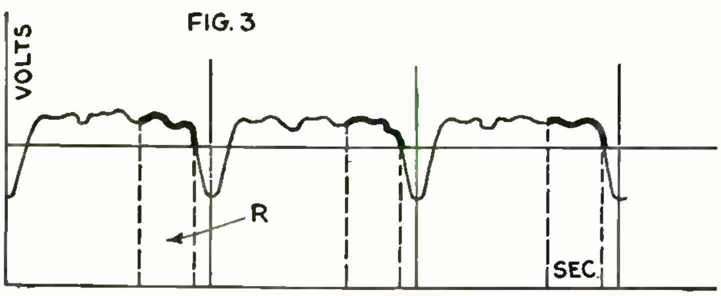


Fig. 3, at left. Shows graphically the image line current, "R", representing that part of the image current which actuates the brake relay.

cuit: for now the potential is higher than the closed-circuit current.

According to Fig. 4, this armature activates a switch, which opens the circuit of a (storage or dry battery) electro-magnet. By this means the magnet releases the brake lever, which now presses against the commutator and brakes it. The braking ceases at the moment when the Nipkow disc has reached the velocity at which the "picture-streak" and the commutator's interruptions coincide. As we see, this synchronizing system operates by braking; it is therefore necessary to have the operating motor always run somewhat faster.

Fig. 4 shows the hook-up; the neon glow-tube being connected directly in the plate circuit of the last amplifier tube. Of course, one may use any other kind of coupling. The commutator indicated here is an ordinary interrupter, which we can make (or buy) for ourselves and which has 60 slits (the illustration shows only 8, for the sake of clarity). As already mentioned, the braking is performed on the commutator, to protect the disc from any injuries which might befall it from direct braking, if it were too violent.

How to Make the Commutator

The commutator we can make out of a piece of copper or brass, 4x4x0.2 inches. After drawing a circle on it (radius 2 inches) we divide it, by a protractor, into 60 parts of 6 degrees each. In the center we bore a hole corresponding to the shaft of the motor. Now the piece of metal is either turned on the lathe, or carefully filed down to the circle drawn on it. In the edge we saw, at the marked 60 places, the slits. One must use a hack saw with as thin a blade as possible; so that the slits will not be wider than .04 to .06 inch. Into each slit we force tightly a little strip of cardboard or Bristol board, and cut off with a razor blade what projects. When all the slits are ready, we lay the disc in a vessel filled with melted paraffin, and let this stand for some time in the oven; until the strips of cardboard are well drenched through and all gaps still existing are filled up. With a rag we rub down vigorously before cooling, and remove with emery paper the paraffin remaining on the edge of the disc.

From a piece of round brass we make an adjusting ring for the commutator. A suitable hole is bored for the shaft of the disc; and a second one perpendicular to this, in which we tap a thread and insert a set-screw. Then the adjusting ring is soldered to the commutator.

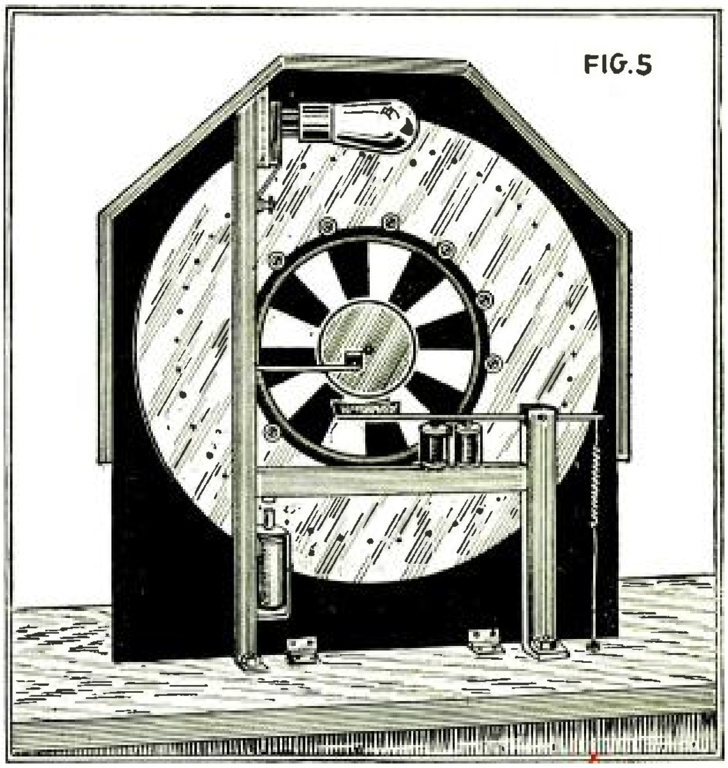


Fig. 5. Appearance of the complete synchronizing relay and brake magnet assembly.

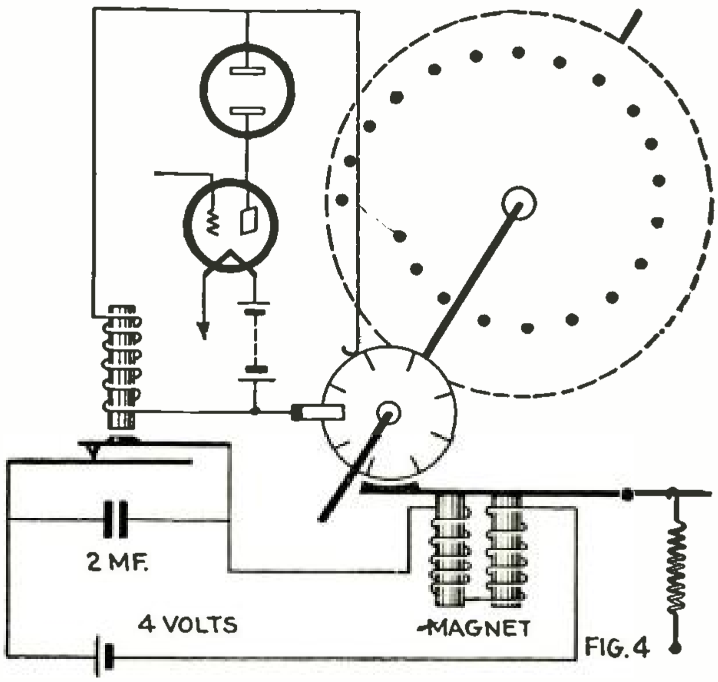


Fig. 4. General hook-up of the synchronizing brake and relay, the lower pair of electro-magnets representing the brake.

The brake lever is made of band iron, 0.6 inch wide. For a shaft there is to be soldered on a screw 1¼ inches long, which is held at each side by a strip of sheet iron; these last serving as pedestal bearings. The brake block consists of a piece of wood, rounded out, and the rounded part having felt glued to it; on the opposite side is fastened an ordinary tension spring.

Building the Brake Magnet

The electro-magnet, which may be fed by a storage battery, we can likewise make ourselves. A piece of ⅜-inch iron rod bent in a U-shape, heated to a white heat and slowly cooled off, serves as core. Two coil bobbins fitting on it are wound with copper wire, No. 24 B & S gauge, double silk covered. The number of turns cannot be given; since the necessary magnetic force depends on whether the brake lever can be pulled down easily, or with more difficulty. Pay particular attention to see that the direction of winding of the two coils is *opposite*, in order to produce North and South poles.

The contact board, the construction of which is shown in Fig. 6, consists of insulating material. The springs are to be bent out of German silver, brass ribbon, or, best, of phosphor bronze. One spring bears on the edge of the disc, the other on the rim of the commutator.

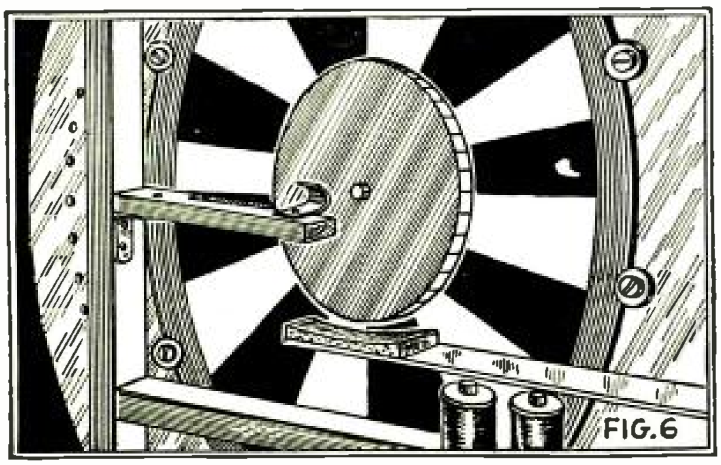


Fig. 6. At left, close-up view of commutator brake and contact brush.

(*Continued on page* 384)

Controlling the "Output" Quality

By GEORGE H. HABY

I HAVE seen the inquiry in TELEVISION NEWS for television accomplishments, etc., so here is mine:

I have a four-stage radio-frequency receiver, with two-stage audio using transformers; the tubes are 224, 227 and 245.

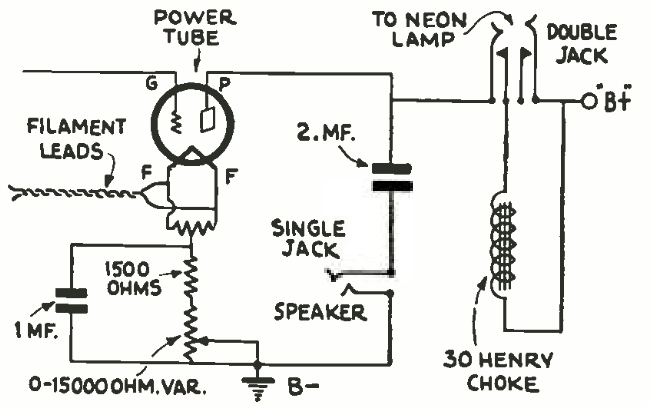
With this article I send a sketch of my output to speaker and neon lamp. With this arrangement one can retune the set while operating the televisor, and still hear the signals. You will find the neon tube (furnished by the Jenkins Company) makes a fairly good load, for impedance, to a speaker; and there will be very little effect on the glow of the neon tube, when the speaker is plugged into the single-circuit jack as marked on sketch. This arrangement will be a very good help to those who have a very sensitive receiver, or (in my case) on account of the little fading of the Jenkins broadcast station. The grid-bias system that I am using will be a great help to those who have trouble with images which are nothing but black and bright white without detail, when the radio receiver is tuned to a good volume. By turning on more grid-bias resistance, the picture will become dimmer, but it will be much clearer in detail; that is if you have a good audio and detector system.

My receiving set is a home-constructed outfit, shielded with copper wire screen (which I described in an article appearing in the March issue of RADIO CRAFT, page 540.)

I tried resistance amplification but had trouble with double, triple (and sometimes more) images in the picture. I am now using transformer audio; 6 : 1 in first stage, 2 : 1 in second stage, with primary windings reversed in first stage to give me a positive picture.

I can truthfully say, that between the slight fadings of the Jenkins broadcast station, I can see the pictures of Lee DeForest and Mr. Replogle more distinct than the pictures photographed in the May-June issue of TELEVISION NEWS (page 95). The moving pictures which have more than one moving object will not come in satisfactorily; possibly because my audio will not carry the frequency. These signals are being received in the city of Akron, Ohio, 400 miles from Washington, D. C.

I have a complete radio experimental laboratory and would like to get in on some of these special test broadcasts if I knew when they would be on the air; and also whatever new is on in television.



Here is Mr. Haby's "output circuit", successfully used on his television receiver at Akron, Ohio. He viewed images picked up from Washington, D. C. (400 miles away!) and other stations.

Tinfoil on Neon Tube Brightens Image

THOSE interested in television reception will doubtless feel an interest in the construction or, rather, the adaptation of a neon lamp for television. Naturally the results obtained with the lamp are not so good as with those actually on sale for television purposes; but it affords the amateur an economical way of getting initiated into television.

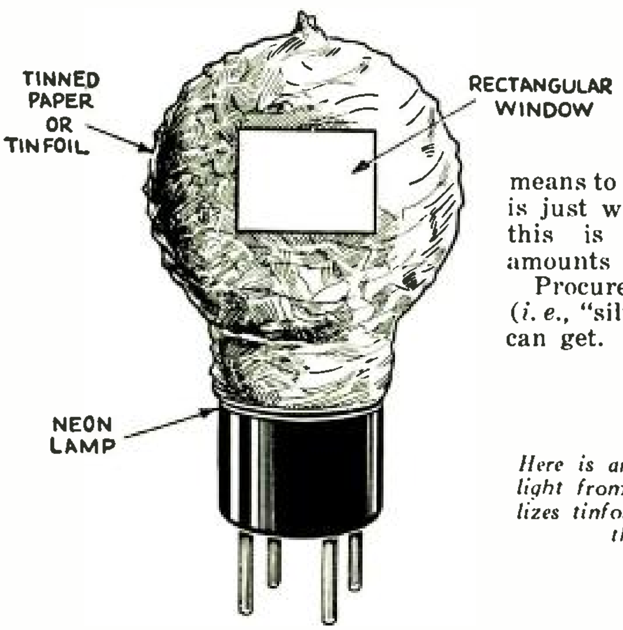
To "make" our television lamp, one must procure at any electrical store a small neon lamp; say, of the kind having in the interior a small metal letter. Housed as it is, one will note the inconvenience of the plate's not being illuminated evenly enough everywhere for the television image to appear with sufficient clearness. A means to overcome this inconvenience is just what we are to describe, and this is what our "construction" amounts to.

Procure a sheet of tinned paper (*i. e.*, "silver paper") as bright as you can get. (Tinfoil can also be used.) This can be obtained easily from the wrappings of chocolate and other dainties; but bear in mind that some are wrapped in *aluminum* paper, which is not so brilliant or so malleable.

Cover the bulb of the neon lamp with varnish or any very transparent substance suitable for gluing; and neatly put on the silver paper, smoothing it carefully and having the brighter side toward the inside. Leave a "window" of rectangular shape corresponding to the height of the spiral, and the distance between two consecutive holes of the television disc; or say, 1.2 inches wide and 1 inch high.

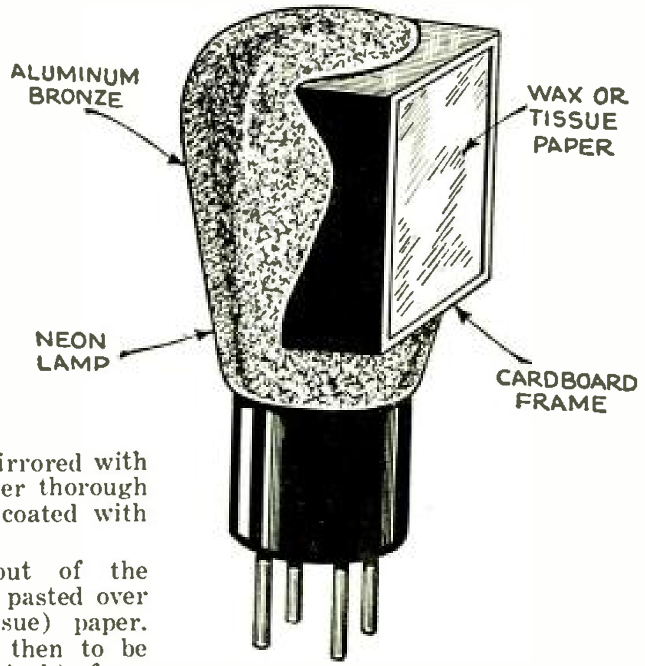
If the silver paper has been carefully smoothed, one will get an inside surface reflecting the light in all directions; and in the window there will appear in view a rectangle of intense light.

In this manner, the constructor avails of the maximum light—not merely that from the front part of the plate, but also that which is produced on the opposite surface—which is reflected by the silver paper and so gives a most satisfactory luminous effect.



Here is another idea for intensifying the light from a neon glow tube, which utilizes tinfoil or "tinned paper" glued over the outside of the tube.

These small commercial neon lamps have inside them, in the lower part of the socket, a resistance of high value; which is not prejudicial, since the lamp functions equally well with it, but requires so much higher voltage for functioning. One obtains a little more luminosity, with less voltage, by cutting out the resistance and connecting the lamp in the radio circuit; but under these circumstances he should take care not to light it from the power main. Without the internal resistance the current will be so strong as to burn out the lamp and make it useless.—*Radio Revista.*



One method of improving and conserving the life of a neon tube, by using a shield and also aluminum bronze over the outside of the tube.

RECENTLY, H. Tzschentke has recommended, in *"Funke-Bastler,"* a small alteration of the glow-lamp in order to make better use of its light. In fact, he proposes gluing on the bulb of the lamp (with white lacquer or shellac) the frame shown in the illustration, which is made of stout cardboard. It rests firmly against the glass and has in front a rectangular opening 1 5/16"x1⅞" (inside measurements). The edges must be perpendicular to the base of the lamp. The free part of the bulb is mirrored with aluminum bronze and, after thorough drying of the bronze is coated with black spirit lacquer.

The rectangular cut-out of the cardboard frame is to be pasted over with silk (waxed or tissue) paper. The luminous surface is then to be placed about 3 mm. (⅛-inch) from the perforated disc. This arrangement has the advantage that the light of the glow-lamp is concentrated on the Nipkow disc, and is not previously radiated in all directions. Besides, the entire waxed paper surface is more evenly illuminated, through its greater distance from the cathode. The picture screen is to be put in front of the perforated disc.—*Rafa.*

Synchronizing the Televisor

THOSE who have followed previous explanations about the construction of television receivers will be interested in the explanations given for maintaining synchronization in the receiving set.

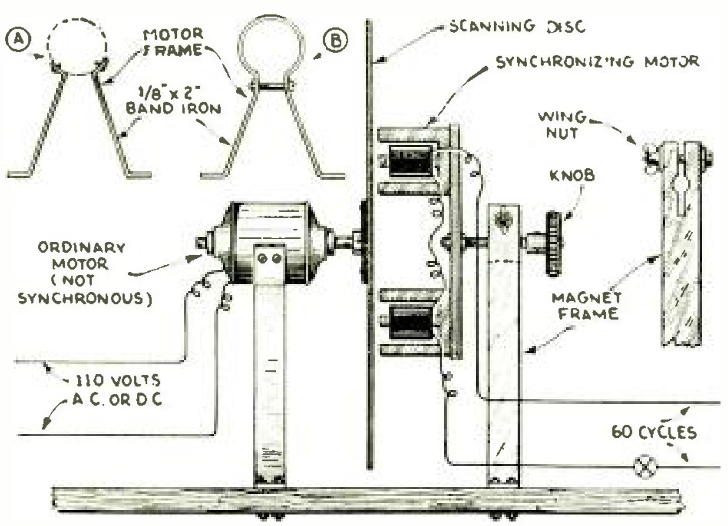
The procedure consists in using the 60-cycle alternating current to keep the speed of the receiving disc constant.

For this purpose the disc is a sheet of iron, a millimeter (.04" or 3/64") thick, there being left in the center six spokes about ¾-inch wide, the rest being cut out. Examine the drawing, which shows the details.

By means of a support, two electro-magnets (2 old A.F. transformers may be used, connecting to the primaries) are mounted in the manner indicated in the drawings; in such a way that the two pass simultaneously in front of two of the iron spokes.

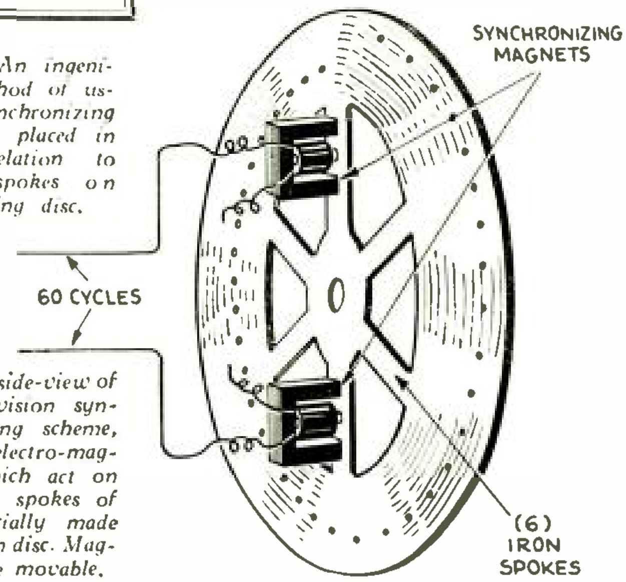
The coils of these electro-magnets are connected with the alternating current by means of a switch. If the set has already a disc of aluminum or some other metal, one can fasten to it, by means of screws, strips of iron 1 or 2 mm. (.04 or .08 inch) thick; so as to form 6 equidistant spokes. The dimensions of these spokes (strips of iron) will be such as to cover the width of the electro-magnets.

To synchronize the receiving disc, start the motor without applying current to the electro-magnets; by means of the resistances, regulate the speed of the motor. When the image appears in the exact square, suddenly connect the electro-magnets to the A.C. 60-cycle supply. A horizontal balancing of the image will be seen, and this will go on diminishing, little by little, until it is perfectly steady in the square.—*Radio Revista.*



Right: An ingenious method of using synchronizing magnets, placed in close relation to iron spokes on scanning disc.

Left: A side-view of the television synchronizing scheme, using electro-magnets which act on the iron spokes of the specially made television disc. Magnets are movable.



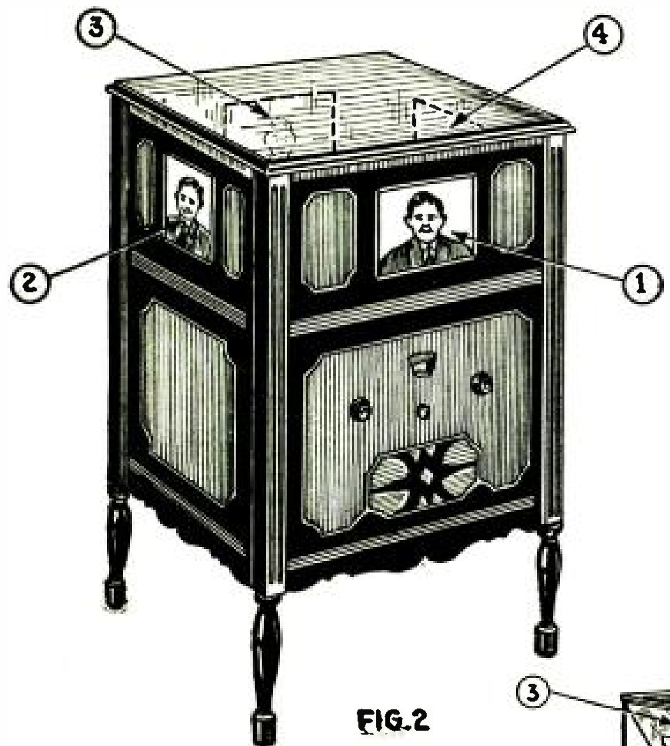


FIG.2

Above: Another design of multi-screen television cabinet and receiver, the same image appearing on all four sides of the cabinet.

Right: One form of the multi-screen television receiver, utilizing mirrors or other screens on which four or more scanning beams reflect the same image.

The "Multi-screen"

MAKES IMAGES Visible From *All Angles*

By C. MAGGI

The nucleus of a revolutionary idea in television scanner design is here revealed. By projecting multiple images, persons in any part of a room can view them.

THERE is one objection to all of the television receivers of today as the writer sees it, and that is—the few persons who can see the image have to crowd together so as to be in a fairly straight line with the lens (or small screen) upon which the image is projected. With my "multiscreen" idea, here illustrated, one can see the image from any side of the room and the drawings show one method whereby the four (or more) images may be projected upon screens on four sides of the television cabinet.

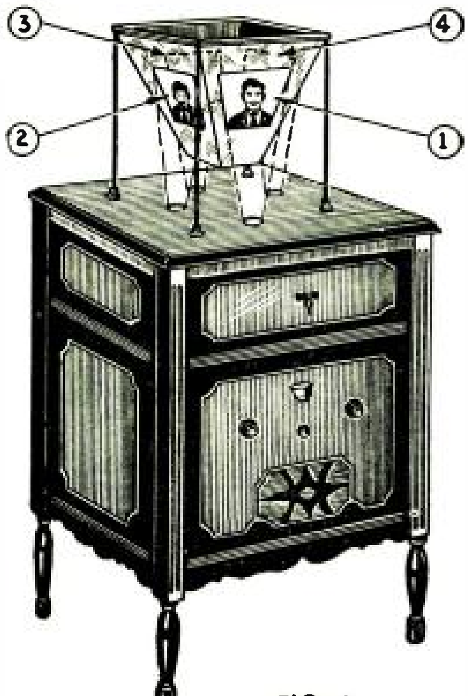


FIG. 1

In the simple scheme which the drawing here discloses, a synchronous motor may drive a master gear; and this in turn would mesh with, say, four gear pinions, mounted on the ends of the four scanning-disc shafts. Behind each scanning disc is placed a neon tube, which may be of the new high-intensity "crater" type, together with a suitable lens assembly; or else the new lens type discs may be utilized.

Another scheme, which can be readily worked out by optical experts, would involve the use of but one neon crater tube for instance, with a lens scanning disc mounted over it in a vertical position; the four screen images can then be produced by optically reflecting the beam of light coming from the single revolving scanning disc, by a suitable arrangement of prisms and mirrors. The single scanning beam could, in other words, be so reflected as to show on the four (or more) screens simultaneously.

At first thought, one might believe

Right: Changes in speed are caused by improper alignment of gears. Below: Gears driving four scanning discs, a neon tube being placed behind each disc.

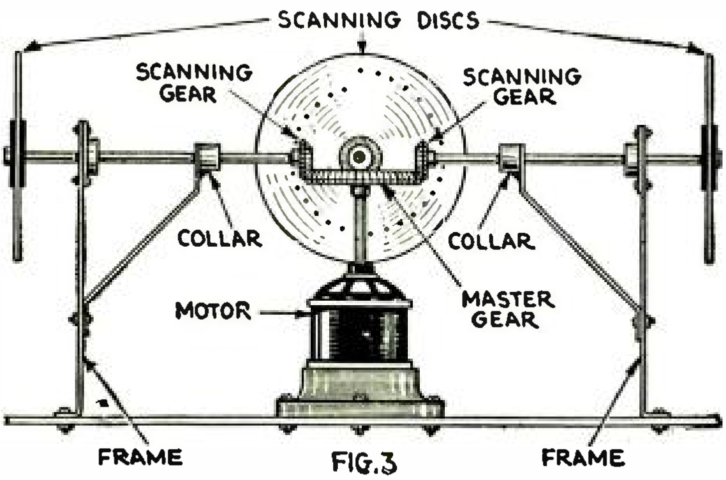
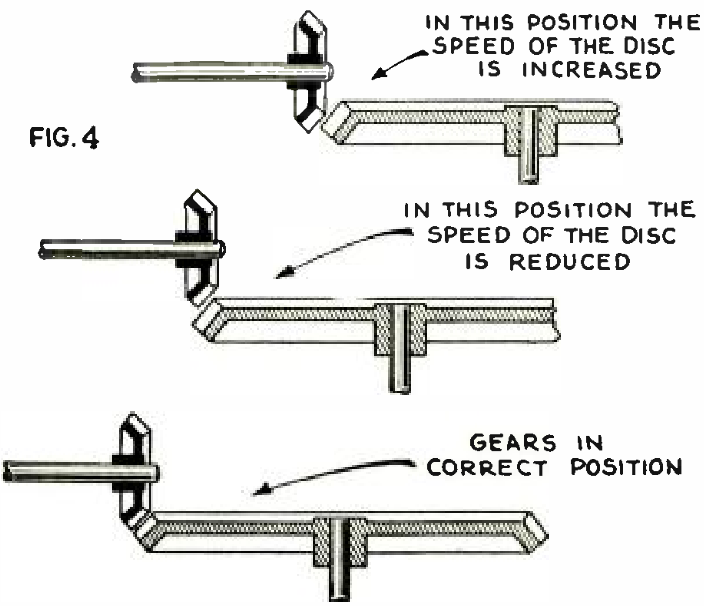


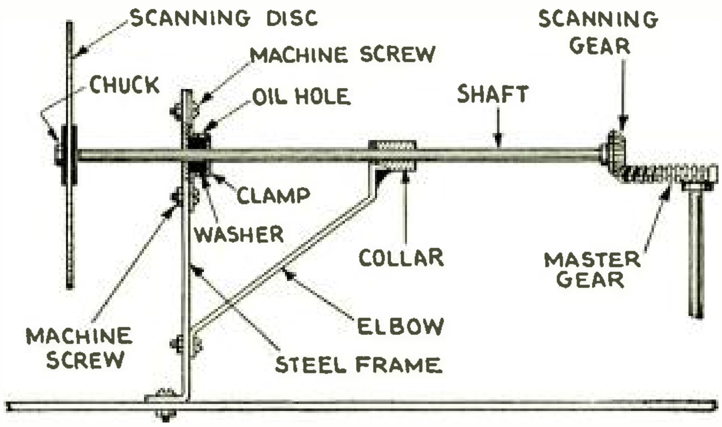
FIG.3

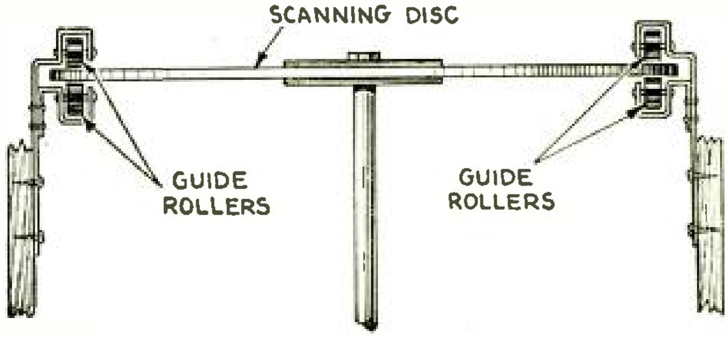
FIG.4



that it is much more expensive to build a "multiscreen" receiver; but such is not the case, since it would cost but a little more than the ordinary single-screen receiver. The essential parts needed are: four scanning discs, four neon tubes, four screen assemblies, one upright motor and five gears. In assembling the multiscreen scanner, mount the motor to the baseboard. The master gear (4 inches in diameter) is mounted at the end of the motor shaft, and four gears (2 inches in diameter) are mounted about the master gear (90 degrees from each other) with a ¼-inch shaft 7 inches long. One end of the shaft goes to the scanning disc and the other to the scanning gear, which is revolved by the master gear. (See Fig. 3.)

Below: Detail of a single scanning disc and shaft with support bearings.





Above: Fig. 5. The edges of the scanning disc are prevented from wabbling by guide rollers as shown.

The four scanning shafts are supported by means of a four-sided steel frame, with its associated collars, etc., thus making a rigid support for the scanning shafts. Care should be taken in mounting the scanning gears; for the displacement of one gear as little as 1/32 of an inch will alter the speed of the scanning disc (see Fig. 4). Two sets of guide rollers are also provided for each scanning disc (Fig. 5).

For aligning the scanning discs take the exact center of the picture frame and place across it a very fine string or wire, with a source of light behind it. Rotate the scanning disc until the first aperture is at the exact position of the string. Then fasten the motor chuck and repeat with the other three, without displacing the one preceding the one you are adjusting. In other words, the first aperture of the four scanning discs must cross the center of the picture frame at the same time.

Television Motor Driving Hints

SEVERAL motor-driving schemes of interest to the television experimenter are shown herewith.

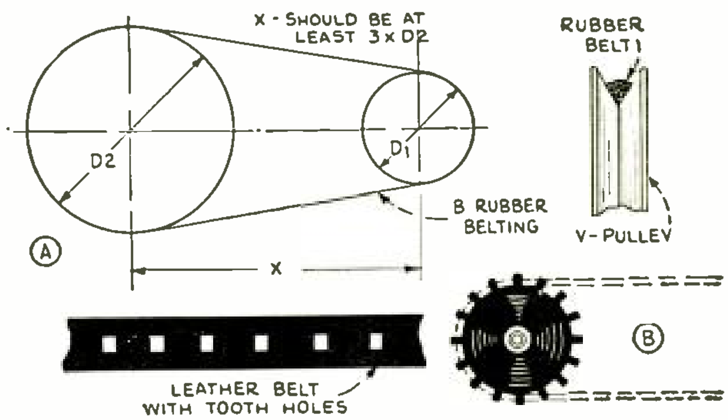
At Fig. A, we see that unless an idler pulley is used to cause the belt to press tightly against the respective pulleys, that where open belt drives are concerned, the distance "X" between the centers of driver and driven pulleys should be at least three times the diameter of the larger pulley. A very good motor drive, of the belt type, calls for the use of a fan belt, such as is employed on automobile engines, a common form of which is the "V" shaped belt. In any event, whether gear chains or belts are used, there must be practically no slippage, if the picture is to be kept steadily framed.

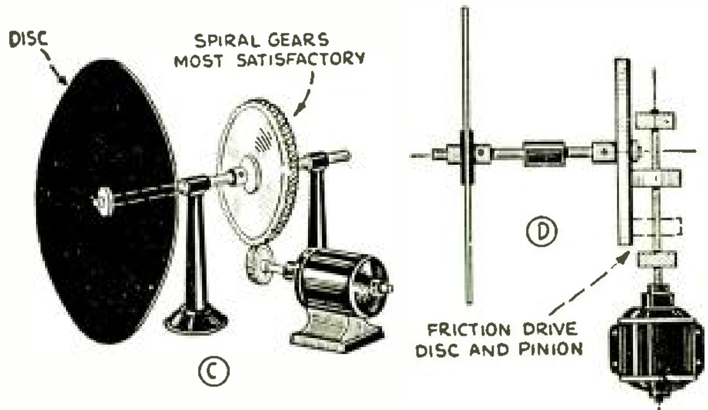
Another form of belt drive which has been used by Westinghouse and other laboratories in television experiments, involves the use of a leather belt into which square holes have been accurately punched, these holes meshing with the teeth of a specially made gear or cogwheel, as shown at B.

Gear and Friction Drives

One of the commercial (Pilot) television companies some time ago employed a spiral gear drive between the

(*Continued on page* 385)





Figs. "A" to "D", above, show various ways of driving a television scanning disc. "A" shows proper spacing of pulleys with belt drive. "B" shows notched belt and spur pinion drive. "C" shows spiral gear drive and at "D" we have the sliding friction pinion.

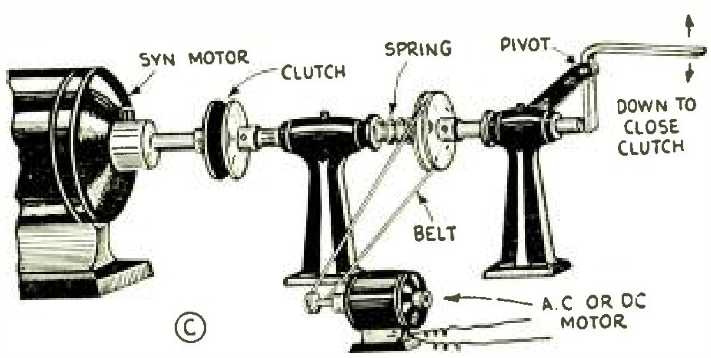


Fig. "E" (left) shows one method of arranging a clutch between a synchronous motor and its accelerating motor.

NOVEL TELEVISION IDEAS

As Seen Through European Eyes

(A Flash from Vienna)

Some brand new angles on television from Europe, including the latest ideas on scanning by spiral mirrors, instead of Nipkow discs; modulating an electric arc directly with the television signal; new amplifier circuits and latest photo-cells.

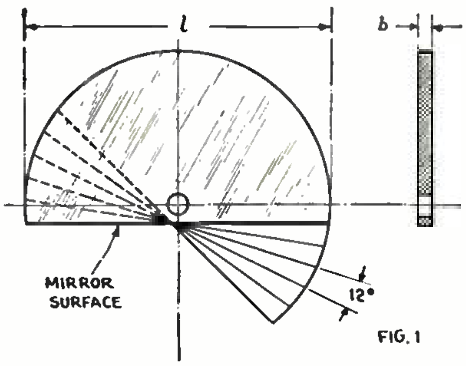


Fig. 1—Section of a spiral scanning mirror, indicating the principles of its design.

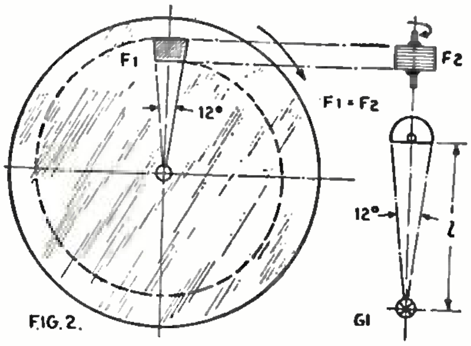


Fig. 2—Showing the comparison between a spiral mirror and Nipkow disc, for the same size picture F.

Spiral Mirrors

ONE of the most important television novelties of the past year is the analyzing apparatus known as the spiral mirror (built by the Telehor Co., of Berlin); this really forms a special kind of mirror wheel, and in design and mechanism far surpasses the mirror wheel. As with the mirror wheel, there are two possibilities of designing the spiral mirror: first, with reflecting surfaces, parallel to the axle and simply set at the necessary angles to one another; in the second design, the reflecting surfaces are set also at a definite angle to the common axle.

Fig. 1 shows a section of a spiral mirror, indicating the principles of its design. The width "b" of the reflecting surface defines the breadth of the pictorial element, and the distance *l* the line length of the picture. The number of mirror segments determines the number of lines; the width of a segment being the determinant of the width of the pictorial element. It is evident that the necessary dimensions are very much more compact with the spiral mirror than with the Nipkow disc; since for a picture 40 x 30 mm. (1.6 x 1.2 inches) the spiral mirror has about 50 mm. (2 inches) as its greatest diameter, and is composed of 30 segments 1 mm. (.04 inch) thick; while the Nipkow disc for the same size of picture has to be about 400 mm. (16 inches) in diameter. Fig. 2 shows the comparison between spiral mirror and Nipkow disc for the same size picture F (indicated by the cross-hatched surface). From the same illustration it is clear that to use the spiral mirror a differently-built glow-lamp is necessary; this must be either a "dot lamp" (casting a point of light) or a wire glow-lamp. The breadth of the luminous cathode must absolutely conform to the breadth of the pictorial element. Hence, it is plain that with such glow-lamps, operating conditions being otherwise equal, greater light intensities can be attained. It is important in looking at the picture that the distance "*l*" of the glow lamp from the spiral mirror be large enough so that the extreme edges form an angle of 12 degrees with the glow-lamp.

Some hints and ideas for the construction of complete modern television receivers incorporating *spiral mirrors* have been given; one of the examples is shown in Fig. 3. The glow-lamp and analyzer are so mounted that the rays of light pass above the radio tubes and produce the picture in the mirror at the right.

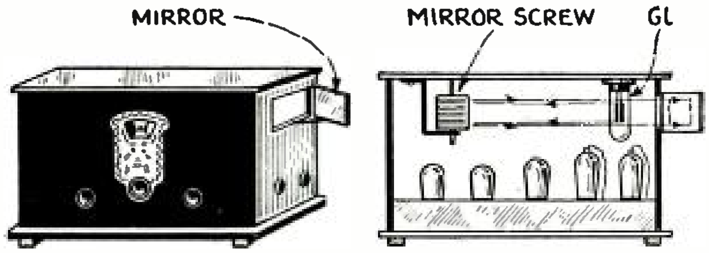


FIG.3

Fig. 3—At the left, shows one arrangement of glow lamp "GL" and rotating spiral mirror, placed inside of television receiver cabinet. The image is observed on the flat mirror, at the end of the cabinet.

Different Scanning Schemes

There was some discussion of the position of the picture with regard to the Nipkow disc; since, as is well-known, the picture (in Germany) is received as in Fig. 4a; while Baird in England transmits according to 4b. In general, it seems at first glance indifferent which way the picture is put; and at most one might assume that the horizontal scanning (4a) should flicker less and not produce the impression of rain. The advantage of the Baird design does not become clear until one has worked with it for a sufficiently long time. At the same

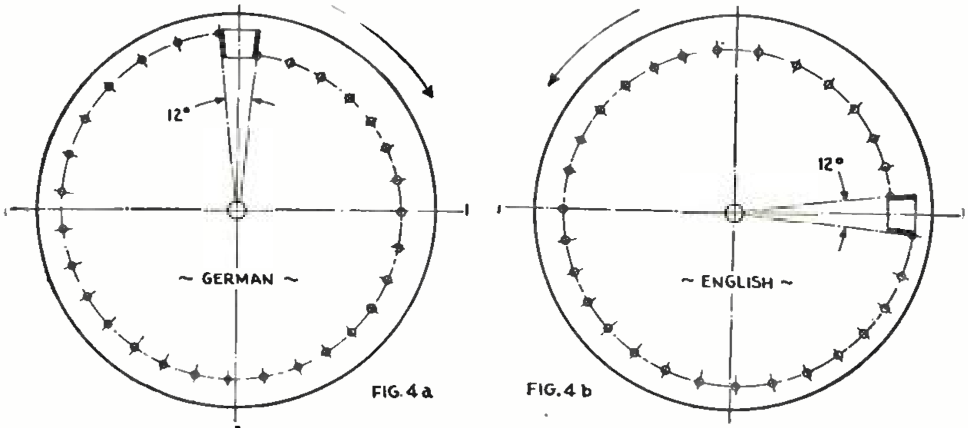


Fig. 4—A, above at left, shows how a picture is scanned at top of disc in Germany and America, while Baird (England), transmits and receives the image at the side of the disc, as at 4-B.

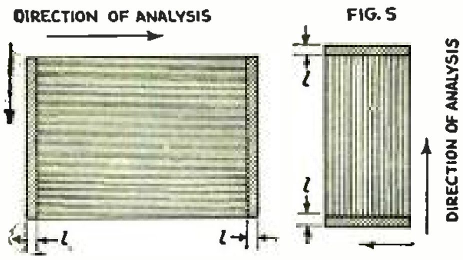


Fig. 5—Shows two different directions of scanning and narrowing of the real picture field, occasioned by some methods of synchronizing.

time, one must keep in mind that the general introduction of television will not be practical until the set is very cheap. Let us consider the pictures resulting from the two kinds of transmission more closely and assume that in both cases only such special synchronizing means as the ordinary, simple La Cour (phonic) wheel is used. This, without any local oscillator, is stimulated by the line-frequency specially provided by the beginning and end of each frame. As many of us know, the line-frequency (375 cycles) is obtained by masking part of the frame until the real picture field is narrowed by the width of two pictorial elements. Accordingly, the black lines are exactly as wide as the pictorial element itself.

The screened strips are represented by the dark streaks in Figs. 4 and 5. Now, if the phonic wheel is in parallel or in series with the glow lamp (as in Baird's original apparatus) then, in case any action is taking place in the pictorial fields, the frequency of 375 cycles seldom comes out sufficiently strong to carry along the synchronizing wheel; this weakness causes a rocking or swaying of the picture.

In the German system, the frequency mentioned can very easily arise undesirably; since the direction of scanning coincides with the direction of motion in the picture. A moving hand or a gymnast (especially in silhouette) would at every movement of the body by the hands or the bar in the scanning direction carry the picture along; and, without a strong local oscillator, the picture would never remain perfectly still. In the English method, or the Jenkins method, this cannot so easily happen.

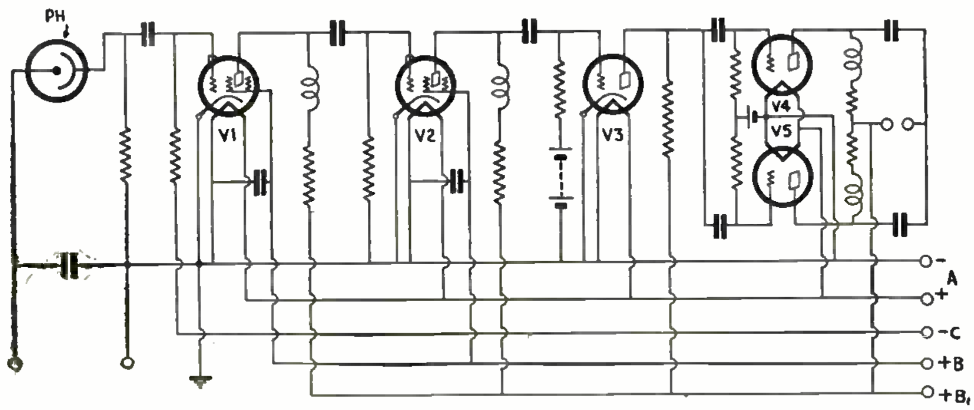


Fig. 7—Amplifier circuit for television transmitting purposes, showing photo cell PH at left; its characteristics being shown at Fig. 8.

Baird Modulates An Arc Directly

The methods of analysis have undergone another novelty. Baird has lately shown a transmitter and receiver with three frequency-channels, and has also demonstrated his new system of *direct control* or modulation of a small arc lamp in operation. With this the question of a fairly great light intensity without the complicated (and for the general public, impractical) Kerr cell would seem to be solved. The three-channel receiver has given recognizable pictures of eleven persons with great light intensity. The picture was projected by a Weiller mirror wheel on a ground-glass screen and was clearly visible in an otherwise bright room. This is due chiefly to the extremely high efficiency of the modulated arc lamp.

Photo Cells Advance Greatly

Parallel with the general development, the photo-cells also have been so much improved, on account of the colossal sound-film development, that now one needs but two stages of amplification. Just consider that in America alone there are about 20,000 sound-film theatres. Cells with hydrogenated-potassium coating and rare-gas contents now manifest in practice very high sensitivities; many times greater than those of vacuum cells, as shown in Fig. 6. For practical purposes, however, the sensitivity of the potassium cells is somewhat unfavorable with regard to their selectivity; since it falls in the blue-violet field and, for ordinary light sources (especially for incandescent-lamp light) high sensitivity to red-yellow would be needful.

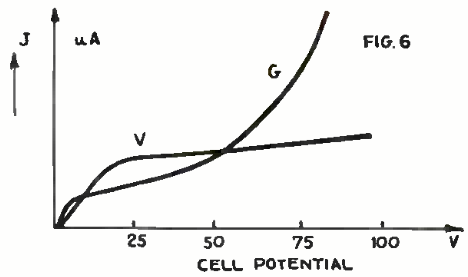


Fig. 6—Shows increased sensitiveness of new gas-filled photo-cells (G), compared with ordinary vacuum photo-cells (V), J indicating degree of light.

Here the last year has again produced almost incredible things. Both in America and on the Continent new cells have been evolved; especially Dr. Zworykin's magnesium-cæsium cell and L. R. Koller's cæsium-oxide-silver cell (General Electric Co.). Dr. Ives (Bell Telephone) likewise has evolved a cæsium cell, which represents a sort of mean between the two above mentioned and contains slight traces of sulphur and oxygen. In our case (Germany) came the wonderful cæsium cell of Drs. Geffken and Richter (Thuringer Vakuumrohren-Fabrik O. Pressler), which as a vacuum cell is superior to the previous rare-gas cell, and is about a tenth higher in sensitivity than the latter.

In all the cells mentioned, the field of highest sensitivity falls in the red-yellow range, which is just the most sensitive for incandescent-lamp light. These go by the name of "monoatomic cells"; since the cæsium photo layer lies so thinly on the silver or magnesium underlayer, that one assumes it is of the same thinness as the dimensions of the atoms themselves (single-atom layer).

Caesium Cell Combined With Amplifier Tube

Besides the ordinary cells, two new forms have been evolved, as for example (according to Zworykin) a

(*Continued on page* 387)

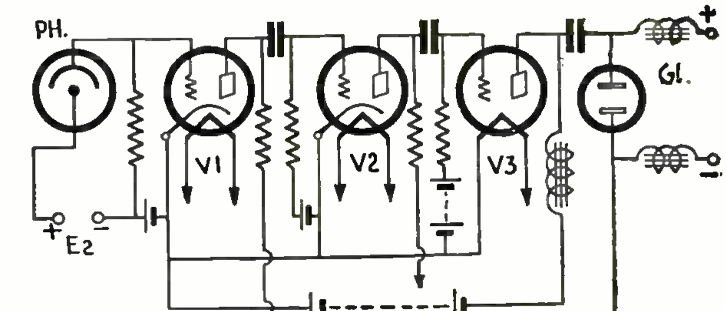


FIG. 9

Fig. 9—Another television photo-cell amplifier employing resistance-coupled stages.

Keeping In Step

By HENRY TOWNSEND

Every student of Television, especially the gentle art of "Synchronizing," will find the various methods here described for maintaining constant speed, of great interest.

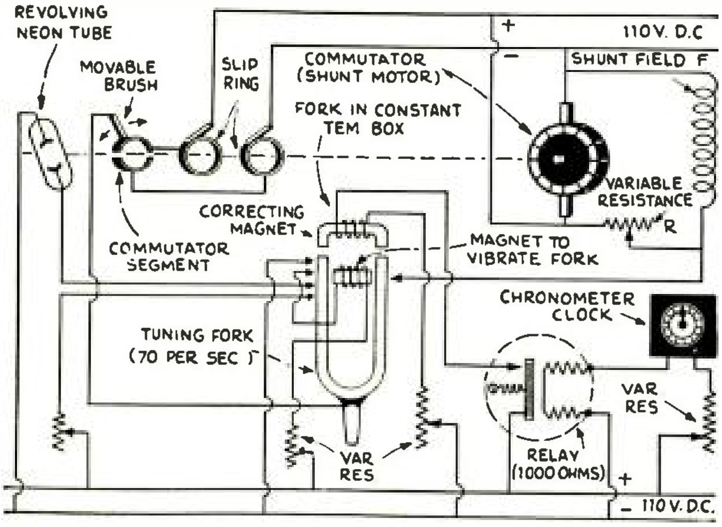


Fig. 3—"Constant speed" motor control circuit devised by Capt. R. H. Ranger and used in maintaining telephoto motors at constant speed of rotation.

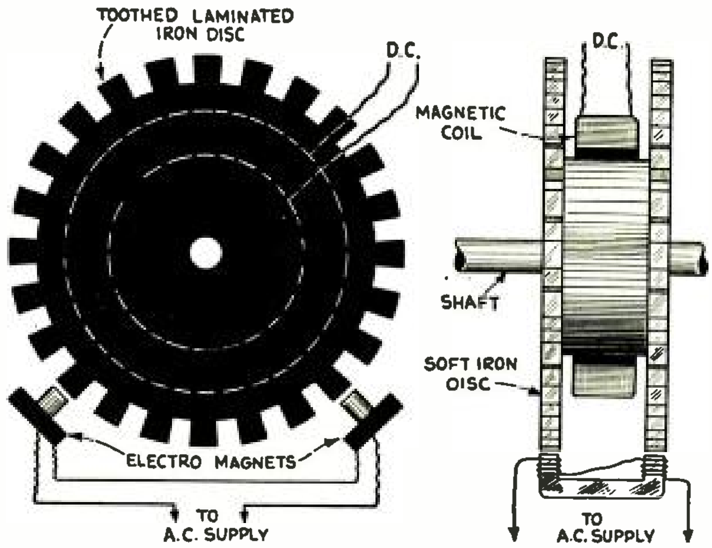


Fig. 2—Simplest design of synchronous motor with D.C., excited field, which should prove of interest to all television and picture transmission enthusiasts.

WHILE the hints herewith offered on the problem of synchronism and its solution may not be applicable to our immediate problem of keeping the scanning disc rotating at an absolutely constant speed for the reception of television images now being broadcast, they will provide interesting food for thought which may prove useful in television and picture transmission work.

In the diagram at Fig. 1, there is shown a method of producing a constant high frequency A.C. source, and one which has been used in the laboratory for the purpose of maintaining synchronism between telephoto transmitters and receivers. This system utilizes an electrically driven tuning fork, a correcting electro-magnet being periodically energized by a contact on the pendulum of an accurate clock. The vacuum tube, in connection with the two sets of electro-magnets placed on either side of the tuning fork prongs, maintains a constant vibration of the fork, and the high frequency alternating current super-induced in the circuit is passed through an output transformer into a V.T. amplifier.

The A.C. output from the amplifier may be applied to two or more synchronous motors, each motor having on its respective shaft also an ordinary type driving motor.

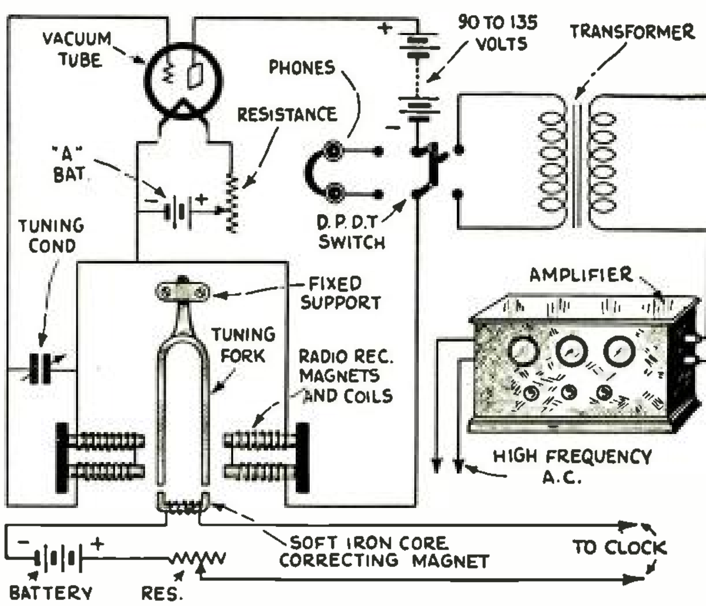


Fig. 1—Circuit for the production of a constant frequency A.C., suitable to be applied to synchronous motors on picture or television machines.

Fig. 2 shows a simple phonic wheel type of synchronous motor, which may be used on telephoto or television machines, in connection with a source of 100 to 1,000 cycle A.C., developed from a source such as that shown in Fig. 1, for example.

Two electro-magnets act on the toothed iron disc and if it is desired to have this motor of the true synchronous type, the toothed iron disc, or rather two of them (as shown on the right of Fig. 2), may be joined by a central laminated iron section, around which there is placed a stationary magnetizing coil which is supplied with direct current. In this case the two-pole A.C. electro-magnet, also with laminated iron core, may be placed as shown so as to co-act with both sets of toothed rotor discs.

Fig. 3 shows an interesting diagram of the synchronizing method developed by Capt. R. H. Ranger for maintaining constant

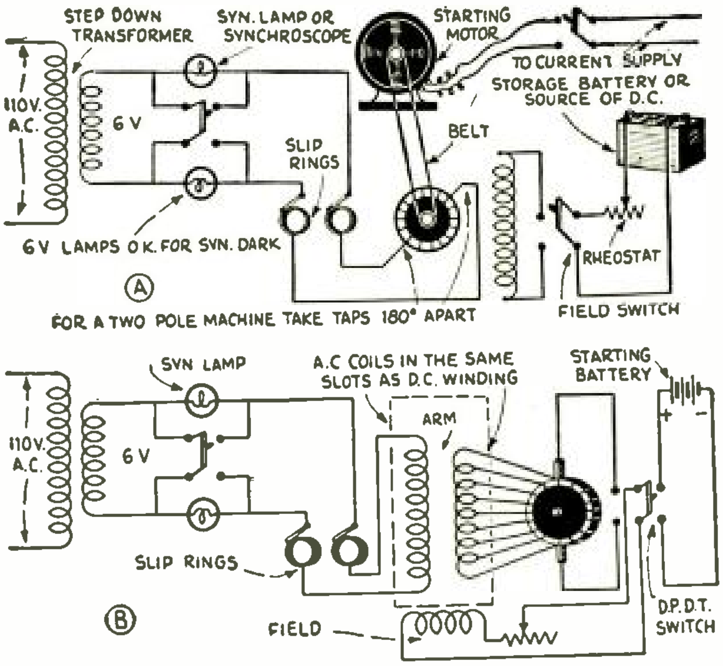


Fig. 4—Two methods of arranging small motors to operate in synchronous style with D.C. excitation of the field windings.

speed on his telephoto transmitting and receiving machines. As will be seen an accurate clock operates a relay, say once a second; the rélay closing the circuit through a correcting magnet, which acts on the vibrating prongs of the tuning fork shown. This is an electrically operated tuning fork, which is placed in a temperature controlled box, in which a constant temperature of say 70 degrees is maintained by using thermostats, heaters, etc. As the legs of the fork vibrate back and forth, they cause pulses of light to appear in the revolving neon tube when the motor is rotating in synchronism. The neon tube will appear to stand still when the motor is rotating at synchronous speed. The fork also controls the shunting circuit in conjunction with the field of the motor which acts so as to weaken and strengthen the field periodically, and thus maintain constant speed of the motor. Small motors, such as battery motors, have been operated in synchronous fashion from step-down transformers and the like. At Fig. 4-A two slip rings are fitted on the motor shaft and these are connected to two leads joined to two commutator segments 180 degrees apart (for a two-pole field). The synchronous motor is accelerated by an auxiliary motor belted to it. When the synchronizing lamps are dark the A.C. switch is closed, feeding A.C. through the slip rings into the armature winding of the motor. The D.C. field switch has been previously closed of course.

For those interested in synchronous motors, an interesting circuit is shown in Fig. 4-B. Here the armature of the machine has A.C., as well as D.C., windings placed in the same slots. The separate A.C. winding in the armature slots connects to the slip rings into which A.C. is fed at the moment when synchronizing by lamps or other means; while the D.C. excited field of the motor is switched from a storage battery D.C. supply, to the D.C. terminals coming from the brushes of the commutator.

An interesting synchronizing scheme for television discs is that shown by the diagram of Fig. 5. This idea is predicated on the fact that the transmitting station must send out an extra strong impulse while the last two holes in the spiral are passing. This arrangement would have to be worked out in conjunction with the television transmitting stations of course. As shown at the right of Fig. 5, the television signals according to this scheme (due to Geloso, formerly one of the Pilot Company's television experts), are fed into the regular neon tube in the fashion indicated, while a tuned, steel reed relay is supplied with the proper strength of current from a potentiometer as shown. Now for example, if the two first or two last holes of the scanning spiral on the transmitter disc have been blanked, and if a special contact is caused to liberate a stronger pulse of current from the radio transmitter at the television station, this stronger pulse of current when it passes through the amplifier tubes of the receiver, will cause the relay to attract its carefully adjusted reed-armature, closing in turn the battery circuit through the synchronizing magnet between the legs of which the receiver scanning disc is rotating.

An iron button or armature is fastened on the scanning disc; it will now be evident that if, as the disc rotates, the iron button is not in exact line with the magnet poles when the synchronizing impulse arrives, the magnet will tend to attract the iron button and yank the disc either backward or forward to the proper position. This scheme was tried out in 1928 by Mr. Geloso and was said to have worked satisfactorily.

In the diagram on the left of Fig. 5, a second electro-magnet is shown encompassing the scanning disc. This represents one scheme of attempting to regulate the speed of the rotating disc, the magnetic drag set up between the revolving disc and the magnet poles tends to reduce its speed. The amount of magnetic "drag" is controlled by means of a rheostat in series with a battery as shown.

Dan Beard, Veteran Scout Master, Says of "Television"

DAN BEARD CAMP (Inc.)
Box 218, Suffern, N. Y.

July 14, 1931.

Mr. Eric Palmer,
Shortwave and Television Corp.,
Eighth Ave. and Fourteenth St.,
New York, N. Y.

My Dear Mr. Palmer:

My greatest interest is in the development of our youth in mind, morals and physique and to build up these qualities, the five senses must also be developed to the greatest degree, for as you know our character is made up of impressions, and, "the more sensitive one is to these impressions, the greater is one's capacity for development". Therefore, speaking as a man of a one-track mind, **the opportunity for usefulness of television, as an educational medium, is practically unlimited, be that education good or bad.** *This places a tremendous responsibility upon your shoulders, a responsibility which I believe you fully appreciate and will accept as a medium of doing your good turn to the world.*

Hastily but cordially yours,

(Signed) DANIEL C. BEARD.

DCB/AAC

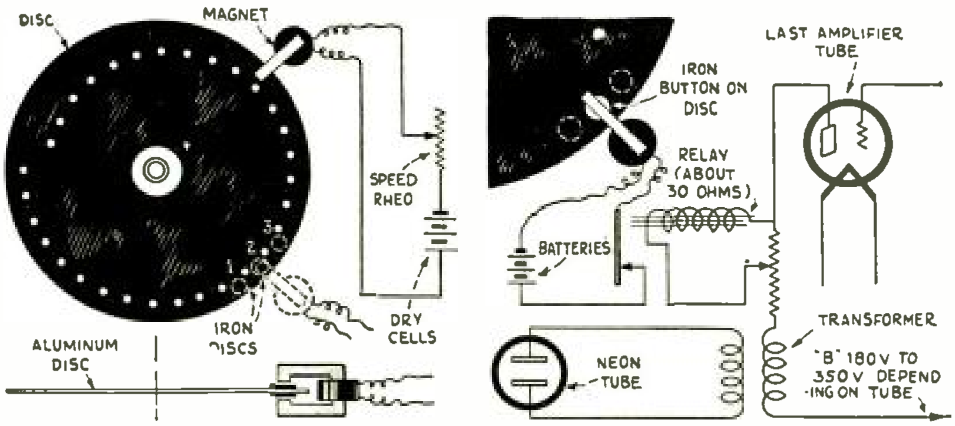


Fig. 5—The Geloso method of maintaining synchronism of a television scanning disc. An extra strong impulse or signal is supposed to be transmitted once in every revolution of the "transmitting" scanning disc. These extra strong currents actuate the relay shown, which reacts periodically, closing the synchronizing magnet circuit placed close to the disc as illustrated.

CAN THE *AMATEUR* HELP PERFECT TELEVISION?

"Yes!" says A. G. Heller, Chief Engineer, Insuline Corp. of America—250,000 television amateurs and $12,000,000 market waiting!

TWO powerful television groups are arrayed in battle, to decide whether or not the path of television development will follow that of radio through the cellar, attic, and workshop of every American "home mechanic," or be secretly developed and perfected in the laboratories of the great research organizations.

Television is not ready for the public, say one group. Their arguments for the "secret" development of television are largely based on the difficulty of putting entertainment into television programs at the present time, and the adverse public opinion that will be built up by having the great mass of people come in contact with the crudities of a growing art. For the sake of brevity, let us sum these arguments up. They say:

The Negative Argument—Does It Ring True?

In so highly technical an art as television, the home experimenter can not hope to develop and build for himself any apparatus which will prove otherwise than disappointing. Better keep what progress has been made, completely under cover, until such time as the television art can be presented to the public in completed receivers ready for home use. If mechanical scanning is presented to the amateur at this time, should the cathode-ray system finally merge in practical form, most of the equipment developed or used in the home workshop would immediately become worthless and obsolete. Furthermore, why allow the experimenter to buy equipment when programs are but meagre and spotty?

Most of the statements by members of this group are only ramifications, or enlargements of the above reasons for keeping television development in the large commercial laboratory.

Television Is Ready for the Amateur!

On the other side we have a host of "independent experimenters" who **claim that television is ready for the amateur to develop!** They agree that the art has not progressed sufficiently to allow for the presentation to the public of a finished and perfect product. They admit that television is yet crude and, to any but the enthusiast, possibly unentertaining. They are perfectly willing to concede that television is not ready for the parlor. But they contend that, just because it is not ready for the parlor, there is no reason that it should not be allowed in the amateur's workshop. This group contends that television is ready for the home mechanic and they back up their contention as follows:

How Amateur Helped Develop Radio

The analogy with radio does hold. In 1920, when broadcast programs became available to the home experimenter, reception was greatly inferior to the only comparable medium of reproduction, the phonograph, as it then existed. Thousands upon thousands of ingenious men worked night after night, until the early hours of morning, constructing, tearing down, rebuilding, attempting to perfect sets that brought in reception, punctuated largely by howls, whistles, cat-calls and whatnot. Yet that same army of "home experimenters" provided an insatiable demand for improved apparatus, that acted not only as a spur upon the manufacturers, but also provided the necessary money to make radio's leaping advancement towards perfection.

And now the champions for open experiment in television ask, "Who dares deny every line of early radio history, and claim that this same group, who were so largely instrumental in the rapid strides during the early days of radio, would do more harm than good to television?"

(*Continued on page* 386)

Large Image Produced by New Scanner

New design utilizes horizontal scanning disc with enlarged image focused through lens on to a mirror

Illustration courtesy Insuline Corp. of America.

An enlarged image, visible to many, is seen on new scanner.

ONE of the newest American television scanner kits is that here illustrated, which occupies a minimum of space, considering that a 12" 60 hole disc is used, together with a driving motor. A standard flat-plate neon lamp is mounted under the disc and the image is picked up by the powerful lens mounted in the top of the disc housing, which in turn projects the image on to the mirror as shown. Demonstration has indicated that an image as large as 2½"x3" can be thrown on the mirror and this is then visible to a number of people instead of one. The kit of parts is sold at a nominal price.

This scanning kit, the latest addition to the well-known Insuline television line, contains all necessary parts to easily assemble and construct a practical and efficient television receiver. It incorporates several novel features which materially add to the comfort of viewing television images. Unlike the systems most commonly employed, the image is not viewed through a lens, but in a mirror and this accomplishes a threefold purpose. The angle of vision is considerably widened, permitting more people to look in, and the adjustability of the mirror permits the picture to be focused to suit the level of the observer's eyes, whether he is standing or sitting. A lens, interposed between the disc and the mirror greatly magnifies the picture to twice its normal size, without distortion or loss of detail.

(*Continued on page* 391)

New TELEVISION KITS Help Popularize *the* Art

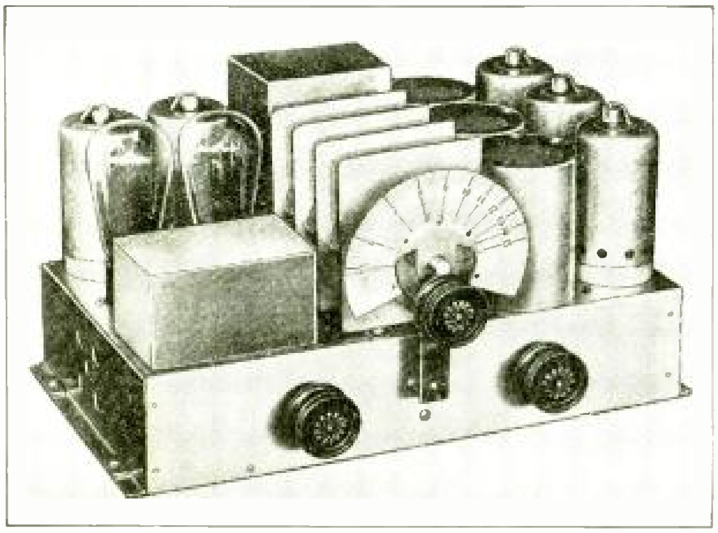
"Tuner-Amplifier" and "Scanner-Motor" Units of New Design

New Freed-Eisemann scanner kit after assembly. Note large lens.

THE well-known house of Freed-Eisemann, of neutrodyne fame, (and who can forget the early days of broadcasting, when it was a "mark of distinction" to own a neutrodyne receiver bearing this famous name), have now entered the television field. The accompanying photographs show the very excellent design and high quality A.C. operated television receiver and also scanner, each of which can be had in kit form at a nominal price.

Each of the kits contain everything necessary to completely assemble the apparatus. All of the parts are very expertly designed and of super-fine workmanship, as the writer can attest after having seen them.

Right: How the scanner kit comes to the purchaser, complete with neon tube.



Above: The Freed-Eisemann television receiver assembled.

Right: The television receiver kit, containing every part except tubes.

The Freed-Eisemann television radio receiver is an A.C. operated, seven tube, short-wave set, specially designed by their engineers to operate with their Telescanner.

The receiver comprises a tuner-amplifier, the tuning element consisting of two screen-grid R.F. amplifier stages, with '24 tubes; a type '27 power detector; a resistance-coupled audio amplifier, employing two '24 screen-grid tubes, and an output stage of high power, utilizing one of the new Pentode tubes. This receiver has plate and bias voltages supplied by an '80 mercury rectifier tube of the latest type, which insures plenty of power at all times.

The radio frequency amplifier stages are specially designed to pass all the necessary (wide band) of frequencies required for modern television reception. It is very important that any television receiver have properly designed R.F. stages, as if they are tuned too sharply and the side-bands cut too closely, an imperfect image lacking in detail will invariably result.

The audio amplifier is also a tre-

(Continued on page 390)

A SUPER-CRATER NEON TUBE

By C. H. W. NASON

The newest source of high intensity, small target, neon tube, for television scanning, is the Super-Crater or "electron-ionization" tube here described by Mr. Nason.

ALTHOUGH marked strides have certainly been made in the realm of "pure physics", certain developments are founded on a logic so simple that one is amazed that they have not turned up sooner. Television, among other ailments, suffers from a paucity of the modulated light available at the receiver, despite desperate attempts at the hands of many and competent investigators. All attempts at obtaining an intense source of modulated light have been notorious failures, in one way or another. Even Alexanderson, although he produced a satisfactory large image at Schenectady, employed the largest available motion-picture arc for an extremely short throw and a relatively small screen. The over-all efficiency of his light apparatus was less than 2 per cent.

Atomic Action

The study of the structure of the atom has progressed apace in the past two decades, and we are today sure of many facts that yesterday were matters of guesswork. Now it is known that the hydrogen atom consists of a nucleus having a positive charge, about which there travels, in a fixed orbit, an electron. The nucleus represents a positive charge, and each electron a single unit of negative electricity. The helium atom has a nucleus with two positive charges; and it is twice as heavy, since the positive charge governs the element of mass.

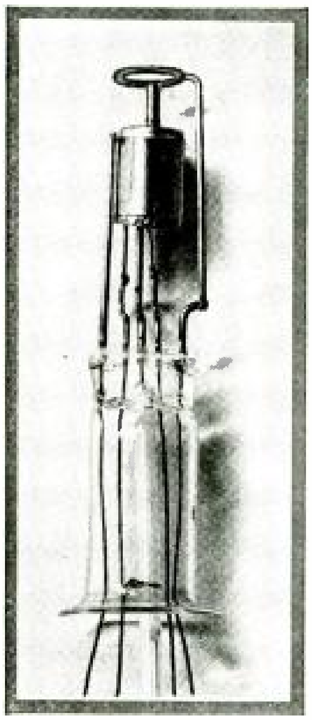


Fig. 4—Actual photo of new "super-crater" tube elements, before being mounted in glass bulb.

It also has *two* electrons, travelling in their orbits at fixed distances. Lithium comes next in its general complexity, having three positive charges and three electrons supposedly arranged as shown in Fig. 1. Neon, the gas used in most television glow-tubes, has a total of ten positive charges and there are ten electrons, arranged with two in the inner orbit and eight in the outer. How we know all these things is another story—perhaps we are wrong—but so long as we have a theory by which to predict happenings with accuracy, we may justly consider our theory as correct.

It is possible to knock off an electron, leaving the atom unbalanced—that is, with one more positive charge than it has electrons. The gas is then said to be ionized, and has an extra positive charge on the nucleus. Ionization, in the normal type of neon tube, is brought about by the fact that the potential of the positive electrode is sufficiently high to dislodge electrons by the simple process of attraction. Once ionization is thus established, the glow-discharge takes place.

How Ionization Is Used in New Tube

Ionization may be obtained in many ways. Heat has a marked effect, and so has the presence of ultra-violet light. Ionization may be achieved by

(*Continued on page* 382)

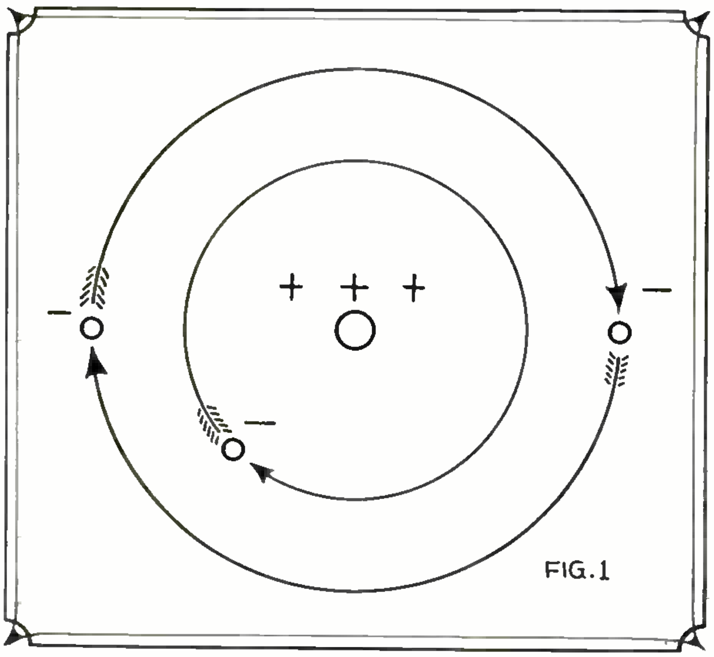


Fig. 1—Shows arrangement of electrons in the Lithium atom, having three positive charges and three electrons.

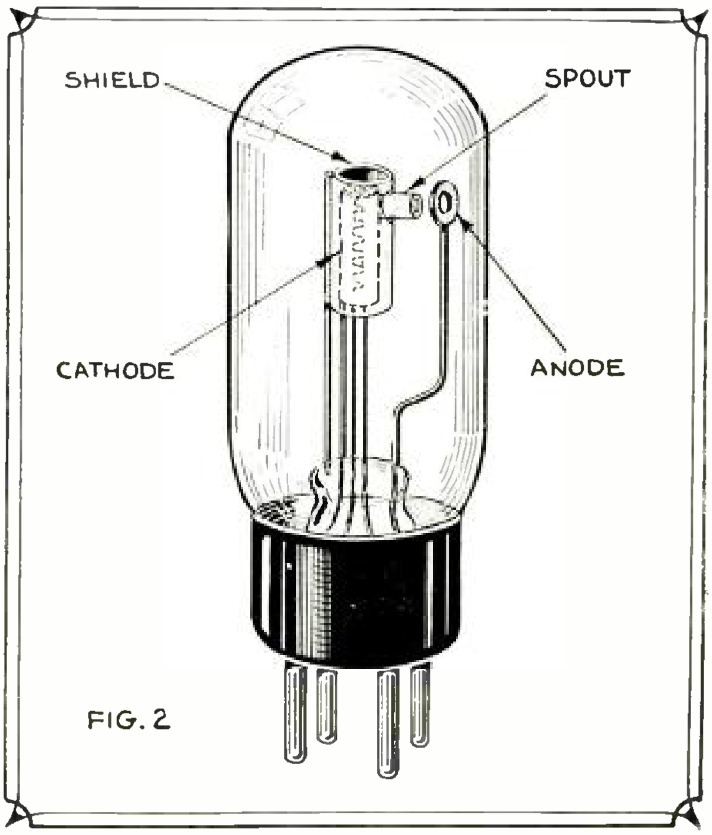


Fig. 2—Appearance of super-crater or "electron-ionization" tube here described, and which gives a powerful, concentrated spot of light behind the scanning disc.

Digest of Television Patents

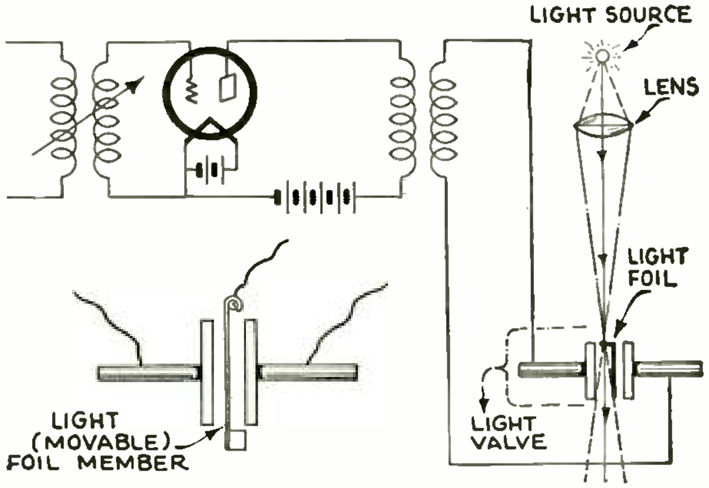
The essence of valuable and interesting television patents extracted for you by an expert.

NOTE: The letters Patent described herein are chosen both for their historical value and for the general interest which they hold for the amateur technician and the independent investigator.

Patent No. 1,521,192, issued to Charles Francis Jenkins of Washington, D. C., Dec. 30, 1924.

Electroscope Picture Reception

Light from any source is focused on an aperture consisting of two condenser plates, having between them a thin-foil element which, normally, is in such a position as to block the passage of the light. The output of the television receiver or signal amplifier is fed to these two plates by means of a transformer. The foil member is always at ground potential and is free to be attracted to whichever of the condenser plates is at high potential with respect to ground. The amplitude of motion of the foil is in proportion to the magnitude of the charge on the plate to which it is attracted; the light passed through the system being correspondingly proportionate to the amplitude of motion, the magnitude of the charge and, it follows, the signal amplitude.



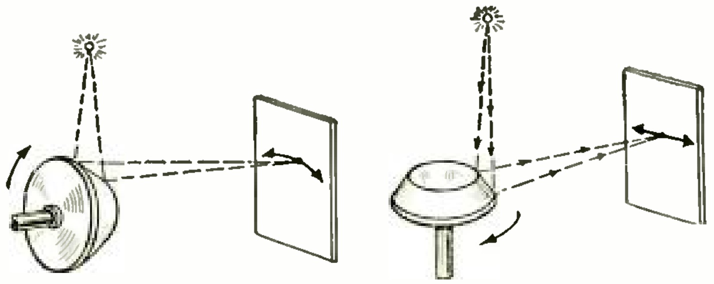
The drawing above shows an interesting and novel form of television receiver, which utilizes a light valve in the form of an electroscope.

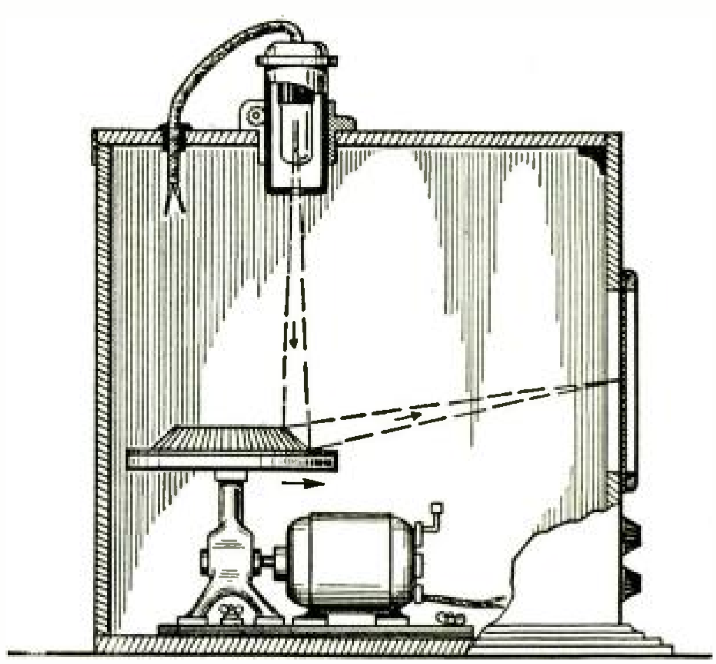
Patent No. 1,787,921, issued to Arthur H. Watson of Chicago, Ill., January 6, 1931.

Television Apparatus

This is a method of construction for a mirror-wheel scanner, by which either straight-line or curved-line scanning may be accomplished, according as the transmissions are from disc or drum scanners. Off-set mirrors provide the vertical scanning component, while the horizontal motion of the ray is obtained from the motion of the mirrors in rotation. The mirrors are ground concave, to focus the light effectively to a point in the plane of the screen.

Apparatus shown below and at the right illustrates Mr. Watson's scheme, by which either straight or curved line scanning can be accomplished with a mirror wheel.

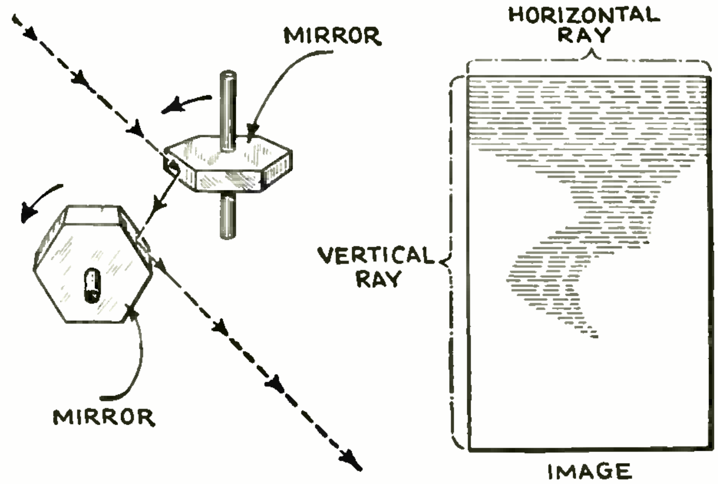




Patent No. 1,791,481, issued to O. Tervo of Norway, Maine, Feb. 3, 1931.

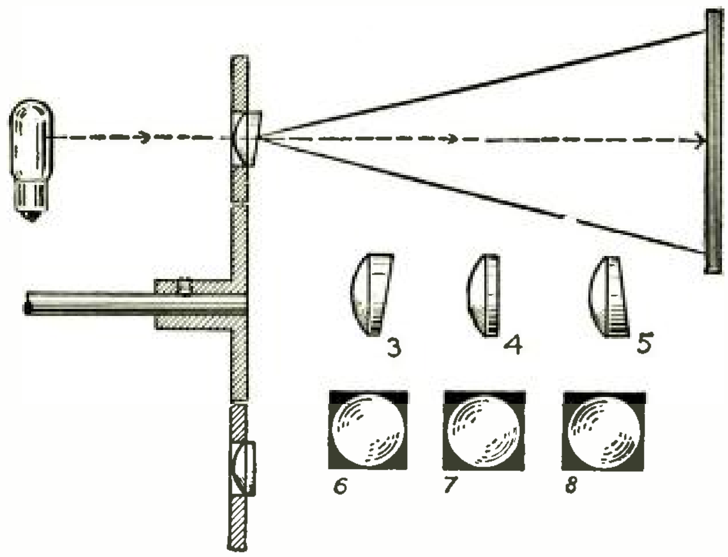
Mirror Scanning System

The ways of the Patent Office are peculiar, and here is a case in proof. This invention embodies a combination of two Weiller wheels, after the fashion of Lazare Weiller and of Rosing (1907). Advantages over the prior art are not specified in the patent; nor are they obvious to an interested reader. Light source is focused on one surface of a mirror wheel, which provides a horizontal scanning motion. The light is reflected from this wheel to a second wheel of similar structure, which imparts the vertical scanning motion to the ray.

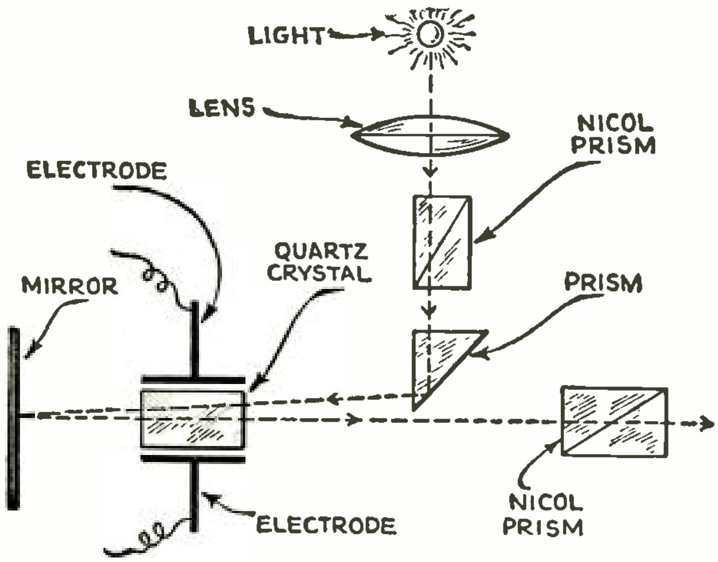


Scanner wherein a light beam is reflected from one mirror wheel (vertical) to another horizontal wheel, thus providing vertical and horizontal scanning.

Interesting Television Patents Reviewed



C. Francis Jenkins received a patent on the "prism-lens disc" scanning idea illustrated above.



Whitaker and Brown took out the novel patent illustrated above, which involves the use of a quartz crystal.

Patent No. 1,521,191, issued to Charles Francis Jenkins of Washington, D. C., December 30, 1924.

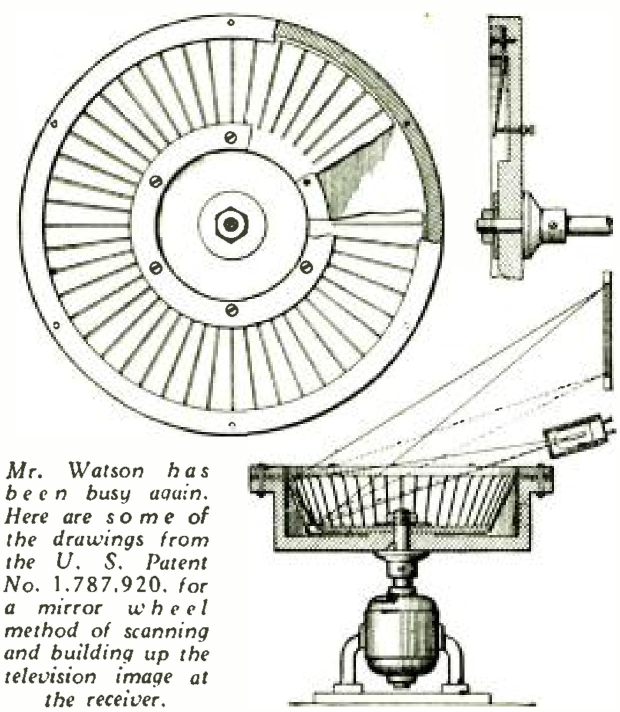
A Prism-Lens Disc

A disc with any prescribed number of apertures has affixed therein a number of lenses, so ground that one surface constitutes a prism. The lens surface serves to focus the light. while the changing offset of each progressive prism provides a vertical scanning component. The horizontal component is provided by the motion of the lenses in rotation.

Patent No. 1,787,920, issued to Arthur H. Watson of Chicago, Ill., January 6, 1931.

Television Apparatus

This is a method of construction for the mirror wheels described in the review above. A suitable number of tabs are stamped into a ring of polished metal, to form a system of mirrors. Set-screws in the mounting plate serve to adjust the angle of the mirrors, to provide the proper degree of vertical scanning. Prior to stamping, the mirrors are ground concave in a single operation; the concavity being in such a degree as to provide focus of the ray in the plane of the viewing screen.



Mr. Watson has been busy again. Here are some of the drawings from the U. S. Patent No. 1,787,920, for a mirror wheel method of scanning and building up the television image at the receiver.

Patent No. 1,677,590, issued to Charles Francis Jenkins of Washington, D. C., July 17, 1928.

A Prism-Lens Unit

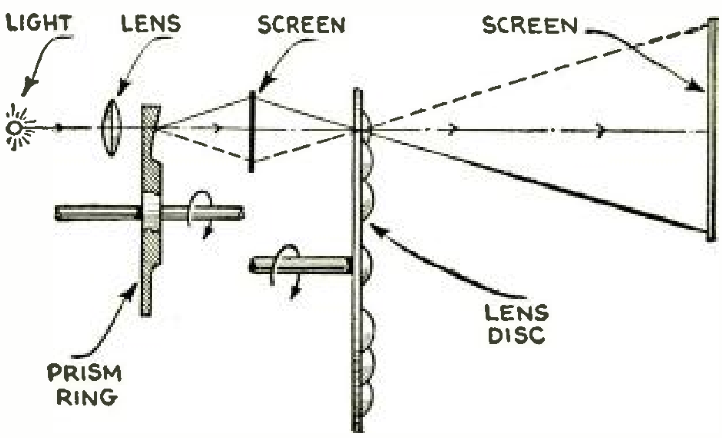
Light from a modulated source, is bent (in a vertical sense) by passage through a rotating prism, the angle of which is constantly varying during rotation. The rotation is at a speed corresponding to the number of complete pictures to be transmitted per second. Focusing of the light beam on a screen is provided by a lens system mounted on a scanning disc. Horizontal scanning is provided by the motion of the lenses, due to the rotation of the disc.

Patent No. 1,740,673, issued to Alfred Whitaker and Cecil Oswald Brown (Assignors to the Victor Talking Machine Co.), Dec. 24, 1929.

Light-Controlling Means

Light from a point source is passed through a Nicol prism or polarizer, and through a prism which re-directs it substantially at a right angle to its original path. It then passes through a piezo-electric crystal between two condenser electrodes, is reflected from a mirror, and passes back through the piezo crystal to an analyzer or second Nicol prism. Double passage through the crystal serves to cancel any dispersion of light, since the dispersive

(*Continued on page* 380)



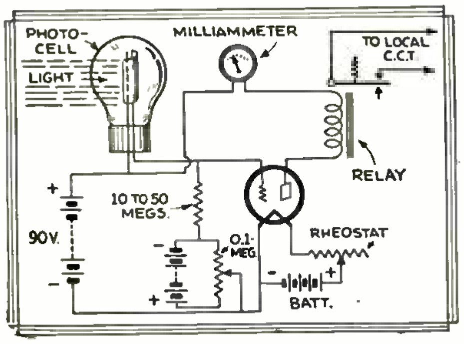
U. S. Patent No. 1,677,590 issued to C. F. Jenkins, covers his scheme for scanning through a rotating prism and a lens disc.

New Photo-Cells *and* Neon Tubes

ONE of the oldest tube manufacturing concerns in America has been doing a lot of research work in the realm of photo-cells and neon tubes. Some of the photo-cells of the potassium and also the new caesium types, as well as plate type neon tubes for television scanners, are shown in the accompanying illustration. An examination and test, of the tubes and cells, demonstrates their very superior workmanship and design. The bases of the tubes are made of moulded bakelite, and the glass bulbs, enclosing the active elements of the tubes, show exceptionally fine skill in make-up. One of the most attractive features of the Arco line of radio and television tubes is the exceptionally low price at which they are offered to the public.

Arco potassium-magnesium type cells have anodes which are doubly supported by sturdy wires; while the anode itself is constructed of wide nickel ribbon, faced edgewise to the window. The bases are of bakelite, standard UX (4-prong) and the tube measures 4 inches overall.

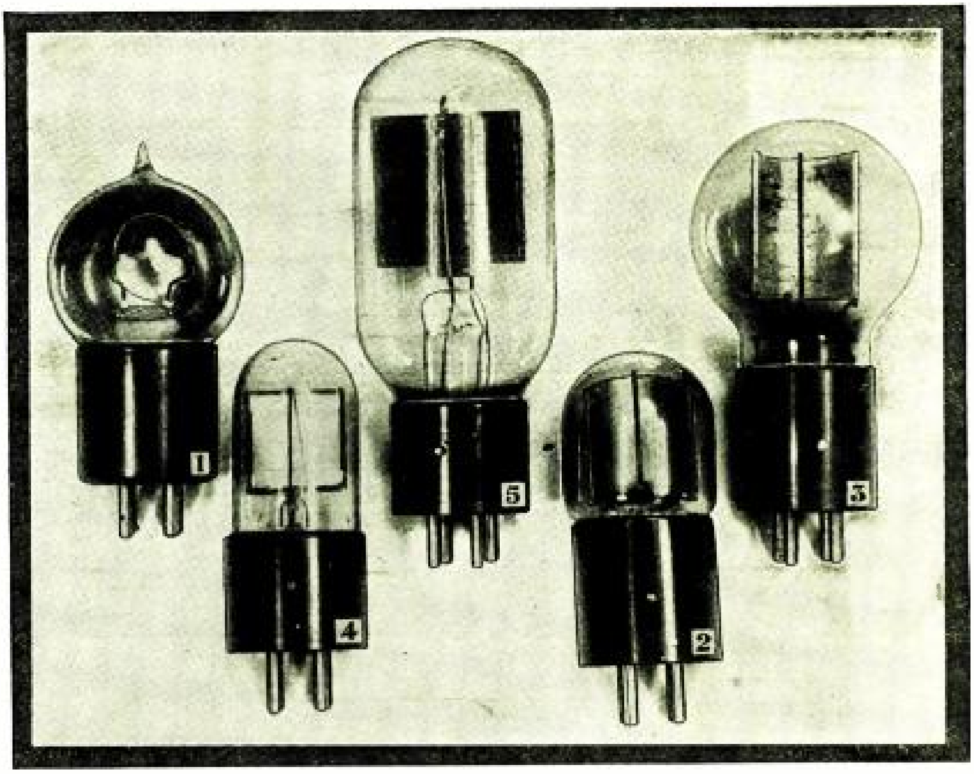
The caesium cells possess high sensitivity and give very perfect reproduction at all frequencies. These cells, as tests have shown, are very constant in operation and no continuous or frequent adjustment of voltage is required. The caesium cells contain the newst type of inserted-metal-plate construction, and mark a decided improvement over the potassium type of cell.



Hook-up of photo-cell and relay.

All Arco photo-cells and neon tubes are manufactured under the strict supervision of an expert in tube manufacturing, with many years of experience in the art. None of the cells or tubes leave the factory until they pass the severest test for clarity and volume. The caesium cells come in two sizes: one measuring 3 1/16 inches overall and the larger one measuring 4¼ inches overall.

Photo-cells are finding more and more uses every day and among their varied uses we find: Burglar and Fire Alarms; Sound-Picture Work; Television Transmission; Talking Movies; Matching of Colors; Circulation Control Devices; Facsimile Transmission; Timing Devices; Relays, light and dark; Calibration of Motors; Safety Devices—for smoke detection and fire protection; and many other mechanical and electrical devices.



No. 1—Arco potassium photo-cell; No. 2—Small caesium photo-cell; No. 3—Large caesium photo-cell; No. 4—Small flat-plate neon tube; No. 5—Large flat-plate neon tube.

The Arco square-plate neon-tube, for use in television scanners, requires about 200 volts with a suitable protective resistance inserted in the circuit; the current required is 25 to 35 Ma. (milliamperes). These tubes have an impedance of approximately 15,000 ohms.

With regard to the photo-cells, the caesium type has a half-round silver plate inside the bulb, which permits a greater deposit of caesium to be formed upon it. The caesium cell has about five times the electrical output of that produced by the potassium cell, under similar light conditions. The caesium cell gives about 28 microamperes per *lumen*, while the potassium cell gives about 5 microamperes per *lumen*. The Arco television, plate-type, neon-tubes have been especially developed to avoid a high space charge; and the metal of which the electrodes are formed, has been so chosen that any streaks or spots of extra high brilliancy over the illuminated surface of the plate are eliminated. The elements of the neon tubes are rigidly supported by means of sturdy glass rods. The tube containing a plate one inch square measures 1¼"x3½"; the 1½-inch, square-plate, neon tube measures 2"x6". The diagram herewith shows how to connect a photo-cell to a relay.

Book Review

TELEVISION—ITS METHODS AND USES, by Edgar H. Felix. Cloth covers, size 5¼ x 7¾ inches; 272 pages; 73 illustrations; indexed. Price, $2.50. Published by McGraw-Hill Book Company, New York.

Mr. Felix, well-known to the radio fraternity, has given the public a very interesting and understandable book on television. The author explains with simple diagrams and well-chosen photographs how the image is scanned at the transmitter and also at the receiver. The principal systems such as those developed by Baird, Bell Laboratories, and others are very clearly described and illustrated.

This book is one that you can hand to the youngest reader and he will have no difficulty in comprehending what the author is writing about. The transmission and reception of television signals, as well as the commercial aspect and also program possibilities of television are covered by the author. The closing chapters of the book cover the subjects of "television entertainment service" and the "future progress of television". All in all, this is a clearly written and attractively printed treatise on television, which everyone interested in the subject should read.

Hints on Synchronizing

How to use glow tubes, tuning forks and other devices for checking synchronism.

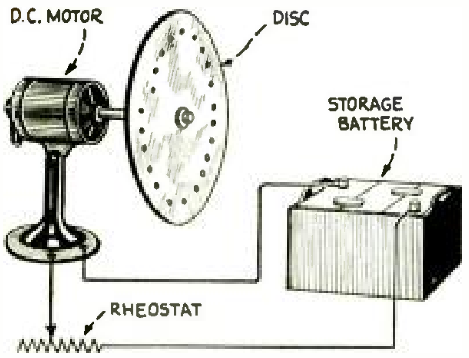


Fig. 1—Simplest "constant speed" regulator system for scanning motor and disc.

THE television experimenter, especially when he is using both transmitting and receiving apparatus in his laboratory, is naturally interested in the problem of how to maintain exact synchronism between the two scanning discs at the respective ends of the system.

One of the simplest methods of attempting to maintain synchronism, is that shown in Fig. 1, which involves the use of a finely-adjustable rheostat, either of the wire-wound or graphite-compression type. Here the motor draws its current from a storage battery; this method has been used in several of the larger television laboratories for experimental work, and surprisingly constant speed can be maintained, when the battery is kept well charged. Only infrequent adjustments of the rheostat are necessary to compensate for loss in voltage, as the battery becomes discharged.

A system like this will serve quite well for the television experimenter, particularly when a heavy flywheel is mounted on the shaft with the scanning disc, which will serve to markedly steady the constancy of rotation.

Where both transmitting and receiving discs are in the same laboratory, or even in two laboratories which are under the supervision of the experimenter and his associates, the system shown at Fig. 2 illustrates one method of checking synchronism. A contact pin on the transmitting disc touches a metal brush or spring, once in each revolution, and at the moment it makes contact a pulse of light from the neon lamp will be seen through the slot in the scanning disc.

Of course the slot on the receiving disc has to be positioned in the first place, so that the number one holes on both scanning spirals start to scan the image simultaneously.

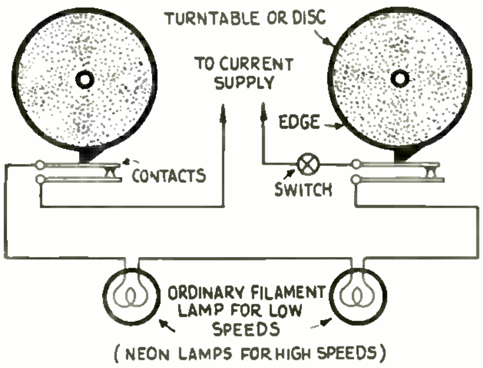


Fig. 3—Unless both discs are rotating in perfect synchronism, one of the contacts will be open and the lamps will not light.

Still another interesting circuit is that shown in Fig. 3, where two synchronism indicating lamps, one at the transmitter and one at the receiver, are employed; the contacts being closed by a raised boss or pin on the periphery of the scanning disc (or phonograph turn-tables where these are being used for certain experiments).

It will be seen from Fig. 3, that unless both discs are rotating at the same speed and at the same relative position to one another, then both sets of contacts, which are in series, will not be closed at the same moment and therefore the lamps will not light.

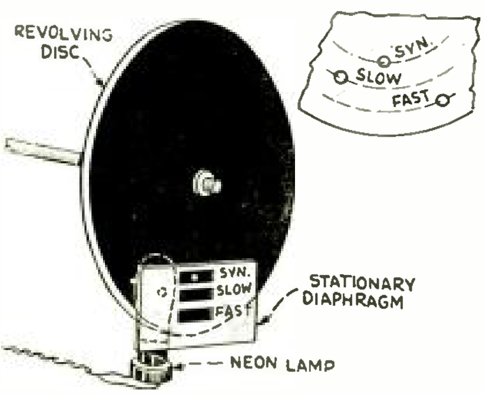


Fig. 4—Improved dial which indicates synchronous speed and also "slow" or "fast".

Fig. 4 shows an interesting dial which, in conjunction with three holes drilled in the scanning disc, will indicate whether the disc is revolving at synchronous speed and also "slow" or "fast". This idea is to be used in conjunction with that shown in Fig.

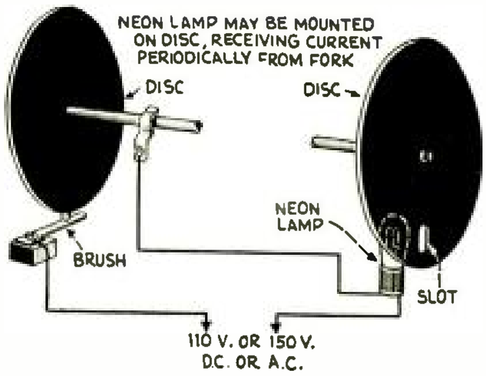


Fig. 2—At each revolution of the transmitting disc, a contact is made and a pulse of light is seen through the slot of the receiver disc, if it is rotating in synchronism.

2. One must take care to see that the disc holes used for indicating synchronism, as shown in Fig. 4, are drilled or punched in a different part of the disc than those used for scanning the image.

Still another method of checking synchronism between two revolving disc or turn-table systems, is that illustrated in Fig. 5. Here an electrically driven tuning fork, or other source of constant frequency, closes the neon lamp circuit; the respective operators at the transmitting and receiving ends of the system, have then to adjust their motors or the position of the disc with respect to the motor (such as by rotating the frame of the motor through a part of a revolution), so that the pulses of light from the tubes are seen through the holes in the discs.

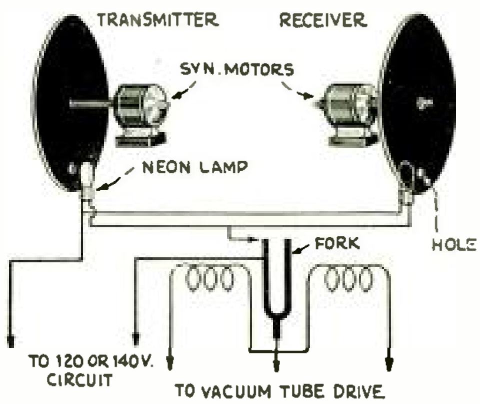


Fig. 5—Here a "master" tuning fork, or other circuit interrupter, causes pulses of light to be seen in the neon lamp through the holes in the discs. Each operator adjusts his motor until he sees the light pulses.

Possible Solutions *of the* TELEVISION PROBLEM

By P. F. v. d. BOOGAARD
Of the Faculty of Sciences of the University of Liège, Founder of the Institut International de Télévision of Brussels

Mr. Boogaard, one of the leading European scientists, here presents several plans for solving the television problem and asks for your opinion and cooperation.

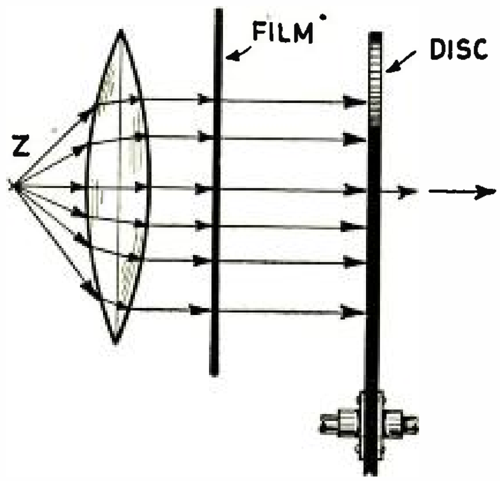


FIG. 1

Fig. 1—Diagram representing television scanning wherein all the rays emanating from an image are projected "successively" on a photo-cell by a mechanical method.

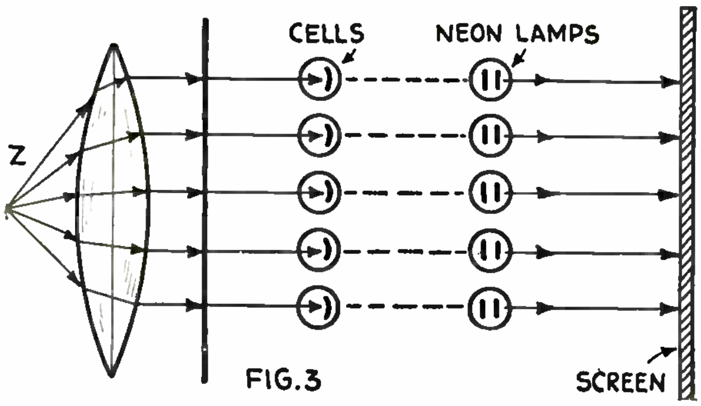


FIG. 3

Fig. 3—With regard to multiple element projection, we may project all the rays emanating from an image "simultaneously", on a great number of photo-cells, and likewise projecting the neon tube rays, in the same order, on a receiving screen.

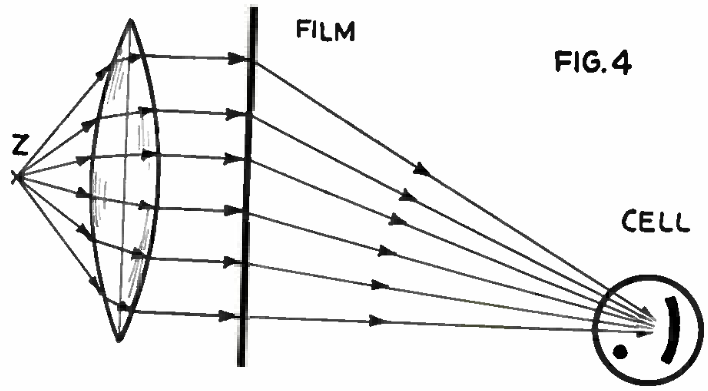


FIG. 4

Fig. 4—Projecting all the luminous rays of an image "successively" on one photo-cell, for transmission by the static method.

TELEVISION has for its aim: The transmission of the image of one or more objects electrically and the projection of this image on a screen; the reproduction of the image having to occur in less than 1/16 of a second.

That is the statement of the problem in its simplest form. The conclusion is that the transmission of the image will be the more perfect, as the greater number of elements of the image are transmitted in this very short time.

To transmit perfectly an image the maximum size for the pictorial element or point must be 1/2143 of a square inch (0.3 sq. mm.); that is, 2,100 points to transmit for each square inch of the image.

The degree of perfection of any television system will be expressed by dividing the number of pictorial elements in the image by 2,143 times the number of square inches.

Methods of Television

There are two methods of television:

(1) Transmitting the elements of the image successively:
 (*a*) by a mechanical method;
 (*b*) by a static method (without moving parts).

(2) Transmitting the elements of the image simultaneously:
 (*a*) by a mechanical method;
 (*b*) by a static method.

Efficiency of Present Scanning

The problems of the first method may be summed up thus:

(*a*) Projecting all the rays emanating from an image *successively* on a photo-cell, at the transmitter, by a mechanical method (see Fig. 1).

(*b*) Decomposing a ray of variable intensity, emanating from a luminous source at the receiver, by a mechanical method, into elements of suitably-proportioned intensities and afterward projecting these rays in the same order on a screen (receiving) (Fig. 2).

The actual demonstrations of the first method (by mechanical means) and their imperfections, are as follows, according to published reports:

(*Continued on page* 383)

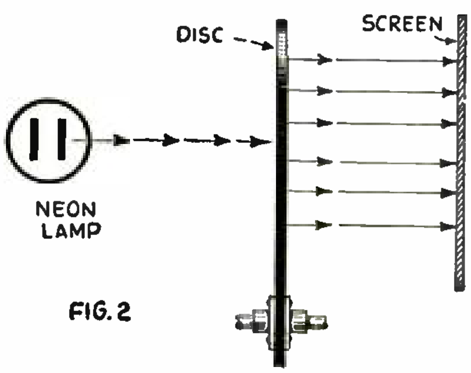


FIG. 2

Fig. 2—Decomposing neon tube ray of variable intensity, by a mechanical method, and afterward projecting these rays in the same order onto a screen.

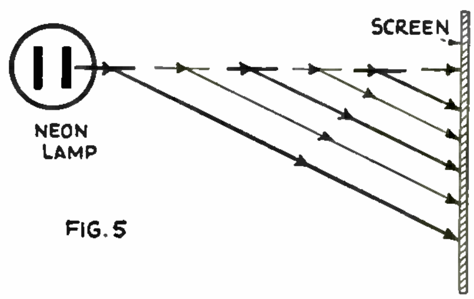


FIG. 5

Fig. 5—Decomposing a ray of variable intensity, from a luminous source, into elements of suitable intensities, and projecting these rays "successively" in the same order, for reception by the static method.

An Electronic Light Valve

By WOLF S. PAJES
Television Engineer

A really new idea for a light valve or "modulator", which utilizes the simple principle of interposing an electro-luminescent medium of certain characteristics in the path of the light beam used for scanning. The system is particularly adapted to large image reproduction.

GLOWING gases or vapors absorb particularly those light waves which are radiated from an external source of the same frequencies which said gases emit themselves when in a glowing state. For example: when light from an incandescent body, such as a carbon arc, passes through a flame which is characteristically yellow—indicating the presence of sodium—two dark absorption bands are formed in the orange yellow part of the spectrum. When the arc's rays are cut off, the light emitted by the sodium flame, if analyzed by means of a spectroscope, will show two bright narrow bands, which occupy exactly the same place in the spectrum band as did the dark absorption lines. This example illustrates Kirchhoff's law of "light absorption by gases."

Absorption By Glowing Gases

Gases and vapors—when *electro-luminescent*—function in like manner, absorbing from an exterior source light waves of frequencies corresponding to those which the gases themselves emit. If, therefore, we pass light, emitted from a constant intense source, through a gas which is glowing because of the ionizing effect of an applied potential difference (voltage), the emerging light will be of a reduced intensity; and especially in the characteristic portion of the spectrum. This reduction factor will be proportional to the intensity of the gas excitation; a fact which makes it possible to utilize this phenomenon for *light-modulation* purposes, such as we require in television, sound recording and other allied branches of the art.

The present invention is characterized by the fact that, instead of imposing a dual function upon the electronic tube (*i. e.*, "illumination" and "light modulation"), the two functions are separated. The electronic tube is used solely for the purpose of modulation, the illumination being furnished by a separate and constant source of light. The incoming, modulated television signal, whose intensity varies in proportion with the brightness of the transmitted image elements, is applied to the electrodes of the "absorption tube." The glow of the tube changes accordingly, rendering the gas more or less transparent to the light coming from the exterior source.

Spectrum of Illuminant and "Valve" Must Correspond

As already stated, a glowing gas will absorb radiation energy of such wavelengths only as the gas itself emits when glowing. It is necessary, therefore, to see that the spectrum of the exterior source is approximately the same as that of the electronic glow; since otherwise the glowing gas will not be absorbent. This condition can be fulfilled by making both light sources of the same chemical element or compound. A light system comprising a sodium arc and a sodium-vapor-filled tube, illustrates clearly the basic idea here under consideration.

Fig. 1 represents a television receiving scheme, in which my invention is embodied. Referring to Fig. 1: *1* is the constant, intense light source of a particular spectrum. By means of the lens system *2*, the light is focussed on the light-absorbing tube *3*. The tube is filled with a gas which, when glowing, shows an identical or very similar spectrum to that of the light source at *1*. The electrodes of the absorption tube are connected to the signal amplifier *4*. The light from *1* is passed through the electronic modulating tube and is focussed by means of a lens system *5*, on the aperture in the diaphragm *6*. The illuminated aperture acts as an independent light source and, in conjunction with an appropriate lens-scanning disc, or similar device *7*, projects an enlarged picture or image on the screen *8*.

(*Continued on page* 394)

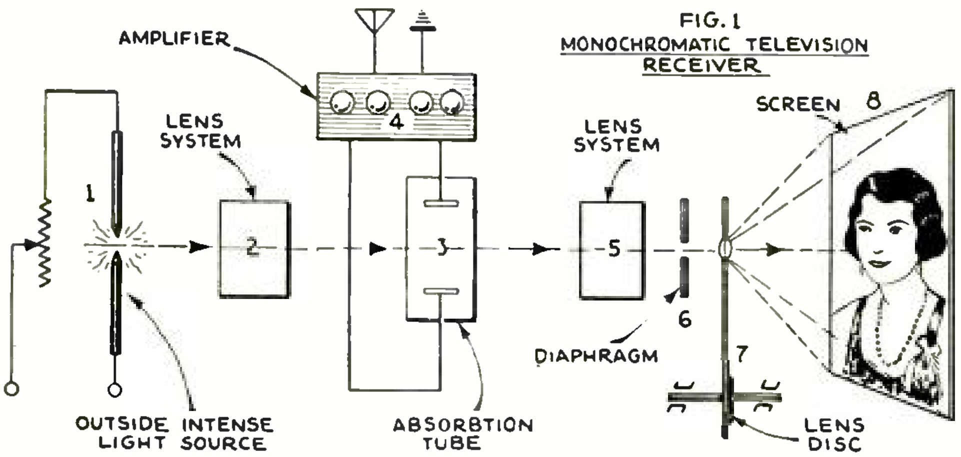


Fig. 1—Mr. Pajes' new scheme for a light valve of the absorption type (3) placed in line with the source of the scanning light (1): the received image signals operate through amplifier (4), to modulate the absorption tube light at (3) and in turn the scanning light beam passing through the valve.

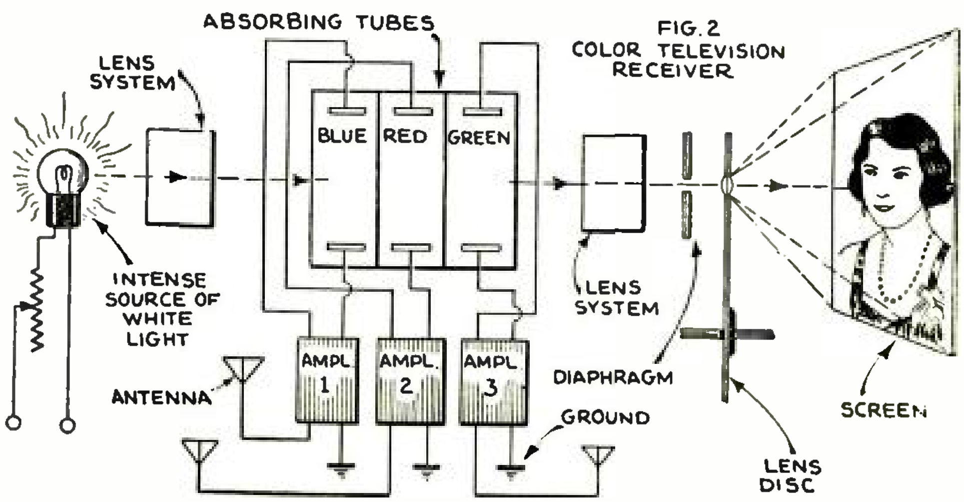


Fig. 2—Above, shows Mr. Pajes' ingenious and yet simple scheme for producing colored television images. The three transmitted color signals, pass through their respective color absorption tubes, and in turn modulate the beam of scanning light.

The Necessary DIFFERENCE *in* Transmission Frequency *for* TELEVISION

By E. KINNE

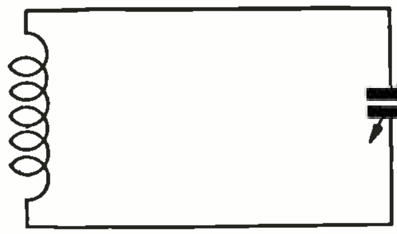


Fig. 1. Coil with variable parallel capacity.

JUST because of the different response of the sense of hearing, compared to that of sight, the difference in frequency between two neighboring radio transmitters is quite another matter in television broadcasts than in the case when music or voice is radiated.

Whoever has had the opportunity to compare a local receiver (that is, one of low amplification without regeneration), with a very selective receiver by hearing them both on musical programs, will be amazed how distorted the distant reception sounds. In fact, even the low tones are missing, which one can still reproduce with the local receiver. The cutting of the audio-frequency response in the distance receiver is due to the increased selectivity.

The matter of selectivity is closely connected with that of tuning. If we have the usual resonant circuit (Fig. 1) tuned to one transmitter, this means that the effective impedance of the tuned circuit is at a maximum for the radio-frequency signal to be received. Now, if we detune the circuit by turning the variable condenser, then the volume at which we previously received the transmitter in question becomes less; because the effective impedance of the tuning circuit has become less. If we turn the variable condenser of the tuning circuit of a receiver to the point at which we receive a station; then, for the reason given, the effective impedance to the signal will rise slowly, then suddenly, until the maximum is reached at the point of resonance. Now, if we turn the variable condenser further, we can bring about a decrease of the resulting impedance until it is so small that the station previously heard is no longer audible. The action just described is illustrated by the "resonance curve" in Fig. 2.

It is well known that, on turning the condenser of a non-selective set, the local station already audible becomes louder very slowly, and that accordingly the resonance curve rises slowly, fairly flat, and descends in the same way. The resonance curve of a local receiver will therefore be very broad at the bottom; because the rising and descending slopes of the curve are only slightly inclined toward each other (Fig. 3). A resonance curve narrow at the bottom, on the other hand, indicates a great selectivity of the set, whose variable condenser only needs to be turned a few degrees to eliminate a station, which means that the impedance of the tuned circuit rises suddenly and very steeply (Fig. 2). With the varying of the condenser, we always tune our resonance circuit to a different frequency (and consequently, wavelength).

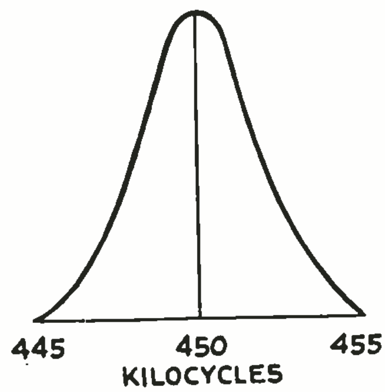


Fig. 2. Resonance curve for tuning circuit shown in Fig. 1.

Our diagrams show us that a frequency of 450 kilocycles undergoes the greatest drop in potential across the tuned circuit; since, of course, the impedance is also greatest for this frequency. The drops in potential are considerably less at 445, or 455 and at 430 or 470 kilocycles; naturally the sidebands are also unfavorably affected, in the voltage amplification.

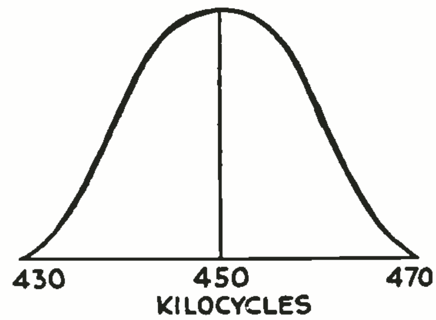


Fig. 3. Broad resonance curve.

The nature of radio transmission of sound is that the radio-frequency current is modulated by audio-frequency oscillations. Then the higher frequency oscillates in the rhythm of the lower frequency, to an extent dependent on the width of the audio-frequency band. There is an analogy in television, in the use of a low-frequency alternating current for modulation.

As shown by investigations made in the laboratory of the writer, the lowest frequency resulting from the analysis of film pictures can be set at 16 cycles; presupposing that a black surface is to be televised during a time not longer than one frame. This frequency could even be measured, in the transmission of a "news" broadcast. The highest frequency was attained at 11,250 cycles while maintaining the established normal values (transmission of walls, hedges, and the like).

Accordingly, the high-frequency carrier waves can be modulated at about 11,250 cycles in film transmissions. In tuning for sharpness it is essential to heed the point thus determined. It would, of course, be an error to make the resonance curve of a receiver so narrow that it would pass a frequency band of only 6,000 cycles, when we have to modulate the glow-lamp up to 11,000 cycles for television purposes.

Before we pass to the determination of the resonance curve, we must explain to what extent attenuation of the sideband frequencies are admissible in television broadcasts. I have been able to determine that, with the

(*Continued on page* 389)

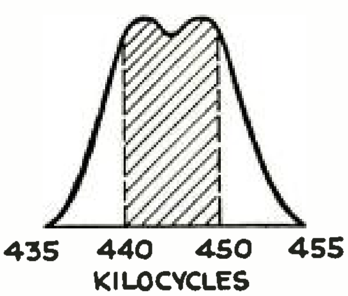


Fig. 4. Receiver curve for television.

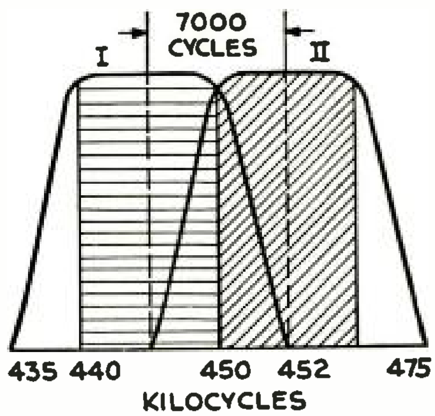


Fig. 5. Overlapping of two stations.

The TELEVISION QUESTION BOX

Edited by
C. H. W. NASON

Mercury Arc

Samuel Gilbert, Jr., Curtis, Nebraska.

Q. 1. What is the correct way to lay out the scanning drum in the system described on page 198 of July-August TELEVISION NEWS?

A. 1. The scanning drum is nothing more than a mechanical equivalent of the rotating disc. The optical and mechanical relations are such that a spiral scanning motion is obtained. The edge of the disc is turned up in the manner shown in Fig. 4 and the apertures are cut or lenses mounted in the side-wall in a spiral fashion.

Q. 2. Where can I obtain a *Mercury Arc* of the type described in that article?

A. 2. It is unfortunate that such a device is of a purely experimental character, and is not obtainable from any commercial source. The Cable Radio Co. of Brooklyn, N. Y., have a high-intensity light source which is of an entirely practical nature and they may be in a position to supply you if you call their attention to the "Electron Ionization" tube, so that they will know to which tube you refer.

Q. 3. In the same issue you described an experimental cathode-ray scanner. How shall I connect the neon tube oscillator?

A. 3. The connections are given in Fig. 2. Note that a vacuum tube of the '12 type is used as the variable resistance. The plates of the oscillator condenser and neon tube are in parallel with the deflecting plates of the cathode-ray tube. The motor-driven potentiometers mentioned in that article rotate at a speed equivalent to the frequency desired, and they are designed to give the desired saw-tooth waveform.

Blue-Prints for Laying Out Discs

E. L. Grimm, 716 14th Street, N. W., Washington, D. C.

Q. 1. Can you supply me with a blueprint or drawing for a thirty-inch, 60-aperture scanning disc for a 1.5-inch neon tube?

A. 1. You cannot make television scanning discs from templates with any degree of accuracy. In the article on page 126, of the May-June issue, full details regarding the layout of the disc are given.

Q. 2. How can I change over a receiver now using the '45 tube to operate with the pentode? Would this tube give satisfactory results?

A. 2. These data are also given in issues of TELEVISION NEWS. I refer you to the July-August issue—page 184. The tube will be entirely satisfactory for your purpose.

Lenses for Television

E. Nathaniel Skokan, 4407 No. 28th St., Omaha, Nebraska.

Q. 1. I am interested in constructing a television transmitter and receiver of the type described on page 128 of the May-June issue of TELEVISION NEWS. Can I supply both amplifiers from a single power supply?

A. 1. This is doubtful practice in a circuit structure where at least six resistance-coupled stages are used. I would advise that the first amplifier be entirely battery-operated; since it is rather difficult to get the hum level of an A.C. job below the small input voltage available from the photo-cell.

Q. 2. Where may I obtain, at small expense, a lens suitable for use at the transmitting end?

A. 2. There is no use trying to mislead you. You need the best photographic lens available, if you are to get any real results. The Hugo Meyer Company can supply you with a F 1.5, 2-inch lens, designed for cinematography and termed the Kino Plasmat. This lens is entirely suitable for the purpose. The best way to obtain this lens is through your local camera supply house.

Q. 3. Give names of manufacturers who can supply me with moderately priced glow-lamps for use with the '45 tube. Also let me know where I can obtain Caesium-Oxygen photo-cells for experimental work with the infra-red rays.

A. 3. Get in touch with the Argco Laboratories in New York, or the Cable Radio Co., Brooklyn, N. Y. The financial returns from television are so slight that it is only through the courtesy of certain far-sighted organizations that we are able to obtain anything for experimental purposes.

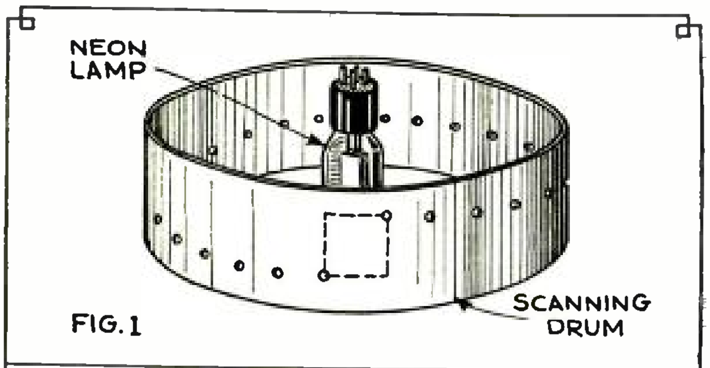


Fig. 1—At left, shows how neon tube is arranged inside a scanning drum, instead of behind a scanning disc.

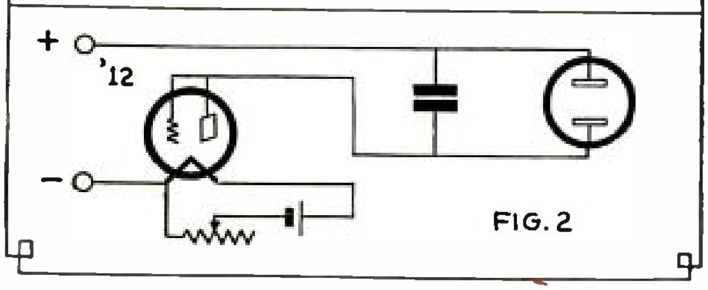


Fig. 2 (left)—Shows connections for neon tube oscillator.

Transformer Coupling Seems Best?

Richard Carruthers, Kenosha, Wisconsin.

Q. 1. I have heard from numerous sources that a transformer-coupled amplifier cannot be successfully used in television reception. Despite all such advice, I find that I can receive better images with a transformer between the output tube and the neon lamp, than I can when the neon lamp is directly in the output of the power tube. Why is this a fact in my particular case?

A. 1. The television signal includes frequencies ranging from about 20 cycles up to nearly 45,000 cycles. In order to pass these frequencies without discrimination, a highly-developed, resistance-coupled amplifier is necessary. Resistance-coupled amplifiers, of the usual type designed for the greatest amplification of frequencies in the voice range, do not approximate this need in even a small degree. If, therefore, your receiver up to the power tube is not passing frequencies in excess of about 5,000 cycles, the use of a transformer in the output to couple the neon tube will not result in any marked deterioration of the received image. Indeed, there might be an improvement, due to the fact that there is a better "impedance match" between the plate circuit of the tube and the load when the transformer is in the circuit. If you will re-construct your receiver in accordance with the most modern views on the subject, I am sure that your results will be improved; since the mere fact that the transformer does not noticeably spoil the image is a sign that your receiver is at fault.

Experimental Cathode-Ray Scanner
Charles Kostler, 129 Menohan Road, Brooklyn, N. Y.

Q. 1. I would appreciate more data on the cathode-ray arrangement described by Mr. Nason in a recent issue of TELEVISION NEWS. I have placed an order with the Argco Laboratories for one of these tubes, and hope shortly to have it in operation.

A. 1. The cathode ray scanner which I have used employed a tube similar to that illustrated in my article. The results were not decidedly superior to those obtained with the disc; because the action of the signal not only acted upon the intensity of the cathode beam, but also changed its focus. Despite this fact the results were quite gratifying. You will find given here a diagram showing the use of a '12 type tube as a variable resistor for the adjustment of the scanning frequencies. Two such oscillators must be made; one operating at 20 cycles per second, and the other at 1200 cycles per second. The frequency will depend upon the resistance and the capacity in the circuit, and the characteristics of the neon tube; as well as upon the voltage of the supply system.

Because of this, it is better to use one of the old '74 tubes, as a voltage regulator across the power supply for the oscillator, so that no variation of the voltage will result. In Fig. 3 there is shown the method of connection for the tube, with the signal applied across the D.C. accelerating potential. There will shortly be available cathode-ray tubes designed for television, in which an additional electrode for the signal will be situated close to the emitter. This electrode will act to alter the shape of the space-charge cloud which surrounds the emitter, in order to alter the intensity of the beam, without changing the focus of the ray. These tubes will be capable of a reproduction superior to that obtainable with the disc. The writer is not at present at liberty to divulge their source—but hopes that a commercial announcement will shortly be made.

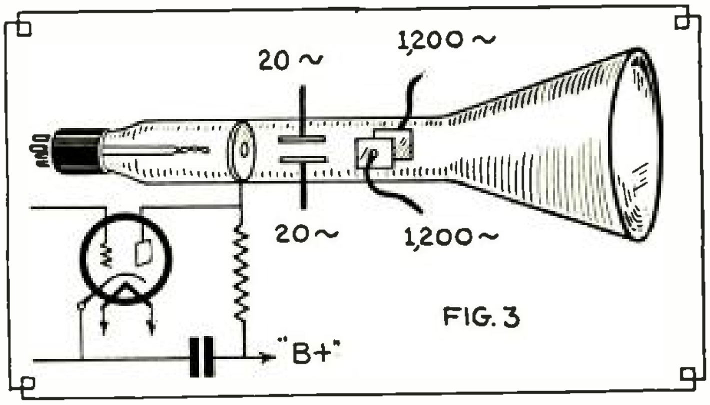


Fig. 3 (left)—Shows connections of cathode ray (Braun) tube scanner for television.

Tuning Forks for Synchronizing
Ralph F. Hunter, 108 Victory Avenue, Schenectady, N. Y.

Q. 1. I have been quite successful in receiving television images from Boston, New York and Wheaton, Md. My station is located at Catskill, N. Y. My troubles fall under three groups: fading, "ghost" images and synchronization. I realize that the first two await the coming of more favorable weather conditions. In connection with the third, however, may I ask why tuning forks are not used at the transmitter and receiver for keeping the synchronous motors in step? The method was used early by Jenkins; and it seems to me that the use of a fork of fixed frequency at the transmitter and a fork at the receiver, having a frequency adjustable to that at the transmitter, would solve the problem. I believe that suitable circuits could be developed to be controlled by these forks; for example—the Thyratron inverter.

I realize that these ideas are not new; but it seems to me that the use of the scanning frequency for synchronizing presents insurmountable difficulties in the case of fading signals.

A. 1. If you have time and space to experiment with antennas of various types you might effect a solution of your "ghost" image difficulties. The ghosts are caused by the fact that the *ground component* of the signal and one or more *sky components* arrive at different times; either overlapping each other or directly interfering. Why don't you try various antennas—dipoles, etc.? The requirements of dimensions should not interfere in suburban locations; as it is possible to use R.F. transmission lines to feed from the antenna to the receiver. But please remember that I am a poor city dweller and can suggest these things only from an engineering viewpoint, rather than from a practical angle.

Tuning forks may be all right for experimental work within the laboratory; but, if you intend to use them for long-range work, you must arrange to superimpose the fork's output on the signal and filter it out at the receiving end. This is entirely practicable; but the constancy of the forks does not approach a degree whereby a variable-frequency fork could be used at the receiver to match that at the transmitter. Why not work out a system whereby the scanning frequency could be used to control the output of a pair of Thyratrons in such a manner that they would tend to retain their stability, even when fading removed the controlling force? If you can get the Thyratron tubes, you have the advantage of me; and I would appreciate your arranging to let me have a few, provided the price is not outside my limits. As you probably know, the suggestion above is entirely practicable; and the only reason it has not been used is that the Thyratron is not a familiar quantity to the average investigator. I have prepared an article on the use of Thyratrons in television, but those that I have made for myself are not up to scratch and suffer an early death.

Crater Tubes—Where Procurable
A. J. Neef, 1073 East 39th Street, Brooklyn, N. Y.

Q. 1. Where may I purchase an air-cooled crater lamp?

A. 1. For a high-intensity, air-cooled crater lamp, I suggest you get in touch with the Cable Radio Company of Brooklyn, N. Y.

Q. 2. Where may I purchase various sizes of matched lenses?

A. 2. Houses supplying apparatus for high school laboratories can supply you, if you are in a position to give exact specifications. (Send stamped and addressed envelope for names of companies.)

Q. 3. How is a pair of '50 tubes used in the last stage of the amplifier to operate the crater lamp? A '50 tube is not intended for resistance-coupled operation.

A. 3. It certainly shows a sharp mind to catch that point—and I think that, if you ponder the thing a moment, before continuing, you will dope the thing out for yourself. The '50s, as well as other tubes of high output and low plate impedance, is prone to draw grid current. This grid current creates across the grid-leak resistance a voltage drop which is subtractive from the bias of the tube. This loss of bias aggravates the condition, and the high plate current, due to the decreased bias, results in the destruction of the tube. If the grid bias is obtained by means of a resistor in the plate return (that is, between the filament and ground) the increasing plate current will result in an increased voltage drop across the biasing resistance, and will compensate for the destructive effect. The warning against the use of resistance coupling with the '50 is given in the fear that the bias will be obtained from a battery, or other non-automatically controlled source.

TELEVISION TIME-TABLE

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

Location of Transmitter	Lines per Frame	Call Signal	Frequency in kilocycles (meters in parentheses)	Power (watts in antenna)	Licensee and Address
California:					
Gardena (near)	—	W6XS	2,100 (142.9 to 2,200 (136.4)	500	Don Lee (Inc.)
Illinois: Chicago	48	W9XAA	2,000 (150) to 2,100 (142.9), 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	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	W3XK	2,000 (150) to 2,100 (142.9).	5,000	Jenkins Laboratories, 1519 Connecticut Ave., Washington, D. C.
Massachusetts:					
Boston	60	W1XAV	2,850 (105.3) to 2,950 (101.7)	1,000	Shortwave and Television Laboratory (Inc.)
New Jersey:					
Allwood	60	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	60	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	W2XR	2,100 (142.9) to 2,200 (136.4), 2,850 (105.3) to 2,950 (101.69)	500	Radio Pictures, Inc., 3101 Northern Blvd.
New York	60	W2XAB	2,750 (109.1) to 2,850 (105.3)	500	Atlantic Broadcasting Corp., 485 Madison Ave.
" "	60	W2XBS	2,100 (142.9) to 2,200 (136.4)	5,000	National Broadcasting Co. (Inc.), 711 Fifth Ave.
" "	60	W2XCR	2,000 (150) to 2,100 (142.9).	5,000	Jenkins Television Corp. 655 5th Ave.
Ossining	—	W2XX	2,000 (150) to 2,100 (142.9)	100	Robert F. Gowen.
Schenectady	—	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	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	W2XAP	2,000 (150) to 2,100 (142.9)	250	Jenkins Television Corp.
Bound Brook	60	W3XAK	2 100 (142.9) to 2,200 (136.4)	5,000	National Broadcasting Co., Inc.
New York State:	—	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	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.

Experimental television stations, such as those operated by the N. B. C., Westinghouse, General Electric Co., etc., are on the air practically every day, testing, and can be picked up.

The Jenkins stations' time schedules are as follows:

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 (D.S.T.). 60 holes.

W2XAP—Passaic (Portable transmitter). 60 line, 20 frames per second "standard"—Time irregular—Experimental.

W2XCD—Passaic (De Forest Radio Corp.). 9 to 10 P.M. daily. Sound accompaniment transmitted on 1,601 k.c.

Columbia Broadcasting System (W2XAB) went on daily transmission schedule July 21st, 60 holes, 20 frames (revs.) per second (or 1,200 r.p.m.). Voice transmitted on 6,120 k.c. (49.02 meters) W2XE.

Short Wave and Television Corp., Boston, Mass., transmits image (W1XAV) daily, 60 holes, 20 frames per second, and voice accompaniment on 1604 k.c. or 187 meters (W1XAU).

It is understood, of course, that two receiving tuners or sets are required to pick up voice and image, such as from W2XCR and WGBS, one set tuned to 117.5 meters for reception of the image and one set tuned to WGBS or 384.4 meters to pick up the voice.

Daily image programs are broadcast by the Boston station W1XAV, and also by the Chicago stations W9XAA, W9XAO and W9XAP.

Jenkins New Home Projector

(Continued from page 353)

bined broadcast and short-wave receiver by the simple expedient of changing the unique ganged plug-in coil units. It is a truly universal receiver not only in the matter of covering different wave bands, but also in providing the ideal degree of selectivity for each class of reception.

For television reception, the Jenkins receiver covers the wave band from 80 to 200 meters, with the necessary broadness of tuning for maximum pictorial detail. Additional plug-in coils conveniently ganged and housed in a metal casing as single units, to facilitate rapid change from one band to another, can be employed to cover the "broadcast" and the "short-wave" bands as well.

The receiver includes two stages of tuned radio-frequency amplification, with single-dial tuner for simplified operation. A knob controls power switch and output volume, while another knob switches the output from loud-speaker to radiovisor. The resistance-coupled amplifier delivers an output of 55 milliamperes for the operation of the DeForest crater neon lamp in the Jenkins Projector Radiovisor. A dynamic speaker is included.

The tube equipment comprises four '24 A.C. screen-grids, one '27 A.C. detector, two '45 power tubes, and one '80 rectifier. The Jenkins receiver is designed for 110-120 volt A.C. operation. Its components are fully shielded. The receiver is available in chassis form or in a beautifully finished walnut console cabinet, alone or with the Jenkins Projector Radiovisor.

Behind the Scenes in a Television Studio

(Continued from page 337)

eyes are focused almost straight into the optical pick-up; each sheet of manuscript is dropped on the floor as soon as it has been read. The right-hand picture shows how a piano bench and "baby" upright piano are mounted on stilts, so that the artist's face (and occasionally the hands also) can be "picked up" by the televisor.

Light-Controlling Means

(Continued from page 372)

effect is in the opposite sense for each traverse. The passage twice through the crystal doubles the effect of a voltage across the condenser plates in rotating the plane of polarization and valving light. The system may also be used in a straightforward manner, without the double-passage feature, by inserting an idle piezo crystal in the path of the ray, so orientated as to cancel the dispersion due to the active crystal.

Television at the German Radio Exposition

By DR. FRITZ NOACK

(*Continued from page* 335)

In consequence of the negative potential of the cylinder, there is now formed about the filament a cloud of electrons, or "space charge", whose strength is changed by the television signal voltages in the rhythm of the television signal currents. Thereby the number of free electrons is influenced; now, if one applies to this cylinder a negative potential, and to a perforated anode (placed in front of the cylinder), a positive potential of about 4,000 volts, the electrons liberated from the "space charge" cloud, are hurled at constant speed against the anode, and through it upon the luminous screen. The important thing is, that independent of the controlling action by the television currents. the electrons striking the luminous screen through the anode, maintain their velocity practically the same at all times. This result other inventors were unable to attain or could accomplish only with difficulty. The significance of the von Ardenne system becomes clear, when we further perceive that the electron stream must be electrostatically deflected by two condenser systems, so that it describes lines of light on the screen; and that these must be very exactly drawn, which is only possible, if the electrons always have the same velocity.

The deflection of the cathode ray by means of the condenser plates (both in the transmitting tube and in the receiving tube), is accomplished by von Ardenne with periodically fluctuating potentials, whose frequency can be changed at will. These fluctuating potentials are known as "tilting potentials", and are produced by the periodic discharge of a condenser through a glow-lamp. Therefore, von Ardenne requires no rotating parts, but instead he operates his apparatus solely with properly varying electric potentials. Thereby his system differs from all others. However important von Ardenne's Braun-tube system is, at present, it certainly still has one disadvantage; and that is the rather short life of the Braun tube. He hopes to overcome this disadvantage before long.

The firm of Telefunken-Carolus did not take part in the Exposition at all this year.

Tekade this year again showed their television kits for amateurs, which are designed for receiving the experimental television broadcasts of London and Berlin; for 30-line scanning, 12½ frames per second. The kits contain all the necessary parts for a television receiver, with the exception of the driving motor and a cabinet.

For the amateurs and the trade this year, Philips, Rectron, and Pressler offered surface (plate) and point-glow (crater) lamps, both large and small.

A Super-Crater Neon Tube

By C. H. W. NASON

(*Continued from page* 370)

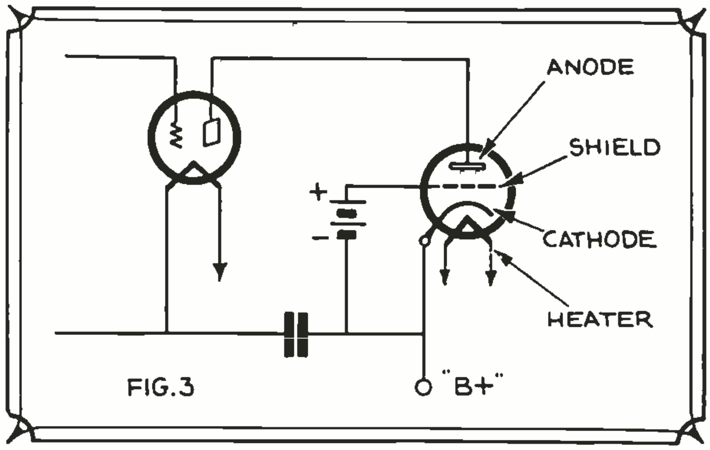


Fig. 3—Circuit hook-up of last amplifier tube to new "super crater" tube.

collision of the gaseous atoms with rapidly-moving free electrons; and it is by this means that the high efficiency of the tube to be described is obtained. The sketch (Fig. 2), shows a tube having a high-efficiency electron-emitting element, or *cathode*, enclosed within a shield which has a small aperture or spout through which some of the electrons will pass. In order to accelerate the electrons to a high speed, the shield is maintained at a high positive potential, with respect to the emitter. Directly outside the spout is a small ring electrode or anode and, across this electrode and the shield, the television signal is introduced.

The flow of electrons from the spout results in a high degree of ionization of the gas within the tube in the region of the ring electrode. This means that the glow discharge itself can be efficiently formed with a signal of small magnitude; since the ionization is taken care of by the electron stream flowing from the shield. The variations in intrinsic brilliancy are taken care of by the signal variations.

Voltage Drop Across Tube

The voltage drop across the shield and cathode is of the order of 30 volts, once the glow-discharge is established. A supply system capable of delivering 200 volts, at a constant drain of about 200 ma. (milliamperes) is necessary to supply the *accelerating potential* between the emitter or cathode and the shield. An '80 tube would be quite satisfactory for this service. The signal power necessary to the operation of the tube is small; but the relatively low impedance of the load, presented to the power tube, makes it necessary that certain care be taken in devising the circuits. The new tube has certain advantages in that it has neither the "hopping off" point nor the "extinction point" of the ordinary flat-plate neon tube or the "crater" lamp.

Crater lamps heretofore used, in the attempt to secure a large image, are notoriously inefficient and productive of distortion, and the new tube represents a marked advance. In Fig. 3, the circuit arrangement of the tube is shown and in Fig. 4 there appears a photograph of a commercial tube soon to be available on the American market. Note that this tube can be in no wise termed a "neon arc", but is an application of the widely-known principle of "electron ionization" to the peculiar exigencies of television.

New 3 By 3 Ft. Image Projector

(*Continued from page* 333)

output of any standard television receiver. The amplifier consists of one stage of voltage amplification, a De Forest 503-A tube which is resistance, capacity coupled to the power stage. The power stage consists of 4 '45's operated in parallel and coupled directly to the crater lamp.

The projector cabinet must be considered compact in order to house the above mentioned details; to be exact, the cabinet is but 34 inches long and 26 inches high.

Above and to one end of the power cabinet is located the Jenkins lens disc which is rotated by a ½ H.P. 3-phase synchronous 1,200 R.P.M. motor. The lens disc is 27" in diameter and holds sixty 1⅛" diameter lens arranged in a spiral, permitting the scanning of standard pictures broadcasted today. The lenses in this disc are carefully selected and individually mounted.

Directly above the motor in proper alignment with the lenses in the scanning disc we have the Jenkins crater lamp. This lamp is filled with neon gas and fitted with a .030 inch square aperture.

The crater lamp has been adopted for its intense brilliancy. The square aperture of the crater lamp is projected upon a frosted or ground glass 3 feet square, placed from 5 to 15 feet from the lens disc.

Possible Solutions of the Television Problem

By P. F. v. d. BOOGAARD

(*Continued from page 375*)

System	*No. of Points*	*Time*	*Max. Frequency*
Deutsche Reichspost	1260 (30 x 42)	1/12.5 sec.	7,875
Telehor	1600 (40 x 40)	1/12.5 sec.	10,000
Baird	2250 (23 x 63)	1/15 sec.	17,000
Telefunken	2500 (42 x 30)	1/20 sec.	23,000
R. C. A.	4320 (60 x 72)	1/20 sec.	43,200

As indices of perfection of these different systems we get, according to the rule above:

Deutsche Reichspost	1260/13332	or	10.5%
Telehor	1600/17776	or	11 %
Baird	2250/16098	or	14.5%
Telefunken	2500/13998	or	18 %
R. C. A.	4320/47995	or	11 %

One concludes from this that these systems are still very far from perfection and that, probably, *they never will get there*, because of the inertia of the moving parts.

Multiple Element Projection

The problems of the second method may be summed up thus:

(*a*) Projecting all the rays emanating from an image *simultaneously*, whether by a static method or by a mechanical method, on a great number of photo-cells (Fig. 3).

(*b*) Projecting all the luminous rays, coming from a same number of luminous sources, in the same order on a receiving screen; either by a static method or by a mechanical method.

As to practical applications of the second method, by a static system, and their inconveniences; while it is possible to attain a perfection of ½, or 50% (provided the frequency is not less than 6,000 cycles), unfortunately, because of the great complexity of the apparatus and the great expense, these systems cannot be practical.

Admitting that it is certainly impossible to transmit all the points *simultaneously* by means of *one* photo-cell, there remains only the final solution:

Transmit all the points of the image, successively, by means of one photo-cell by a static method without inertia.

The problem can be defined as follows:

(1) Project all the luminous rays of an image *successively* on *one* photo-cell. (for transmission by the static method) (see Fig. 4).

(2) Decompose a ray of variable intensity, emanating from a luminous source, into elements of suitable intensities; and project these rays successively in the same order, for reception by the static method (see Fig. 5).

The perfection of this system will be 100%, but it necessitates a photo-cell of special construction. The inventors or manufacturers wishing to give their support to the practical development of this system, are asked to send their proposals to the author of this article, at once.

Address:

La Section Néerlandaise de l'Institut International de Télévision,
61 *Admiraal van Gentstraat*
Utrecht (*Holland*)

How to Build an Automatic Synchronizing Brake

By W. MANSFIELD

(*Continued from page* 357)

The relay must be so built that two contacts are separated by the attracting of the relay armature. It may be purchased from telegraph and electrical supply houses. The relay I used has 11,000 turns of No. 34 B & S gauge copper wire, and a resistance of 500 ohms.

Assembly of the synchronizing apparatus is shown in Fig. 5. The parts of the apparatus are fastened to a framework made of wooden lath or strips, held at the under side by hinges; so that we can at any time quickly open it and remove the Nipkow disc. When all is fastened together we must bring the commutator into its correct position. Then we connect it between the source of plate current and the glow tube; and connect the negative side of the battery to the free terminal of the glow tube. The commutator is fastened on the motor axle.

Testing the Scanner

Now, with a quick run of the Nipkow disc, we shall see in the picture window an image more or less like a vertical streak. By this we recognize the quality of our commutator. If the line shows great irregularities (Fig. 7-a), it is useless for our purposes. In Fig. 7-b, is shown the streak of a serviceable commutator. Now the commutator must be displaced until the line appears, that is, divided, at the left and right of the picture (Fig. 7-c). The commutator remains fixed to the shaft in this position.

A B C

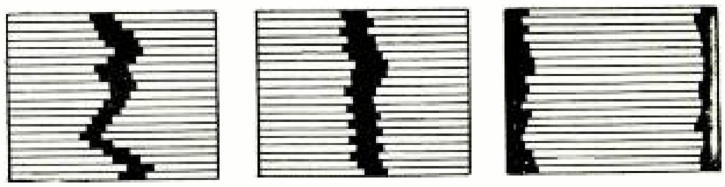


FIG.7

Fig. 7 — Showing graphically, the proper adjustment of the commutator.

After all connections are made, the first experimental tests can be made. (Be careful! The plate current of the power tube goes through the commutator placed on the shaft of the motor! So do not ground the motor housing!) In the experiments, as remarked above, the relay armature must be carefully adjusted, likewise the tension spring of the brake lever. The adjustment may offer some difficulties of its own but, once this is done, one finds extreme pleasure in the smooth running of the disc and the accurate, "constantly framed" picture.

Stenode Applied to Television

By ZEH BOUCK

(*Continued from page* 352)

to cut off the sidebands, that the high frequencies are present to a greater degree in the amplitude variations than in the sidebands.

When this is the case, it is obvious that the loss in the high notes can be compensated, without bringing up the sideband admittance, or broadening the resonance curve, to anywhere near the characteristics of a flat-top, band-pass receiver. (*As a matter of fact and observation, in any receiver, regardless of the degree of sharpness, it is apparent that modulation must be due to both sideband and amplitude variations, and the compensation required is never that which would be necessary if the sidebands alone were responsible for frequency reproduction. This explains why "resonance curves" have never checked exactly with frequency attenuation curves; and the fact that engineers in the past have been content to explain such discrepancies as "experimental errors" or "transients" is by no means complimentary to those engineers who are still satisfied with that explanation.*)

This proposition can be clarified by an inspection of the curves in Fig. 2, which approximate those made by a laboratory of international prestige. Curve "A" shows the response characteristic of the Stenode as the frequency is varied from resonance. Curve "B" shows the frequency-attenuation characteristic—the manner in which the high frequencies are attenuated as the modulation frequency is raised. Inspection will show that the compensation required for a 3-kc. note is about 30 db. This will also bring up the interfering sideband or carrier, 3 kc. off the resonant point of the Stenode, 30 db. The interfering signal, however, will still be 40 db. down!

It may be maintained that the difficulties of compensating for television modulation frequencies are insurmountable, but experiments do not indicate that this is the case. Compensation is probably a more simple matter, over present-day television bands, than achieving the advantages of Stenode reception in any other way—if that were possible. And if still higher frequencies are ever to be transmitted, as suggested in our introductory analysis, the Stenode offers the most fertile possibilities.

A Practical Stenode Television Receiver

The problem is greatly simplified by splitting the audio frequency amplifier into three or more channels following a preliminary correction channel. Fig. 3 illustrates schematic line-up of a practical Stenode television receiver. The output of the three different amplifiers can be recombined either in a single neon tube, or in several individual tubes operating through an optical system of "transparent" mirrors. The audio frequency components will be adequately filtered, and the use of exponential tubes in which the amplification varies inversely with the amplitude, will simplify the correction. Engineers are working on such a circuit at the present time. Three audio channels should be sufficient to amplify and correct for a 72 x 60 image.

Other Advantages of Stenode

Other advantages of the Stenode in the reception of contemporary television signals are analogous to its performance on broadcast channels. The complete absence of "background disturbances" between stations, will facilitate tuning and synchronizing. With television pretty much of a local proposition, the lowered r-f (radio-frequency) amplification will make it possible to take full advantage of reduced "background disturbances" in the neighborhood of the signal carrier. The fact that "background" is noticeably reduced on weak carriers opens possibilities in the way of distant television reception and the adequate use of automatic volume control. The reduction of interference from all possible sources is obvious, resulting in a flash-free image. In addition to the described selectivity characteristics, it is possible to cut out a heterodyne signal on either side of the desired carrier by a variation in the crystal balance control, thus eliminating, in many instances, the interference patterns caused by broadcast station and other harmonics.

Intelligent application of the Stenode principles should contribute much to the development of television in the future. Regardless of the degree of detail required—the number of picture elements scanned per second—the image can readily be confined within a ten kilocycle band, or less, permitting television to assume its rightful place in the broadcast bands, where the image definition will only be limited by the frequency of the carrier.

(A second article is being prepared by Mr. Bouck, dealing with the practical construction details of a Stenode television receiver. This article will appear in the next issue of TELEVISION NEWS.)

Television Motor Driving Hints

(*Continued from page* 361)

motor and television scanning disc shaft, as shown in Fig. C. Today, 1,200 R.P.M. synchronous motors may be obtained on the market, but in many cases the experimenter may have a perfectly good motor available, or else can buy one cheaply at a second-hand electrical shop, so that with gears, belts, or other forms of mechanical drives, the motor may be able to operate at normal speed, say 1,750 R.P.M., while the scanning disc is geared to rotate at 1,200 R.P.M.

If a gear drive is to be utilized, spiral gears should be insisted upon, as they minimize any back-lash or lost motion. Severe belt slippage or lost motion between gears will cause checkered pattern lines to appear on the television image screen.

Friction drives have been used quite successfully by a number of television experimenters, including C. Francis Jenkins. In any event the preferred form of friction drive is that where a small motor has a conical (or straight) friction pulley fitted on its shaft, and the motor (or friction pulley) moved back and forth in contact with a friction disc mounted either adjacent to the scanning disc, or at the free end of the scanning disc shaft. With the motor operating at a fixed speed, the speed of the scanning disc will vary depending upon the position of the friction pinion. When the motor pinion is moved toward the center of the large friction disc, the speed of the scanning disc will be faster; but as the small pinion is moved toward the periphery of the larger disc, the speed of the scanning disc will be slower. In some cases a "finger" or adjustable guide moves the smaller friction pinion back and forth, as a speed adjustment handle is turned.

Fig. E shows how a leather-faced, or other type of friction clutch may be arranged between a synchronous motor and a small accelerating motor, where the synchronous unit is of the type which has to be first speeded up to synchronous speed.

A 60-Cycle Phonic Wheel

(*Continued from page* 347)

The 60-cycle phonic motor may be made similar to the others described elsewhere in this magazine, the only change necessary being the use of six poles instead of 60, for the 60-line image. By this means, a synchronizing amplifier is not required; simply connect the phonic motor to the lamp socket.

The six-pole armature should be of laminated construction. Coils may be from an old audio transformer.

Hints on Using a Braun Tube as a Scanner

By DR. ERNST BUSSE

(*Continued from page* 355)

applies this to one pair of deflection plates through a suitable transformer or potentiometer, the spot oscillates back and forth in this direction 60 times a second. If one, for example, wishes to regulate the pictorial frequency to 20, then for every deflection of the pictorial frequency, which is applied to the second pair of deflection plates, there are three changes of A.C. line frequency. There results in this case on the luminous screen the curve shown in Fig. 6. If there are more than three changes of the A.C. network, the frequency is too low; if there are less, then it is too high. The figure appears to stand still at every frequency which can be calculated by a fraction, 60 divided by a whole number. At all intermediate values it moves. The whole number at the same time indicates how often the sinusoidal curve of the A.C. network current appears per saw-tooth oscillation.

In the case of frequencies lying above 60 perform the adjustment in the same way. Only note that now there are several saw-tooth oscillations per network frequency change. *E. g.*, if one wishes to adjust to a line frequency of 375, one first regulates the heating (for tube II) which is necessary in order to adjust a constant curve according to Fig. 7. Here there are 7 saw-tooth oscillations per change of network frequency. Therefore the saw-tooth frequency is 50×7 or 350. After that one regulates the heating of tube II somewhat higher, until a figure appears with 8 switch oscillations per net frequency, and one marks the adjustment for the saw-tooth frequency 400. Afterward one knows that the correct adjustment must lie between 350 and 400 and can perform the further adjustment while receiving the pictures.

Synchronizing Saw-Tooth Oscillation With Image Signal

For synchronizing the saw-tooth oscillation with the arriving image transmission, there are various methods possible. In image transmission the picture mark at the end of each line is, as is well known, characterized by an impulse of potential. By this impulse the oscillation of the line switcher or oscillator must be released. There are several ways of doing this. One can conduct a part of the reception current to the plate lead wire of the line oscillator, through a resistance or transformer; one can likewise couple into the grid lead of the line oscillator with still lower potentials. It is sufficient for this work, if one couples with the grid coil a coil (of a few turns) with reception current flowing through it.

Of course capacitive induction is also possible. Since the tube oscillator apparatus is relatively sensitive, it can be synchronized with extraordinary ease and then needs no further adjustment during reception. A special synchronization for the pictorial frequency is almost superfluous, since the picture usually stands very well after a single adjustment. One can, however, proceed here in the same manner as with the line oscillator, since the arrangement then acts as a frequency reducer, that is, only every thirtieth (in Germany—every 60th in America) pictorial dash point in the reception current introduces the new saw-tooth oscillation.

With the apparatus described the adjustment of any desired line and pictorial frequencies is extraordinarily simple, at any rate simpler than the interchanging of Nipkow scanning discs, La Cour wheels, etc., quite apart from the question of cost. Changing from vertical to horizontal lines is possible by simply turning the whole Braun tube on its longer axis. Different lateral proportions as, *e. g.*, in the case of English and German television transmission, can be adjusted by regulating the amplitude of one saw-tooth oscillator.—*Funk Bastler.*

Can the Amateur Help Perfect Television?

Yes—Says A. G. Heller

(*Continued from page* 366)

Why, they ask, hold television in the secret recesses of research laboratories for years until it is perfected, when even now there are thosuands who would enjoy the task of aiding in its development and at the same time provide employment for many thousand more in supplying the necessary parts and materials?

250,000 Television Amateurs Waiting —Dr. Alexanderson

Dr. E. F. W. Alexanderson, upon presenting an enlarged television image, remarked that he estimated there were 250,000 "home experimenters" who would welcome the opportunity to participate in the development of television! And that it was upon this 250,000 that he placed his confidence for aid in its development!

If our experience with radio is any criterion at all, and it certainly should be, it seems conservative to say that each of these 250,000 "home experimenters" are prepared to spend at

(*Continued on page* 388)

Novel Television Ideas

(*Continued from page 363*)

Fig. 8—Characteristics of the photo-cell amplifier diagrammed at Fig. 7.

Fig. 10 — Illustrating the effect of the values of the resistance on the over-all amplification Figure E2/E1.

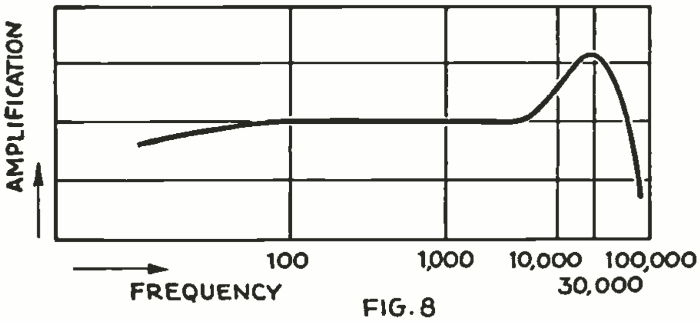


FIG. 8

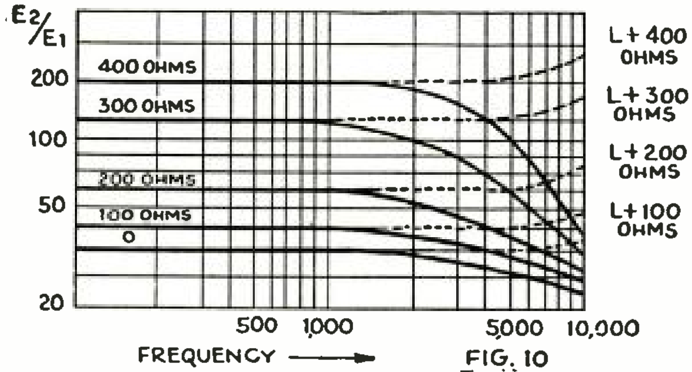


FIG. 10

cæsium cell combined with an amplifier tube escaping inter-electrode capacities and insulation difficulties.

Likewise the glow-lamps; their brightness and constancy improved, their size standardized; and also the color of the light has been changed, somewhat more into the yellow part of the spectrum. The most important progress is shown in the dot-light (crater) glow-lamps (Osram or Pressler); which, on account of their high light intensity, are called "light points" and permit with sufficient energy direct-screen projection for an image 18 x 24 cm. (7.2 x 9.6 inches) with the aid of mirror wheels or lenses similarly arranged. By introducing an auxiliary anode, the disadvantage of the difference between the extinguishing and lighting potential is also eliminated, thus avoiding distortion.

In conclusion, amplifying apparatus for experimental purposes has been so far developed that it is possible to transmit directly frequencies as high as 30,000 cycles and, as becomes necessary, compensate the high frequencies neglected by the input. Fig. 7 shows an amplifier for television purposes, whose frequency-characteristic reaches into the high-frequency field. The characteristic of the amplifier is represented in Fig. 8. Interestingly one can also attain corrections of the higher frequencies by "light regeneration"; whereby at the same time the total amplification is increased. A special amplifier, which works with resistance-coupled regeneration, is shown in Fig. 9. The regenerative circuit has the common impedance Z in the plate lead for the first and last tubes.

The amplifier, if it is to operate satisfactorily, must be run by batteries. The regeneration could be effected by a pure ohmic resistance; whereby, however, the loss of higher frequencies would be still greater and the correction would be absolutely necessary. For this, it is necessary only to connect in series with the coupling resistor an inductance, which not only compensates the loss but even increases the amplification.

Fig. 10 shows the effect of the values of the resistance on the overall amplification figure E2/E1. The ratio E2/E1 can be increased fivefold, without a "whistling" in the amplifier. As the upper resistance limit, a practical value is 400 ohms. The value of the inductance is to be about 4.2 millihenries. For the example a resistance-coupled amplifier was purposely selected; since in all other kinds of amplifiers the requisite linear frequency-characteristic is never attainable; but resonance phenomena come out more strongly through the regeneration. Fig. 10 plainly shows us the increase in amplification, as well as the influence of the inductance on the frequency-response. Van Der Bijl as early as 1919 wrote of such regeneration methods, and even discussed them in his book on thermionic tubes.—*Radio Amateur of Vienna.*

What Shape Scanning Hole?

(*Continued from page 368*)

have the above specified form. This specific image, of the narrow, rectangular light-emitting aperture, is projected by means of lenses or mirrors to work in conjunction with the "flying spot" system on the transmitting end and, for television projection purposes, on the receiving end.

Fig. 3 presents a picture of a scanning disc with slit-shaped holes.

(Continued from page 386)

least $50.00 a year on parts and equipment for experimentation. In other words, there is available at a conservative estimate, a sum of over $12,000,000 a year to be used for the development of television *through the purchase of parts.*

But, far more important than the money involved, is the enormous impetus that these enthusiasts would give to interest in television all over the country. Just as the imperfections of radio would probably have not yet been greatly reduced, were it not for the enormous interest aroused by "individual enthusiasts"; just as no one organization or individual can claim to have brought radio to its present perfection, even though patents running well into the thousands are controlled by different organizations; so there is little hope that there will be an early emergence of a marvellously perfect television set, if it is kept entirely in the big corporations' research laboratories.

How "Cooperative Invention" Works Out

An instance in my own experience illustrates very aptly the difference in viewpoint between the large research organization and the production viewpoint. A friend of mine, chief engineer in a large research organization, had developed a new circuit which he was naturally quite eager to try. In line with regular organization practice, he sent his requisition to the purchasing department for a quotation on the material and estimated time of delivery. After weeks of deliberation, by both purchasing and manufacturing departments, he received his quotation with a promise of delivery within six months.

Extremely interested in the product of his brain, he naturally wished to know what results it would give in a somewhat shorter time than six months. Unofficially he got in touch with me and asked for help. Within a few moments I had referred him to three firms who could probably furnish the necessary parts. He had telephoned to me on a Thursday; on Friday morning he was in touch with the three sources to whom I had referred him. Monday morning his parts were delivered. Some of those concerns had worked over Sunday so that he could have his material in the shortest time possible; and yet the price he paid was one-third the quotation given by the production department of his own organization!

The second example from my own experience that illustrates the second viewpoint comes to mind: During the process of experimentation, it became necessary that we have a certain type of instrument to be used in a circuit which we had laid out. To make that instrument, balance it up, check it, etc., would in the normal course of production take several weeks. Before taking this step, however, we telephoned to eight specific allied manufacturers who might possess that same instrument, and succeeded in finding one who fortunately possessed one complete and ready for use. We learned this in a conversation five minutes before closing time, and by the aid of a taxi reached our friend approximately one-half hour later. He had very kindly waited for our return and, that very same evening, we had in use at the plant an instrument which was exactly what we required for a delightful evening of experiment. But what if there were no allied manufacturers with friendly and cooperative spirits? What if our experimentation were conducted entirely behind locked doors and hush of secrecy? The answer is self-evident. We would have had to consume the weeks necessary to manufacture that instrument because, first, we would fear to allow any rival organization to get an inkling of what we were doing; and they in turn would be reluctant to aid us in our experimentation.

Getting Started in Television

By EDWIN J. BACHMAN

(Continued from page 345)

stationary. The experimenter should employ some method of indicating the exact speed, as he thereby reduces the number of unknown quantities, at least by one. Instead of the small neon lamp just mentioned, a 25- or 40-watt metal filament incandescent lamp may be used; although the spokes will not stand out with as great contrast.

My "Attic" Television Lab.

I built a frame to hold the disc, mounting, motor, radio set, "B" eliminator, filament transformer, loud speaker, etc., in my attic "Lab."

Stations "I See"!

Some of the stations I pick up at Fullerton, Pa.:

W2XR, Radio Pictures, Inc., New York; clear, strong; titles readable.

W8XAV, Short Wave Radio and Television, Boston; clear, strong.

W3XK (Jenkins), Washington, D. C.; strongest of 48-line stations.

W2XCD, De Forest, Passaic, N. J.; clear, when not interfered with by Chicago and W2XBS. Have the most interesting programs of any.

W2XBS (N. B. C.), New York; most steady, 60-line. Very broad, interferes with others.

W9XAP, Chicago, 3-spiral 45-line scanning. Strong, steady signals, but unintelligible here.

The Necessary Difference in Transmission Frequency for Television

By E. KINNE

(*Continued from page* 377)

correct adjustment of the glow-lamp, in the case of the high and low frequencies being 50 per cent. disadvantageously affected, variations of the reproduced pictures from the originals could be perceived.

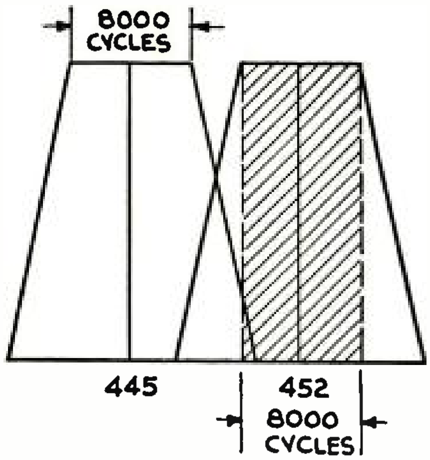


Fig. 6—Ideal receiver curves.

At any rate it is sufficient to have for these purposes a receiver whose resonance curve (according to Fig. 4, at the top) has a width of 10,000 cycles!

With this result, the question of the necessary spacing of transmitter frequencies in television work is essentially solved. If we are not going to be committed beforehand to picture reproductions poor in quality (analogous to distance transmissions of music) then it must be possible to realize and maintain the aforesaid resonance curve of Fig. 4 in television reception.

If two transmitters should operate on the same wave, we should, of course, with proper local conditions, inevitably hear one station on tuning in the other. The same thing happens if two stations are so close together that, because of the breadth of the resonance curve, it is not possible to separate them. For clarity, two adjacent stations may be indicated by the resonance curves of a receiver (Fig. 5). The shaded part of curve I indicates that range of frequency which can be amplified with approximate fidelity. Into this range falls part of curve II; so that this program is also partially received, with the amplification-characteristic of curve I. Here we may neglect the possible interference phenomena. If, in spite of their proximity, we desire to separate two stations, our receiver should show the resonance curves of Fig. 6, which must, of course, be much narrower and more selective.

The resonance curve necessary for proper television transmissions (Fig. 4) presupposes a minimum separation of 12,000 cycles between the adjacent stations. If the stations are closer together, they cut into each other's transmitting channels. As to the result of this simultaneous reception of two or more stations, it can be judged only by one who has himself undertaken television experiments. It can, at least, be said that interference, which in music would pass unnoticed, will render the reproduction of a picture quite unrecognizable. To separate the two stations, we are again required to choose a narrower resonance curve, which is exactly what we want to avoid.

Of course, with a selective receiver, it is possible to receive stations even closer together. But, as has been said, the reproduction suffers in quality, exactly as with music and voice broadcasts. I am of the opinion that installing expensive transmitters for film or sound broadcasts should presuppose the best possible quality. Consideration of this demands that the individual stations be 12 kilocycles apart.

It is especially in picture broadcasts that fidelity to nature demands earnest consideration. Otherwise the result may be that in the reproduction large dark (black) areas will appear light gray; likewise narrow black lines will seem light gray. On the other hand, a normal area also appears light gray; only this time it is true to nature! Imagine, as an explanation of this condition, that a picture is to be sent which shows a small shaded (that is, gray) face on a large black background. The signals corresponding to a large black area (low frequency) are decreased in amplitude because of an unsatisfactory allotment of the stations; so that in reproduction this exhibits only a gray surface at the sides. The face remains gray; since the average frequencies are reproduced normally. The areas located above and below the face will also be black; since for them the frequencies are fairly high. As a final product one then obtains a uniform gray surface, showing darker areas only above and below the part where the face should really appear.

—*Das Funk Magazin.*

DO YOU REALIZE

That each issue of this magazine contains more up-to-date information on "Television" than any $5.00 text-book?

New Television Kits Popularize the Art

(*Continued from page* 369)

mendously important part of any television receiver and in the Freed-Eisemann design this amplifier has been given very special attention by the engineers, so as to pass a very wide band of frequencies, and thus provide the necessary fidelity of image reproduction.

Another point that should not be overlooked is the use of the Pentode tube in the output stage, which gives plenty of power, even on the weakest signals, owing to the unusually favorable characteristics of the Pentode tube, so that a brilliant image is insured at all times. The Freed-Eisemann Telescanner is supplied with a 60-hole disc, and the motor is designed for operation at 20 frames per second, scanning from left to right and top to bottom. The Telescanner is designed for operation on 110-120 volts, 60 cycles A.C.

Building a 1,200-Cycle Synchronous Motor

By KENNETH E. SHERMAN

(*Continued from page* 343)

tus may be used is similar to that described by C. H. W. Nason in the July-August issue of TELEVISION NEWS, as applied to phonic wheels—the "thermionic brake." The theory of operation was explained by Mr. Nason and need not be gone into here. In general, the idea consists of using the synchronous motor as an alternator. The alternating current generated in this way is absorbed by the output stage of the 1200-cycle amplifier when synchronism is reached; which throws a considerable load on the driving motor, and serves to hold it at this speed. The only change necessary to use this system is to connect the grid and plate return leads to ground, in the output stage; the oscillator being used, as before, to maintain the approximate scanning speed at all times.

This Outfit Receives Radio Movies 1,000 Miles

By RAYMOND STEPHENS

(*Continued from page* 340)

the spark coil. The other wire is to be fastened to the terminal, closest to where the vibrators were. From this same terminal a wire goes to one of the binding posts. A wire from the remaining terminal goes to the remaining binding post. Now, on the vibrator end of the spark coil you will notice four screw ends sticking up all near each other. Replace the bushing taken off the longest, and place washers on the smaller ones. Take a piece of bare No. 18 wire, attach it to one

Do You Realize that

TELEVISION WAVES ARE ALL ABOUT YOU!

Build or Buy a "Scanner" and LOOK IN!

In the Next Issue more

"Constructor" Articles

post and make a complete connection to each post. When finished, it will be found in an oblong shape. (See Fig. 3.) Break one of the wires in the primary circuit of the filament transformer about 8 inches from the transformer. Attach this to the A.C. switch.

This attachment is now ready to hook up to the one-tube set.

It might seem that the A.C. current from the output of this apparatus would spoil the incoming picture, it does not in my location. The "B" batteries neutralize this current somewhat.

The Crater Tube

By D. E. REPLOGLE

(*Continued from page* 339)

difficult to secure enough light, from a moderate amount of current, to use these in a simple and inexpensive home radiovisor; so an entirely new principle was developed.

The use of the electric arc has been known for a long time and experimenters have been trying to use this arc for television for several years. Because of its inherent instability, this has been a difficult problem; but the tube research men have come along and utilized the principle of an arc in a gas, to solve their problems in a satisfactory way. An arc is the break-down of a gas medium (somewhat similar to the process used in the earlier neon tubes) but, instead of ionizing a portion of the electrons in the negative electrode, the whole group near the smaller electrodes has been highly ionized, and those give out intense light.

It has been found that, by heating the negative (cathode) electrode—the reverse process to cooling—an arc can be formed, between that electrode and the positive (anode) electrode, and it can be made to present a most intense light-source.

In recent days this new principle has been developed to great length, and now seems to be well on its way to satisfy the condition required for a successful light-source in projecting television images.

There is much of a technical nature involved in the design of these tubes; and it will suffice to say that, among the essential things, are the shape of the electrodes, purity of the gas, method of securing purity, the temperature at which the gas operates in the tubes, etc. All these are important factors which have been tried before production models can be made.

White Light Now Available

Much has been said about the color of the television lamp now in use. A word about the reasons for this color may be of interest.

Neon, which gives a characteristic *orange* glow, was the gas first used for two reasons: the first is that the human eye is more sensitive to the orange color than to white or blue; so that with a given amount of illumination the pictures appeared brighter in that color than in any other. Second, the voltage gradient necessary to ionize neon (though it is not the lowest for any of the gases) is comparatively low.

For a *white* light, nitrogen and argon in proper proportions will give very satisfactory results, with approximately the same voltage applied. Helium gives a bluish white light, but requires considerably more voltage to produce the ionizing condition. Other combinations of gases can be and have been used to produce various colored lights.

It is by use of these various combinations of gases that colored television can be rather simply produced. In this case, three radio or wire channels are necessary: One to transmit the blue color in the image; one to transmit the red; and one to transmit the yellow. At the receiving end, the output from three different colored television lamps is blended to produce the received image. It is even possible to secure satisfactory colored television with two channels; in which case a red and a green lamp are used at the receiving end.

All of the above information will serve to point out very clearly that development work in television, particularly on the receiving end, is very much needed at this time. There are literally hundreds of channels of research work that are opening out before the television researcher.

Large Image Produced by New Scanner

(*Continued from page* 366)

The scanning disc is 12 inches in diameter, containing 60 holes, and is driven horizontally by a small but efficient synchronous motor, insuring constant synchronization with the transmitting station. Vertical framing is accomplished by snapping the motor switch off and on, while a shift device on the neon lamp socket provides for horizontal framing. When attached to the output of a good short wave television receiver, this scanner outfit will give faithful image reproduction. Close adherence to the complete set of blueprints and instructions furnished with the kit, will insure the rapid and easy construction of the televisor. The kit includes a special mirror, visor with focusing adjustments, a rugged frame, the essential motor parts, a synchronizing control and 60 line scanning disc.

Strike One! Greets Japanese Visualists

By H. WINFIELD SECOR

(*Continued from page* 331)

as faces; which is the main object of the Bell Laboratory System, when it is opened for public use.

The Jenkins Television Corporation has been very aggressive in developing a new television "pick-up camera," and this was recently demonstrated at the Park Central Hotel, New York City. The writer first saw this direct pick-up camera in operation at the Jenkins Laboratory last spring; at that time it was "aimed" out of the window and on the receiving screen there were clearly visible clouds in the sky; a railroad train which pulled in about 1000 feet away, with the smoke very perceptible.

The new Jenkins pick-up camera was illustrated on page 246 of the last issue of TELEVISION NEWS. Briefly described, the direct pick-up camera employs an improved and ultra-sensitive photo-electric cell, placed behind a motor-driven scanning disc; the subject is illuminated either by daylight or else by a suitable arrangement of artificial lamps in the studio, as the article in the last issue of TELEVISION NEWS clearly portrayed.

We therefore see, from the foregoing, that "outdoor" scenes have been picked up in England, America and Japan, and probably in other countries. But, after all is said and done, we still have another problem to conjure with—that of finer detail. In other words when you have full-size figures, such as baseball players on a very small screen, or even on a large television screen, we will require more than 60-line scanning to give satisfactory detail to the faces and figures themselves.

To make this statement more explicit, with 60-line scanning you may find that the face of a baseball player, let us say, is being scanned by only four lines, which is bound to result in a very coarse detail. Naturally, if the forehead is being scanned by only one path or ribbon; the eyes and nose by a second; the mouth and chin by a third; and the neck by a fourth ribbon or scanning path, you are not going to enthuse over the remarkable reproduction of the subject's face.

When it comes to picking up prize-fights and baseball games, we will undoubtedly require 120-line scanning or, better still, 200-line or 300-line scanning.

Mr. Farnsworth and a number of other leaders in television research have assured us that, with some very ingenious improvements, which are at present being effected behind closed laboratory doors, we shall be able to easily transmit 200 or 300 scanning lines in place of the present 60.

Why Special Resistors

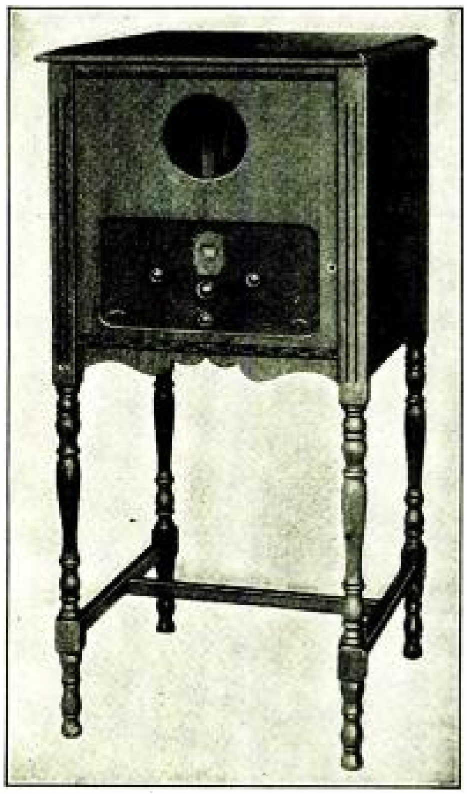
By MAGNUS BJORNDAL*

The best criterion of the utility of a certain resistor for high frequency is its time constant. Good "non-inductive" resistors should have time constants on the order of 10^{-7} to 10^{-8} second. It is easily realized that when the time constant is too large, *i. e.*, natural frequency is too low, the resistors will oscillate and cause considerable disturbances. Daven engineers have made a thorough study of this matter and have devised special methods for winding resistors with extremely high natural frequency for particular purposes. It has in many instances been possible to reduce the reactance at a certain frequency as much as 70 - 80% and thus locate the natural frequency at a much higher point.

*Chief Engineer of the Daven Company.

Daven television amplifier resistor.

New Crater Tube Projector

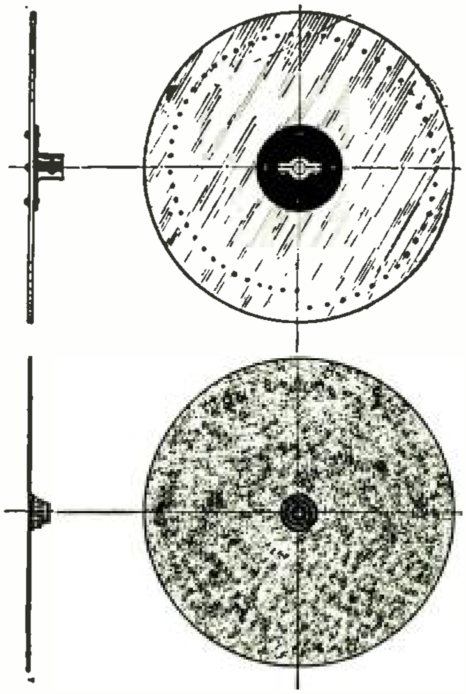


One of the new models of Crater tube—lens disc—large image television receivers designed by the Shortwave & Television Corp., of Boston, Mass.

Low-Price Scanning Discs

TWO forms of television scanning discs which are being offered at popular prices are supplied by Mr. Arthur M. Pohl. For the junior television experimenter whose pocketbook is rather limited, this is just the thing the enthusiasts want and need most badly. Yes, Sir! a 60-hole scanning disc for $1.00. This disc is 15½ inches in diameter and has 60 holes laid out to form the new oblong picture (5:6 ratio or 60 by 72 elements). The disc becomes rigid when spinning at the required 1200 r. p. m.

The metal disc supplied at the nominal price of $7.50 is a very fine job and has been examined by the editors. It measures 16 inches in diameter and has 60 holes with a 5 to 6 ratio.



Above—The Pohl metal scanning disc; below—60-hole "paper" scanning disc.

An Electronic Light Valve

By WOLF S. PAJES

(*Continued from page* 376)

New "Color Television" Modulator

This principle of light modulation also lends itself to color television; Fig. 2 illustrates such an apparatus. The transmission and reception of pictures by color television is accomplished by utilizing three channels of communication, with as many transmitters and receivers. After the colors of varying intensity have been translated into their electrical equivalents, by means of three photo-electric cells (each of them sensitive to one of the three fundamental colors), they are amplified and transmitted.

At the receiving end, the three different signals are tuned in and amplified by three separate receivers. From these the electrical impulses act upon three "absorption type" modulation tubes; each of the tubes absorbing only one of the three fundamental colors. For example: if blue is the color to be reproduced, the tubes absorbing red and green must be strongly excited, in order to absorb those respective colors; whereas the excitation of the tube which is capable of absorbing blue must be kept low. This can easily be accomplished by reversing the phase of the resistance-coupled amplifiers. It is evident that, in this case, the exterior light source must furnish white light.

Seeing Is Believing

(*Continued from page* 367)

The other enclosure is a report of our German image reception taken from the Manchester "*Daily Dispatch*," the leading paper for the north of England.

Yours faithfully,
FRED AND FRANK B. PARRY.
Church Street, Littleborough.
Manchester, England.

(Thanks a lot for your very interesting letter describing your wonderful success in picking up German television images 900 miles away, on your experimental amateur station in England. Although this fine piece of work was accomplished on the other side of the Atlantic, we trust it will fire the enthusiasm of thousands of young Americans, who have no idea of what pleasure they are missing, if they are not already "looking in" at the television images being broadcast in many parts of the country, day and night, by nearly 30 stations. The editors have just had the pleasure of seeing some of the new home type receiving apparatus exhibited at the New York Radio Show, and if you have not seen the brilliant and really remarkable images produced with the new "crater" tubes, even with a small lens disc, you have a big treat in store.—Editor.)

The Promise of Television

By MERLIN H. AYLESWORTH

(*Continued from page* 327)

tell the story, since the figures may be virtually silhouettes.

A Challenge to Telecasters

The limitations of television are simply a challenge to the ingenuity of the broadcasters. The program presentations can in large measure be fitted to the limitations, even giving birth to an unique and pleasing art form perhaps, as in the case of the silent motion pictures of the past and the sightless broadcasting of today. Television is more fortunate in its early struggles than was sound broadcasting, for while the latter worked alone, television enjoys the partnership of an older and firmly established companion art. By means of sound broadcasting, television has a voice whereby to speak the story which it is acting. Synchronized sound broadcasting for television is simply a partnership of both arts. The performers face the combined microphone and scanner, so that voice and action are picked up for transmission via two separate and distinct radio channels. At the receiving end, two receivers are required, one to tune in the sound broadcasting signals and the other for the television signals.

The home television reproduction of today leaves much to be desired, but so did the early broadcast receivers with crystal detector and headphones. The pictures usually measure not over 1½ inches square but may be magnified by a lens in which case pictorial imperfections become more apparent, while the brilliancy is proportionally reduced. Viewed through a shadow-box or peep-hole* by one or two persons at a time, with a greater number of lookers-in if image distortion is no drawback, the performance is reminiscent of the early days of motion pictures when a penny-in-the-slot and the turning of a crank brought animated scenes before hungry eyes. The use of a neon tube causes television pictures to appear in pink, so that pink eye is added to the ailments of television reception.

With television technique in the state of flux, there can be no reasonably stabilized designs for several years to come. And in the absence of stabilized designs, there can be no mass production of home equipment. And without mass production of equipment, there can be no attractive prices to gain widespread acceptance of home television.

Fine Opportunity for Experimenters

On the other hand, television technique offers unlimited opportunities

*Large images which the whole family can enjoy are produced by the new model "crater lamp" and "lens-disc" projectors placed on the market this Fall. Also tubes yielding black and white images have been successfully tried out in the laboratory and will undoubtedly be available to the public before long.

for experimentation. Its present status is simply a repetition of early broadcasting history, when there was more pleasure in the never-ending building and tearing down of home-made radio sets with which to intercept the feeble radio signals. Indeed, through the efforts of practical testing of transmitting and receiving ideas in the field, with laboratory research workers and development engineers receiving the hearty co-operation of radio amateurs and experimenters, it is to be hoped that television progress may be materially accelerated.

All of which is not entertainment in the usual sense of the term. It is "experimentation". And it is upon this interpretation of the status of present-day television that the Radio Corporation of America and the National Broadcasting Company have based their television policy.

While other interests have chosen to go before the public with the preliminary versions of a television broadcasting service, our group has preferred to retain the art in the research laboratories for a longer time, in order that it might develop to more substantial proportions. Without being committed to any particular technique and without the snapping of the whip of commercialism, the large research staff in the RCA-Victor plant at Camden, N. J., has enjoyed an unique advantage. Many techniques have been tried, compared, improved, grouped, eliminated. Out of a vast amount of experimentation, there has slowly but surely emerged a system which, in further refined and improved form, will become the basis of future "home television".

Meanwhile, a similar policy is being followed with regard to television transmission. Experimental television transmitters are being maintained by our group, not with any thought to affording entertainment to the public, since that would be an unfair promise at this early date, but rather as an extension of our laboratory efforts. The transmission is being developed step by step with reception developments, *thereby building up to a complete television system which will soon be introduced to the public as a vehicle of "practical home entertainment", rather than as an experiment.*

A reasonably stabilized technique will justify the mass production of television receivers, so that television equipment will sell at prices within reach of the average purse. And a sufficiently numerous and enthusiastic audience will justify attractive television programs which will then be forthcoming. In brief, we are committed to the introduction of an entire art form, in practical working order, rather than to spasmodic experiments.

Despite its admitted shortcomings, television will develop rapidly. It en-

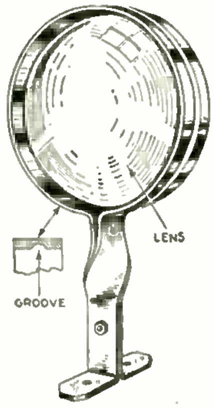
(*Continued on page* 398)

The Trav-Ler Scanner and Receiver

ONE of the newest scanner and television receiver kits placed on the market is that here illustrated, which has been brought out by a St. Louis, Mo., concern, well-known for their portable radio sets. An outstanding feature of this television set is that the scanner unit, comprising scanner disc, neon tube and housing, together with motor and powerful magnifying lens, is all mounted on a special frame-work, which fits over the tuner-amplifier inside a neat cabinet.

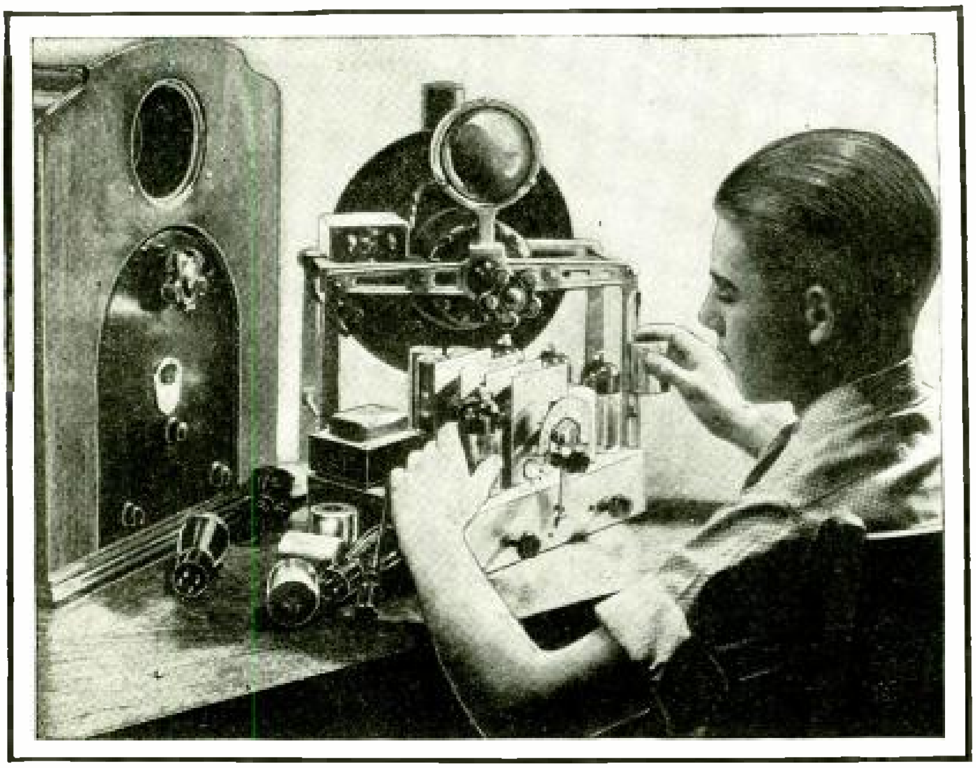
The synchronous motor drives the disc at 1200 R.P.M. and provision is made for framing the image, which is accomplished by turning the large knob just below the lens visor. The receiving tuner and amplifier employs two specially designed R.F. stages with a '24 S. G. tube, these stages passing 80 kc. These are followed by a '24 detector, a '24 first audio, and a second stage of audio with a pentode tube, supplying a strong output to the neon tube.

As Chicago stations transmit negative images and the Eastern stations positive, the short wave receiver is fitted with a special switch which permits changing the detection system from "grid-leak" to "plate rectification" in order to reverse the image when necessary. The tuner and amplifier here described and shown is for use with a plate type neon tube; a new model, which will soon be ready, utilizes two pentode tubes in parallel in the output stage, suitable for exciting a Taylor neon arc or a crater tube. —*Photo courtesy Trav-Ler Mfg. Corp.*



Handy Lens Mount

ILLUSTRATION shows a simple but very well-made lens mounting, which is built to fit any size lens and sells for a nominal price. It is made by a progressive New York City television supply house—"Blan, the Radio Man". A specially shaped groove is cleverly pressed into the band, which, when bent into shape holds the lens rigidly. Mr. Bian has also evolved a clever scheme for bending corners on his "custom-built" shield boxes.



The Trav-Ler receiver and scanner kit shown above is of very excellent design and workmanship. More details next issue.

The Promise of Television

(*Continued from page* 396)

joys the benefit of modern research and engineering methods and facilities, quite as well as the support of the older broadcasting institution.

Will Not Interfere With Sale of "Sound" Receivers

An entirely separate and distinct development, television in no way conflicts with the existing broadcasting situation nor with the radio industry and radio trade. Whatever fears may have been expressed regarding the uncertainty which television would introduce in the radio market, such fears have been largely dispelled by now. The industry, the trade and the public have come to realize that television, for the present, *is a separate though parallel development to sound broadcasting*, and that the ultimate partnership of both arts can only be consummated when television has attained a standard of perfection that approximates that of sound reproduction. *Thus television will not interfere with sound broadcasting, although it will no doubt supplement the latter in an altogether pleasing manner. Television will not replace the existing broadcast receiver, but rather will work independently of or in conjunction with the latter, depending on the program service. The radio buyer will not delay buying a broadcast receiver in the hopes of obtaining a combination model, for the television receiver will be a separate and distinct unit for a long while to come*, on the basis of sound engineering and sane merchandising. The sound receiver having attained a state of relative perfection, while the sight receiver is still in the process of rapid evolution, it would be nothing short of folly to combine both in a single unit.

The immediate application of television is, of course, the visual presentation of the broadcast artist. We may look forward to an early television supplement to our regular sound broadcast programs, in which speaker, singer or artist, will appear on the home television screen as a purely optional feature. In other words, the sound program will be received in the same manner as today. However, if the home be equipped with a television receiver, it will be possible to tune in the animated portrait of the performer. That this feature will prove highly attractive, no one will deny, especially in the instance of a performer whose personality is firmly established in the hearts of the present "blind" audience. The presentation of prominent speakers over the television supplement will also prove a worthy refinement to our present sound broadcasting service.

The Future

If television continues for some time as a supplement to existing sound broadcasting, there will be no serious artistic problems. It can strive towards better detail all the while, with laboratory progress introduced into everyday practice from time to time. Ultimately, when it possesses sufficient detail for a presentation quite on a par with that of sound broadcasting, it may insist on its own way in many broadcasts, with television as the main issue and sound as the supplement. That day will come when television is capable of flashing complete scenes over the air. Sporting events, parades, news events, ceremonies, plays, pageants — such subjects may eventually be handled by television both in the studio and out in the field, at which time the pictorial presentation will surpass the sound presentation in importance. Judged by our present technical standards, however, such thoughts are highly fantastic, although by no means impossible of realization in the distant future. To one who has seen sound broadcasting develop from the faint whisper of the human voice to a full symphony orchestra, or the motion picture industry from the crude penny-in-the-slot machine to the remarkable sound pictures of today, anything is possible and indeed probable. Modern research seems without limit.

If anything, the majority of the radio performers would welcome the television feature at this time, inasmuch as it would give them a much desired opportunity to display their histrionic wares.

What television may mean to broadcast performers is perhaps best expressed in the personal appearance of our artists. Time and again, the audiences before whom they appear are delighted to see the performers in person, and carry away a permanent impression which supplements subsequent listening in on their performance, making for far greater appreciation and enjoyment. When personal appearances become part and parcel of the broadcast program, the appreciation and enjoyment must be all the more keen.

I can assure you that there will be no disappointments when your favorite radio personalities appear before you on the television screen. The problem of having our enthusiastic musicians keep on their coats and collars will be more serious than that of having our stars look their best. And, of course, television make-up will cover a multitude of sins.

That television has long been anticipated in our studios is proved by the fact that the NBC Chicago studios, located on the roof of the Merchandise Mart, have been built with television requirements in mind. Our other studios may be readily adapted to television presentation, particularly since television will be a supplementary service in the nature of a close-up of the performer, who will face a compact scanner as well as the usual microphone.

Our group contemplates a television broadcasting service to the public in the near future. Within the next year, we shall have a television transmitter located at the top of the new RCA building at 570 Lexington Avenue, New York City. Another station will be located on the Pacific Coast. Most likely our associated stations will hasten to install television transmitters to supplement their sound broadcasting service. It is certain that once the television art proves its entertainment possibilities, the country will rapidly be blanketed by television transmitters.

And so the experiment of today promises to become the institution of tomorrow. The gap between those who believe that television entertainment is already here and those who concede that it is still around the corner, is steadily closing up. We shall soon be in perfect agreement as to the entertainment possibilities, interpreting those possibilities in our respective ways. Of one thing we are now certain: *the television era has definitely dawned!—Address delivered by Mr. M. H. Aylesworth before the N. E. L. A. convention, Atlantic City, New Jersey.*

STOP SHOPPING!!

HERE'S a NEW plan, which saves you money. *Stop shopping—the lowest prices are right on this page.* Yes, lower than in our own catalog. Why? Because no house can get out a new catalog every month, but by advertising in this magazine we can bring you the latest and lowest prices *up to the time this ad is printed.* We watch our competitors and *do not allow anyone to undersell us.* We meet ANY price on NEW merchandise. *Order direct from this page and save money. 100% satisfaction on every transaction.*

Pacent "250" Power Auditorium Amplifier

One of the Most Powerful Super Power Amplifiers ever made.

Now $8.75

CONTAINS 2 STAGES SUPER POWER A.F. AMPLIFICATION

This famous amplifier is provided with input and output transformers for working from a phonograph pick-up into a 2000-ohm transmission line or into the coupling transformer furnished with most dynamic reproducers. The tubes required are one '26, one '50 and one '81 rectifier. Where maximum output is not required a '10 may be substituted for the '50 in the output. Automatic adjustment takes care of the discrepancy in voltages. The undistorted power output is 2.5 watts—**enough for four small dynamic reproducers.** This degree of power output provides satisfactory coverage for auditoriums having a volume of 25,000 cubic feet. The input voltage necessary to provide maximum output is but .025 volts.

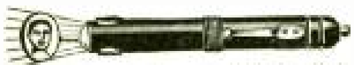
Ideal for theatres seating approximately 3,000 people, dance halls, schools, lectures, hospitals, auditoriums, outdoor gatherings, etc., etc. The gigantic power is at all times within control—for that matter, it can be used in any home, as the volume can be regulated down to a whisper!

A PHONOGRAPH AMPLIFIER—PUBLIC ADDRESS AMPLIFIER SYSTEM, ETC.

Use of the '26 tube in the input stage makes the long "warming up" period unnecessary. Shipping weight, 30 lbs. Overall size, 16 x 9¼ x 6¾" high. List Price, $90.00.

No. 1925—Pacent Model 250 Power Amplifier (less tubes). Your Price $8.75

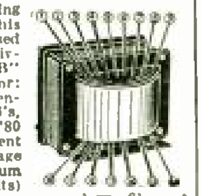
BRAND NEW! RADIO MIRROR PENLITE



The Latest and Cleverest Tool for Radio Serviceman. The only device that enables you to LOOK AROUND CORNERS or UNDERNEATH inaccessible spots. Your vision is ONLY in a straight line, but with the Mirror-Penlite you can look around a 45 degree angle. You can now look under the whole chassis and see every nut, every wire, every socket, behind condensers, transformers, etc. This is made possible by the powerful pocket flashlight to which is attached a **GENUINE DENTAL MAGNIFYING MIRROR.** Mirror clips on or off so flashlight can be used alone if desired. The cleverest device yet. Complete with battery and bulb. Shipping weight 6 ozs.

No. 1695—Mirror-Penlite. List Price $2.50. YOUR PRICE 85c

Earl Power Transformers



Make money revamping the old battery set. This power transformer used in Earl Model 22 receiver supplies "A," "B" and "C" potentials for: two '27's (or screen-grid '24's), three '26's, two '71A's and one '80 rectifier; total current output of high-voltage winding at maximum output (about 200 volts) is 80 ma. High-voltage secondary, filament winding for '27's and for '71A's are center-tapped. Size, 3¾ x 3 x 2¾ inches. 16 long leads and full wiring directions. Shipping weight 5 lbs. List Price, $7.50.

No. 1410—Earl Transformer (without brackets). YOUR PRICE.... $1.73

No. 1411—Earl Transformer, the same but with mounting brackets.. $1.98

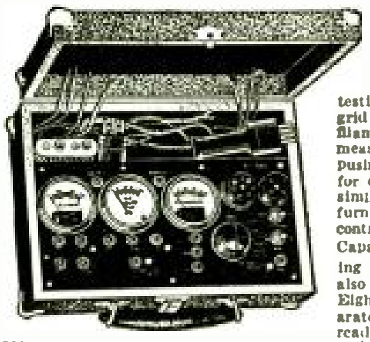
SPECIAL!

Baldwin RIVAL Speaker Unit

A loud speaker unit bearing the world famous Baldwin mark. Designed for use with horn type speakers or with old style phonographs. Complete with cord. Shipping weight 1 lb. **POSITIVELY LOWEST PRICE THIS UNIT HAS EVER BEEN SOLD.**

No. 1520—Baldwin "Rival" Unit. YOUR PRICE 45c

NEW READRITE Analyzer



This three-meter analyzer has selector switch for checking all parts of tube circuits by connecting to the set sockets. Selection for testing voltages of plate, grid, cathode and screen-grid done quickly and accurately. Plate current, filament volts, line and power supply volts are measured. Grid swing test for tubes used. Just push one button for screen-grid and other button for other tubes. Makes testing of all type tubes simple and thorough. 4½-volt grid battery is furnished. Battery is used for grid test and continuity testing of transformers, chokes, etc. Capacity and resistance charts furnished showing use of instruments for testing condensers, also measuring resistances up to 100,000 ohms. Eight scale readings of meters may be used separately with the jack terminals provided. Scale readings are 0-60-300-600 D.C. volts. 0-10-140-700 A.C. volts and 0-20-120 milliamperes. A.C. and D.C. filament voltages are accurately measured on the one meter. Strong case with leatherette covering. Attractive. Compact. Size 10¾x3½x8 inches. Shipping weight 15 lbs. List Price $25.00.

No. 700—READRITE ANALYZER. YOUR PRICE...................... $14.70

New 36 page Summer Edition No. 23

75 New Hook-Ups, etc.
350 Illustrations.

The new Summer Edition of our greatly enlarged RADIO SERVICE TREATISE has just come off the press. If you liked the Winter Issue, you will like this one a hundred-fold. It contains some 75 new hook-ups, circuit diagrams; and some 350 illustrations. **POSITIVELY THE GREATEST BOOK EVER PUT OUT BY ANYONE.** Among the new matters listed are:

VACUUM TUBE TREATISE, with many illustrations; full page Vacuum Tube Average Characteristic Chart; How to Take Care of Your Tubes; How to Connect Phonograph Pick-ups; Improving the Tone Quality of Old Sets; Connecting Additional Loud Speakers; all fully illustrated with diagrams.

Other articles: Modernizing Old Radio Sets; How to Convert Battery to Power Sets; Selection of Tubes; Push-Pull Amplifiers; Replacing Audio Transformers; Phono Attachments; How to Choose Power Transformers; Voltage Dividers; Wattage of Power Transformers; Selecting and Installing Replacement Parts in Radio Sets; Filter Condensers; Repairing Eliminators.

WRITE TODAY. Enclose 2 cents for postage. Treatise sent by return mail.

NEW! NEW!! Superheterodyne S-W Converter

At last a short-wave converter that converts any broadcast set into a superheterodyne short-wave receiver. Employs three 227 tubes and covers from 20 to 115 meters. No plug-in coils! Coil switch is used to cover all wavelengths. Single dial control, no body capacity, no squeals. This converter has built-in filament transformer to heat the three 227's. All you need to obtain from your receiver is a positive B voltage anywhere from 45 to 180 volts. Voltage is not critical; no molestation of the receiver. So simple a child can operate it. Size 7 x 10 x 5 inches. Shipping weight, 8 lbs. List Price $25.00.

No. 1614—Super Converter (less tubes). YOUR PRICE......... $14.69

World-Wide Short-Wave Set NOT A CONVERTER

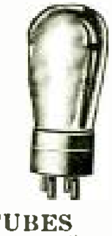
A perfect radio short-wave receiver for use between 17 and 84 meters. To put into operation, connect antenna, ground, 45-volt "B," and 6-volt "A" batteries, and headphones to the posts provided, plug in a type '01A tube, and tune in! An ingenious circuit makes possible a 4-coil single-winding plug-in design. This little instrument has the same sensitivity as many big, shielded short-wave receivers costing ten times as much. A power amplifier may be added for any degree of volume. Complete with 4 plug-in coils. Has fine vernier dial for precision tuning. **Never has a first class short-wave set sold for so little money.** This short-wave set measures 5¾x7x1 in. high, over all. Ship. weight, 3 lbs. List price, $12.50.

No. 1666—World-Wide S.-W. Set. Your price.................. $6.25

6 MONTHS GUARANTEED NEONTRON TUBES

Sold on a 6 MONTHS FREE REPLACEMENT GUARANTEE BASIS, PROVIDING TUBE LIGHTS! All tubes are carefully meter-tested before shipment, and carefully packed. Do not confuse these HIGH QUALITY tubes with any other "low priced" tubes—our low prices are possible because we do a VOLUME business!

NEW



Choice	Choice of	Choice	Choice	Choice	Choice
226	112A	245	222	230	235
227	200A-199X	280	210	231	247
171A	199UV-120	171	250	232	
201A	224		281		
63c ea.	69c ea.	79c ea.	1.58 ea.	1.08 ea.	1.50 ea.

R.C.A. LICENSED TRIAD AND PERRYMAN TUBES

These nationally advertised tubes are guaranteed UNCONDITIONALLY for six months. The prices are slightly higher than our NEONTRONS because these tubes are of much better quality. See listing above for tube numbers.

Choice	Choice	Choice	Choice	Choice	Choice
Price	Price	Price	Price	Price	Price
76c	96c	86c	$1.76	$1.46	$2.09

THORDARSON "245" Power Transformer

A Miniature Power Plant — Supplies All ABC Voltages — 80 Watts

In addition to supplying a full 250 volts to the plates and 50 volts to the grids of two type '45 tubes in push-pull, this transformer may be used to light the filaments of seven or eight 2.5-volt filament tubes; and by connecting in series two of the three 2.5-volt filament secondaries it is possible to light 5-volt filaments too. Five secondaries: S1—5 V., 2 Amp.; S2—310 V. Cent. T.; S3—2½ V., 3 Amp. Cent. T.; S1—2½ V., 10½ Amp.; S5—2½ V., 3 Amp. Cent. T. **Just the power transformer for building up a high-grade public address amplifier to use a screen-grid A.F. amplifier to boost the output of a microphone or phonograph pick-up;** following this with two stages of push-pull amplification consisting of two '27's in the first stage and two '45's in the second. Bottom of transformer has bakelite panel on which are mounted all taps. **It outperforms ANY similar transformer.** Many Service Men keep this model transformer on hand for emergency replacements in hundreds of makes of radio sets. For 110-120 volts, 50-60 cycles. Size: 5 in. high x 4 x 3¼ in. Shipping weight, 8 lbs. List Price, $15.00.

No. 1450—Thordarson Power Transformer. YOUR PRICE....... $3.84

Flewelling-Dayton SW Adapter

This wonderful instrument connects to any A.C. radio set by putting into tube socket in place of the tube (which must be a type '27, or "heater" tube) the plug which is on the end of its 2-ft. cable; then put tube into tube-socket of adapter. Remove aerial from broadcast set and connect to antenna post on adapter. Special plug-in coil No. 1 covers a wavelength band of 17 to 29 meters; coil No. 2, 27-28 meters; coil No. 3, 47-84 meters. Plug-in coil inductances come with the adapter. 5½x7¼x4" high, overall. Ship. weight 4 lbs.

No. 1613 — Dayton Flewelling Short-Wave Adapter. List Price, $15.00. YOUR PRICE (without tube).... $4.93

Short-Wave Converter

Build a short wave converter at lowest price on record, but with which excellent results are obtainable nevertheless. The voltage for the three 227 tubes used may be obtained from an external filament transformer or from a secondary winding of 2½ volts in a power pack. Wavelength from 30 to 110 meters. No plug-in coils; coil switch is used to cover wave band. Single dial tuning; no grunting, no body capacity, no squeals. Leak-condenser modulation. Converter consisting of all parts (less filament transformer) including cabinet, panel, diagram and 4-page instruction sheet (less tubes).

No. 1619—YOUR PRICE $4.85
No. 1615—6-Volt Battery Model, same price.

High-Voltage Condenser Units

We guarantee these condensers unconditionally. They are ideal for general replacement purposes and can be installed in any new power-pack. All condensers are furnished with 8-inch lengths of tinned "push-back" wire.

600 VOLTS			800 VOLTS		
Cat. No.	Mfd. Capac.	Your Price	Cat. No.	Mfd. Capac.	Your Price
1702	½	$0.25	1706	1	$0.40
1703	1	.30	1707	2	.70
1704	2	.40	1708	4	1.05
1705	4	.60			

WE ARE A WHOLESALE HOUSE AND CANNOT ACCEPT ORDERS FOR LESS THAN $3.00.

If C. O. D. shipment is desired, please remit 20% remittance, which must accompany all orders.

If full cash accompanies order, deduct 2% discount. Send money order—certified check—U. S. stamps.

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"Programs from All the World"

PILOT "ALL-WAVE" Super-Heterodyne

10 TUBE
SUPER-HET.
$128 COMPLETE

CONSOLE
7 TUBE SUPER
$89.50 COMPLETE

11 TUBE SUPER-WASP

Now from Short-Wave Headquarters comes ALL-WAVE POWER! Pilot's new SUPER-WASP 11-Tube Super-heterodyne All-Wave Receiver is two sets in one. A 7-Tube Standard Super-heterodyne Chassis in combination with a 4-tube converter. Every tube works. Pulls in everything from 11 to 550 meters. No coils to plug in. Nothing to change. Just a flick of a switch to turn from long-wave to short-wave. As simple to operate as an ordinary receiver. Converter has own power pack and rectifier tube, and more signal strength than ever before possible. Six wave-length tuning stages. No regenerative distortion. Now in one set you can get both all-wave and long-wave programs with good broadcast quality reception and plenty of POWER to spare! Your dealer will be glad to demonstrate the new SUPER-WASP for you.

Table Model **$99.50**

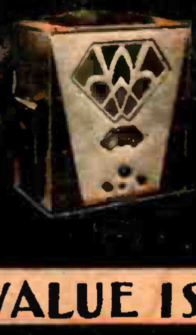
Complete with Tubes

Pilot Radio & Tube Corp.
Lawrence, Mass.

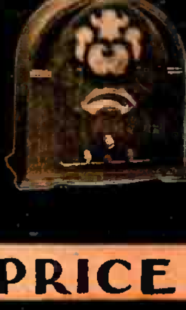
Send me complete information about the new 11-tube Super-heterodyne SUPER-WASP All-Wave Receiver.

Name ....

Address ....



MODERNISTIC
7 TUBE SUPER
$79.50 COMPLETE



5 TUBE
T. R. F. MIDGET
$42.50 COMPLETE

PILOT VALUE IS MORE THAN PRICE DEEP