Television News

FEATURES

LATEST IDEAS IN CATHODE RAY TELEVISION
By HAHNS GUNTHER

THE STUDIO ASPECT OF TELEVISION
By H. J. BARTON CHAPFE,

PHASING THE TELEVISION IMAGE
By C. H. W. NASON

SYNCHRONIZING D. C. MOTORS
By M. RAPPAPORT

SINGLE SIDE BAND TRANSMISSION
By R. D. LE MERT

HOW TO MAKE ACCURATE SCANNING DISCS

TELEVISION IN COLORS

NOW
25¢

Television With a Short Wave Converter
Television

Most efficient television produced for home use. Equipped with Duralumin lens disc 16" diameter. Each of its 60 lenses accurately adjusted focally to produce clear, definite images on screen. Disc driven by heavy duty synchronous motor, with switch and framing device operated from front panel.

Short Wave

The Rawls Short Wave Unit in connection with the broadcast receiver has been especially designed for long distance short wave reception from 15 to 200 meters. Super Heterodyne Circuit incorporating 9 tubes in the combination. The use of the new multi mm and pentode tubes give exceptional tone and power. To switch from one short wave band to another, it is unnecessary to change coils—just the click of the panel switch and the change is made automatically.

Broadcast

A six-tube receiver, designed to give the ultimate in tone, selectivity and power. Uses the following tubes: two 235 Multi Mu, one 224A Detector, one 227 and one 247 Pentode output with 280 rectifier. The tone quality of the set is due to the accurate matching of all parts. Its eight-inch Dynamic speaker handles, without distortion, the tremendous output of the pentode tube. Designed especially for reception of the synchronized voice with television image.

Television

The television receiver is the most important receiver of the combination. Eight tubes T.R.F. circuit, using two 235 Multi Mu in RF circuit, one 224A Detector, one 227 and two 245's in audio circuit, also with the 280 rectifier. Very careful attention has been given the audio amplifier and its frequency response is flat from 15 to 75,000 cycles, which is necessary to give clear, definite television images. Its two 245 tubes are so connected to supply the undistorted output and current necessary for proper operation of the Rawls crater point lamp.

To give the public the very latest in television our engineers have produced the "Ultimate in Television and Radio."—Model TV 85.

Pioneering in the television field they were quick to grasp the need of a set capable of producing a picture large enough for a group to sit by and enjoy.

No longer is it necessary to peep into a small aperture—person at a time. The TV 85 projects a picture on a screen in the panel of set. Invite your friends—any number of people can enjoy the programs.

In addition it is now possible to get the added thrill of LISTENING TO AS WELL AS SEEING your favorite artist on the screen . . . and the TV 85 is not only a television receiver . . . It is also the latest in combination H.F. WIRELESS . . . Covering bands from 15 to 50 meters.

Housed in a beautiful console cabinet that will fit the appointments of the most pretentious home, . . . TRULY the last word in TELEVISION AND RADIO.

Think of the thrill of reaching out with just a turn of the dial to that unknown, unexplored realm of short waves . . . just beyond the range of your present receiver . . .

Distance means absolutely nothing . . . FOR Rawls Broadcast, an exciting chase through the unknown of a distant city bared on the trail of a murderer, thieved, reported clearly by the police department. You don't have to strain to listen . . . sounds come in loud and clear as your local broadcasts.

Listen to AMATEUR STATIONS all over the world.

Near the heart in the field of Aviation. Plans are timed and reported exactly the same as on the most modern railroad . . . Tulsa, Texas, reports No. 623 over . . . quickly the entire country is on the quiver searching for the missing plane.

It is positively thrilling . . . and don't forget all this time you are comfortably seated in your favorite chair surrounded by your family and friends . . . enjoyment for all.

Be up to date . . . order your Rawls TV 85 today . . . costs no more than a good single purpose receiver, yet it provides thrills that you have never experienced.

 LIST PRICE

$295.00

Yellow Base Tubes

<table>
<thead>
<tr>
<th>Tubes</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV1836A</td>
<td>$1.50</td>
</tr>
<tr>
<td>RV1835C</td>
<td>$1.95</td>
</tr>
<tr>
<td>RV18371A</td>
<td>$2.00</td>
</tr>
<tr>
<td>RV1840H</td>
<td>$2.75</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
<tr>
<td>RV18480A</td>
<td>$4.99</td>
</tr>
</tbody>
</table>

W. C. RAWLS & COMPANY
T. N. BANKERS TRUST BUILDING • NORFOLK, VIRGINIA
I will train you at home to fill a BIG PAY Radio Job!

If you are dissatisfied with your present job, if you are struggling along in a rut with little or no prospect of anything better than a skinny pay envelope—clip the coupon NOW. Get my big FREE book on the opportunities in Radio. Read how quickly you can train at home in your spare time to be a Radio Expert—what good jobs my graduates have been getting—real jobs with real futures.

Many Radio Experts Make $50 to $100 a week

In 20 years the Radio Industry has grown from 2,000,000 to hundreds of millions of dollars. Over 3530,000 jobs have been created by this growth, and thousands more will be created by its continued development. Many men and women with the right training—the kind of training I give you in the N. R. I. course—have stepped into Radio at two and three times their former salaries.

Get Ready Now for Jobs Like These

Broadcasting stations use engineers, operators, station managers, and pay up to $5,000 a year. Manufacturers continually employ testers, inspectors, foremen, engineers, service men, buyers, for jobs paying up to $6,000 a year. Radio Operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. Dealers and jobbers employ service men, salesmen, buyers, managers, and pay up to $110 a week. My book tells you about these and many other kinds of interesting radio jobs.

Many N. R. I. Men Have Made $200 to $1,000 in spare time while learning

The day you enroll with me I send you material which you should master quickly for doing 28 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 have made $50 to $1,000 for N. R. I. students in their spare time while training. My course is famous as the course that pays for itself.

Talking Movies, Television, Aircraft Radio included

Special training in Talking Movies, Television, and Home Television experiments. Radio’s use in Aviation, Servicing, and Merchandising Sets. Broadcasting, Commercial and Ship Stations are included. I am so sure that N. R. 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. Send me on completion.

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 your 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., 2GC4
Washington, D. C.

Our Own Home
Pioneer and World’s Largest Home-Study Radio training organization. Men and young men for good jobs in the Radio Industry. Our growth has paralleled Radio’s growth, and in three hundred times as much floor space as we did when organized in 1914.

I have doubled and tripled the salaries of many. Find out about this tested way to BIGGER PAY.

- NEW Radio Equipment for Broad Practical Experience Given Without Extra Charge

With the aid of this equipment you can work out with your own hands many of the things you read in our text books. From it you get the valuable experience that tells an expert from a beginner. In a short time you have learned what it would take years to learn in the field. It’s training like this that puts the extra dollars in your pay envelope. Some of the many circuits you build and experiments you perform are: Measuring the drift of a Tube, building an Ohmmeter, tube voltmeter, and a Grid dip meter for service work. You actually make experiments illustrating the important principles in the 25 best known sets.

Apparatus for transmission and reception of an actual radio signal—one of the many experiments set up with my outfits.

Lifetime Employment Service to all Graduates

J. E. SMITH, President
National Radio Institute Dept., 2GC4
Washington, D. C.

Dear Mr. Smith: Send me your free book. I understand this request does not obligate me.

Name ______________________ Age ________
Address ____________________
City ______________________ State ________
FEATURES:
“Cathode Ray Tube or Discs”—An Editorial by Hugo Gernsback ........................................ 117
The Studio Aspect of Television, by H. J. Barton Chapple .................................................. 118
Cathode Ray Television—Its Progress and Development in the U. S. and Abroad, by Hanns Gunther ................................................................. 120
Single Side Band Television Transmission, by R. D. Le Mert ..................................................... 122
The Dalpayrat System of Dynamic Scanning, by Henri F. Dalpayrat ........................................ 124
Television Progress in France, by Marc Chauvierre ................................................................. 126
Frequency Requirements for Television, by Ivan Bloch ............................................................. 127
Television in Natural Colors, by Manuel de Dios ................................................................. 128
Television Transmission on a Narrow Wave Band, by Lieut. George Wald .................................. 130

TELEVISION RECEIVERS:
Television with a Short-Wave Converter, by Floyd Fellows ..................................................... 130
How to Make Accurate Scanning Discs, by Marcel Marret ...................................................... 131
A Double Disc Scanner, by Jess M. Reed ...................................................................................... 132
Cathode Ray Tubes for the Experimenter ..................................................................................... 135

Our Cover—
Shows How Television Images Are Received with a Short-Wave Converter Working with a Regular Broadcast Receiver. See page 130

TELEVISION NEWS—Bi-monthly. Entered as second class matter at the post office at New York, N. Y., under the act of March 3, 1879. Trademarks and copyrights by permission of H. Gernsback, 98 Park Place, N. Y. C. Text and illustrations of this magazine are copyright and must not be reproduced without permission.

TELEVISION NEWS is published on the 15th of every other month. Six numbers per year. Subscription price is $1.50 a year in the United States and possessions. Canada and foreign countries, $1.75 a year. Single copies 25c. Address all contributions for publication to Editor, TELEVISION NEWS, 98-99 Park Place, New York, N. Y. Publishers are not responsible for lost manuscripts. Contributions cannot be returned unless authors remit full postage.

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

COPYRIGHT, 1932, BY H. GERNSBACK

Published by POPULAR BOOK CORPORATION

HUGO GERNSBACK, President ........................................... H. W. SECOR, Vice-President
Editorial and General Offices, 96-98 Park Place, New York, N. Y.

Australian Agents: McGILL’S AGENCY,
179 Elizabeth St., Melbourne
OPPORTUNITIES are many for the Radio Trained Man

Don't spend your life slaving away in some dull, hopeless job! Don't be satisfied to work for a mere $20 or $30 a week. Let me show you how to get your start in Radio — the fastest-growing, biggest money-making game on earth.

Jobs Leading to Salaries of $50 a Week and Up

Prepare for jobs as Designer, Inspector and Tester — as Radio Salesman and in Service and Installation Work — as Operator or Manager of a Broadcasting Station — as Wireless Operator on a Ship or Airplane, or in Talking Picture or Sound Work — HUNDREDS OF OPPORTUNITIES for a real future in Radio!

Ten Weeks of Shop Training

Pay Your Tuition After Graduation

We don't teach by book study. We train you on a great outlay of Radio, Television and Sound equipment — on scores of modern Radio Receivers, huge Broadcasting equipment, the very latest and newest Television apparatus, Talking Picture and Sound Reproduction equipment, Code Practice equipment, etc. You don't need advanced education or previous experience. We give you — RIGHT HERE IN THE COYNE SHOPS — the actual practice and experience you'll need for your start in this great field. And because we cut out all useless theory and only give that which is necessary you get a practical training in 10 weeks.

TELEVISION and TALKING PICTURES

And Television is already here! Soon there'll be a demand for THOUSANDS of TELEVISION EXPERTS! The man who learns Television now can have a great future in this great new field. Get in on the ground-floor of this amazing new Radio development! Come to COYNE and learn Television on the very latest, newest Television equipment. Talking Picture and Public Address Systems offer opportunities to the Trained Radio Man. Here is a great new Radio field just beginning to grow! Prepare NOW for these wonderful opportunities! Learn Radio Sound Work at COYNE on actual Talking Picture and Sound Reproduction equipment.

PAY FOR YOUR TRAINING

After You Graduate

I am making an offer that no other school has dared to do. I'll take you here in my shops and give you this training and you pay your tuition after you have graduated. Two months after you complete my course you make your first payment, and then you have ten months to complete your payments. There are no strings to this offer. I know a lot of honest fellows haven't got a lot of money these days, but start and want to prepare themselves for a real job so they won't have to worry about hard times or lay offs.

I've got enough confidence in these fellows and in my training to give them the training they need and pay me back after they have their training.

If you who read this advertisement are really interested in your future here is the chance of a lifetime. Mail the coupon today and I'll give you all the facts.

ALL PRACTICAL WORK

At COYNE in Chicago

ALL ACTUAL, PRACTICAL WORK. You build radio sets, install and service them. You actually operate great Broadcasting equipment. You construct Television Receivers and actually transmit your own Television programs over our mod-
WORLD'S BEST RADIO BOOKS


TELEVISION, its Methods and Uses. Cloth covers, size 5½ x 8½, 250 pages. 66 illustrations. Price $2.50. "A complete, easy-to-read book on television today. One of the very best books on this important art in print."

MAGNETIC PHENOMENA, by Raymond Brown. William's Cloth covers, size 5½ x 8½, 150 illustrations. Price $3.00. All electric motors, coils, transformers, and current-carrying lines are described in detail. Price $2.50.


Everything on the subjects of "best" and "worst" 16 mm. films, telling the story of the industry from its primitive production to this magnificent production. Price $2.50.


The most important book on the subject. A complete guide to the use of radio equipment, servicing, and maintenance and service as applied to the short-wave band. Price $1.00.


THE RADIO AMATEUR'S HANDBOOK, (New Revised Edition), by A. Frederics. 488 pages. 130 illustrations. Price $2.00. "If you wish to become a radio amateur, this book is essential."

RADIO SET ANALYZERS, and HOW TO USE THEM, by L. van der Linde. Stiff Paper covers, size 5½ x 8½, 24 pages, 45 illustrations. Price $1.00. The first book giving the fundamentals of radio servicing in a manner which is clear to the novice. No service man can be without it.

RADIO FREQUENCY MEASUREMENTS, by R. V. W.相爱. 5th edition. Cloth covers, size 5½ x 8½, 505 pages, 295 illustrations. Price $6.00. "This large volume contain basic measurements which arise in the design and operation of electronic apparatus. It is written for the expert and is a valuable book of its kind in radio print today."


This textbook gives you the fundamentals of radio theory as applied to radio practice in the field of radio.


The designs of radio apparatus and the principles of radio construction are explained in this book. Price $2.50.


"A fascinating book that tells you how this wonder of the world is affecting to the world."


This is the story of the "Father of Radio." Price $3.00.


Sound pictures on the air. Price $3.00.


Radio amateurs need to be told that this book is a "must" for every radio enthusiast. Price $2.50.


"The Service Men's Handbook. It contains all the standard definitions of electronic radio, plus many hundreds of practical definitions of every imaginable commercial radio set up to 1931.

RADIO SERVICE MANUAL, by R. H. Bergman, Professor of Radio and Electrical Engineering, Indiana University. Cloth covers, size 5½ x 8½, 224 pages, 224 illustrations. Price $3.50.

The book of college work. Price $3.00.

JOHN F. Ramsey, Professor of Radio and Electrical Engineering, Indiana University. Cloth covers, size 5½ x 8½, 224 pages, 224 illustrations. Price $3.50.

The book of college work. Price $3.00.


The book of college work. Price $3.00.

COMPLETE WITH SIX SUPPLEMEN- TALS.


The book of college work. Price $3.00.

RADIO TELEPHONY and TELEGRAPHY, by H. L. Johnson, Professor of Radio and Electrical Engineering, Indiana University. Cloth covers, size 5½ x 8½, 100 pages, 295 illustrations. Price $5.00.

The book of college work. Price $5.00.

"Every amateur should read this book." Price $5.00.


"Every amateur should read this book." Price $2.75.

"Every amateur should read this book." Price $2.75.

"Every amateur should read this book." Price $2.75.

How to order
We cannot ship C.O.D. Our prices are net, as shown. No books include postage. Those that do not will be shipped by express collect if sufficient postage is not included by you.


"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.


"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.

"A handbook that every radio operator should have. The diagrams alone are worth the price of the book.
CATHODE RAY TUBE OR DISC?

By HUGO GERNSBACK

THERE seems to be a good deal of confusion, not only in the public's mind but partly in manufacturers' minds as well, as to which will prevail in the future—the cathode ray tube or the disc.

The writer frankly believes that when television is finally accepted on a par with present-day audible radio, most likely neither the cathode ray tube nor the disc will be found in the television set of 1942 or thereabouts. Radio, as well as all other similar mechanical arts, has proven again that new inventions never spring into existence fully perfected. It is a slow process of evolution. Neither the disc nor the cathode ray tube is perfect, both have their faults and shortcomings, and the chances are that in the future an entirely different television system will be used. It probably will be an outgrowth of the cathode ray tube or it may be a combination of both cathode ray and neon tubes, but it surely will not be a mechanical disc.

The disc should not be condemned entirely, as it certainly has shown its worth up to the present time, and has helped to make television what it is. The trouble with the disc is, of course, the mechanics of it. This feature, for some reason or other, seem to be looked upon with more or less suspicion by the average radio engineer.

The idea of the disc does not seem to present as "elegant" a solution for television as, for instance, the silent and non-mechanical cathode ray tube, which has no moving parts at all. In this respect, the cathode ray tube approaches our present-day radio sets, in which we have no mechanically moving parts, the only "moving" parts being the silent electrons which fly at the speed of light inside the tubes.

As I have stated in a previous editorial—which, by the way, has brought in letters from all over the world—the chances are that in the end we will not "scan" at all, as we know the term today. However, this is probably in the future, and it undoubtedly will be some time before the art catches up with that prediction, possible and plausible as it is.

If it were not for the mechanics and moving parts of the present disc system, we might say that the lens disc, which is in use at present, has reached a fairly high state of development. It is certainly a tremendous improvement over the plain hole discs with which we started out. By means of the crater tubes now available, we really get a very satisfactory amount of illumination, and fair size images can be obtained. As such lens discs are produced now, they are reasonable in price and their results are pretty fair.

A mistaken notion of the advocates of the cathode ray tube is that this tube has cured all the ills of the disc. This is not true at the present time of writing. In the first place, you can now get only small images with a cathode ray tube—about five inches on each side. Making the images larger calls for larger tubes or expensive projection apparatus. These are not practical or economical at this stage of the art, because their cost is commercially prohibitive. Secondly, the color of the obtained image is not any better—if as good—as with the crater tube. With the latter we obtain the familiar orange and black combination, whereas the cathode ray tube gives a green and black effect which, to many, is not as pleasing as the orange and black combination. Other colors can be obtained, but practically all of the tubes now available use green. It is true that the cathode ray tube gives better definition and better detail when working at the ultra-high frequencies, and as the art progresses there is no question but that it will take the lead and in time supersede the disc entirely. That time, however, has not yet arrived. I believe the disc has not as yet seen the end of its ascension, by any means. The chances are that a number of improvements can still be made on the disc to make it vastly more efficient than it is today. In my opinion, the disc will be with us for a number of years to come, even though the cathode ray tube will forge ahead and will eventually come out far in the lead.

A parallel to this might be had in the crystal detector. At one time we had nothing but crystal receivers. Later, the vacuum tube came along and took the lead, and has held it ever since. Yet, strange to say and believe it or not, the crystal detector is still being sold in good quantities today, and thousands and thousands of crystal sets are still being bought all over the world—including the United States.

At the present time cathode ray tubes are necessarily expensive, but it should be remembered that vacuum tubes which sell today for 35c at one time brought $12.00—and were difficult to obtain at that. There is little question that as the art progresses tremendous improvements will be made in the cathode ray tubes to give us better and larger images. At the same time the future cathode ray tube probably will not sell for any more than a good radio tube brings today—with the chances that its price will be even lower.
WITH television transmission establishing themselves gradually all over the world, there are many different aspects of the whole science which are demanding specialization. At the receiving end the amateur can concentrate on his experiments in connection with the vision apparatus itself and also in the design of that type of set best suited to the reception of the vision signals broadcast into the ether.

At the transmitting end, however, not only are concentrated efforts being made from the technical angle, but studio experts are studying a new technique which has arisen so that by the best management what can be seen with existing apparatus will be greatly improved. One writer recently summed up the situation in the following very able manner: "Television, like the pictures and like broadcasting itself, is one of those peculiar mixtures of art and science, of stage management and academic engineering, that demand a true versatility of mind and generous blending of talent if we are to make quick progress."

Director in the studio, with its call for intimate knowledge as to what form of dress, make up and gesture comes over best on the image screen, is showing its effects. This can be substantiated if the trouble is taken to compare modern images with those of, say, twelve months or so ago.

Speaking broadly, there are three types of views which at the present state of the science represent or embrace the scenes or subjects which can be transmitted best. These have come to be known as the close-up, the semi-extended and the extended. Taking these in turn we find that the close-up is one in which the detail is very distinct, but only the head and shoulders are visible. In this view therefore it is necessary to include only those artists whose facial expression and head movements are the main features of the work.

This is covered by those singers who are able skilfully to characterize their songs, comedians with character make-up and lecturers who have models which will illustrate their talk and thus add enormously to its educational value. In the general sense the usual 'straight singer' fails to make an interesting subject while even mimics, siffleurs, etc., have not the same television value as those first mentioned. The long periods of facial immobility during their turn is detrimental to picture interest, a factor which must always loom in the foreground with a television program.

Coming now to the semi-extended or three-quarter length picture, it is found that instrumentalists (violinists, banjoists, etc.) together with novelties like shadowgraphy and cartoons, singers in costume and comedians using props and capable of good action, make the best subjects. Owing to the relatively small space available which artists have at their disposal, very great care and constant supervision are essential to ensure that the area covered by the scanning disc or mirror drum is utilized to the fullest advantage.

Finally we have the extended scene, in which a greater amount of space is available for the artist or artists but unfortunately the resultant detail in the image is less than with the two other scenes, especially the first. In this form of television presentation movement is called for, not just the restricted action of cross talk comedians or the movement of a violinist's bowing arm, but definite body action such as expressed by dancers or in the demonstrations of sport (golf, tennis, etc.) If a small sketch for revue is to be put over then generally they are specially written with the television requirements carefully borne in mind to ensure the best results being obtained.

In some of the accompanying photographic illustrations various stages in this development of studio technique can be traced. The early studio photographs emphasize the restriction imposed by the close-up although since
these were taken in the Baird studios as far back as 1928, great progress has been made. We have the individual vocalist, pianist and lecturer complete with model to emphasize his salient points.

A step forward is then indicated by the semi-extended scenes of early 1931 also taken in the Baird studio. Two scenes from a sketch are shown, only one artist at a time being watch- en on the image screen.

Among some of the best turns which have been "worked up" in England to fulfil television's demands is the weekly cartoon feature which forms part of the Baird television broadcast in the morning program. The cartoonist, Mr. Rupert Harvey, wields his charcoal while maintaining a constant flow of patter pertaining to the sub- ject being shown. The illustration gives a very clear idea of the size of the drawing best suited for presenta- tion.

The positioning of the photo-elec- tric cells is of extreme importance and one of the photographs shows the "boxes," each with six apertures, which house these "light microphones," whose function is to translate light shades in- to equivalent terms of electrical cur- rent. In addition, the microphone must be close at hand and this is seen on the right just below the cell case. The rather heavy cable is the cell lead which passes to the initial stages of the amplifier handling the vision sig- nals.

Taking a very general survey of the whole situation it must be appreci- ated that the individual or individuals looking in are concentrating their at- tention on a very small area and in consequence, to maintain human in- terest through the broadcast, there should be no suggestion of monotony in the program.

Careful observation and an analysis of written commentators has shown that the best way of avoiding this is to break up the program into as many "groups" or turns as possible. These must not be too short or a discon- nected effect is brought about and the procedure adopted in English tele- vision transmissions is to allot approximately four minutes to a single act for each group. Furthermore, where such a course is practicable, changes from one view (i.e. close-up, semi-ex- tended and extended) to another are made to vary the types of subjects.

During these transition periods ex- cerpts from phonograph records are played on the "sound" wavelength while a strong synchronizing signal is transmitted on the "vision" wavelength. The former ensures that anyone at the receiving end will not imagine a breakdown has occurred at the trans- mitter, for the loud speaker still func- tions, while the predominant synchron- izing signal serves the very useful pur- pose of keeping the vision apparatus in both frame and phase without the necessity for re-adjustment when the performer makes his re-appearance.

Numberless experiments have been carried out and are still going on to ascertain the suitability of artists and scenes for television as exemplified by present day methods. As a case in point it can be said that entertainers at the piano are a type which it is advisable to utilize only at intervals. On the other hand, these entertainers use a form of showmanship which is alien to the solo pianist, whose move- ment of the hands over the keys, being the only movement, is hardly broad enough to sustain interest unless he or she is an outstanding personality in the musical world.

It cannot be too strongly empha- sized that an enormous amount of personal care and attention has to be given to every individual, as the tele- vision requirements of separate ar- tists are seldom alike. This is where the studio director can make good use of his intimate knowledge of the sci- ence. There are different positions for the photo-electric cell stands and microphone stand, while details of style, color and costume material, to- gether with ornaments and properties, must be gone into in great detail.

For example, it is necessary to re- member that red, when televised, ap- pears white and, therefore, rouge on the lips or cheeks should be avoided. If it is desired specially to emphasize the lips, then a little blue grease paint will ensure this happening. A dark complexion can be much enhanced by a little flesh-colored powder, while if

house these "light microphones," whose function is to translate light shades in- to equivalent terms of electrical cur- rent. In addition, the microphone must be close at hand and this is seen on the right just below the cell case. The rather heavy cable is the cell lead which passes to the initial stages of the amplifier handling the vision sig- nals.

Taking a very general survey of the whole situation it must be appreci- ated that the individual or individuals looking in are concentrating their at- tention on a very small area and in consequence, to maintain human in- terest through the broadcast, there should be no suggestion of monotony in the program.

Careful observation and an analysis of written commentators has shown that the best way of avoiding this is to break up the program into as many "groups" or turns as possible. These must not be too short or a discon- nected effect is brought about and the procedure adopted in English tele- vision transmissions is to allot approximately four minutes to a single act for each group. Furthermore, where such a course is practicable, changes from one view (i.e. close-up, semi-ex- tended and extended) to another are made to vary the types of subjects.

During these transition periods ex- cerpts from phonograph records are played on the "sound" wavelength while a strong synchronizing signal is transmitted on the "vision" wavelength. The former ensures that anyone at the receiving end will not imagine a breakdown has occurred at the trans- mitter, for the loud speaker still func- tions, while the predominant synchron- izing signal serves the very useful pur- pose of keeping the vision apparatus in both frame and phase without the necessity for re-adjustment when the performer makes his re-appearance.

Numberless experiments have been carried out and are still going on to ascertain the suitability of artists and scenes for television as exemplified by present day methods. As a case in point it can be said that entertainers at the piano are a type which it is advisable to utilize only at intervals. On the other hand, these entertainers use a form of showmanship which is alien to the solo pianist, whose move-
CATHODE RAY TELEVISION

This article describes a new cathode ray television perfected in the laboratory of Manfred von Ardenne and tells about the hopes attached to this television process. By way of supplement there follows a report about the physical basis of the process and its previous development. Television, which in the last few years made surprising advances for a while, has doubtless for about a year reached a standstill, at least so far as the usual television systems with mechanical scanning are concerned. It is perfectly possible to transmit living pictures, but the reproductions appearing in the receiver have a relatively coarse grain; if one seeks the causes, one sees that further progress in the methods hitherto used is possibly only at very great expense, and that the results even then will leave much to be desired.

Cathode Ray Has No Inertia

Under these conditions it is natural to seek other means for realizing television in which the fundamental difficulties connected with rotating perforated discs, mirror wheels and similar devices are not encountered. An excellent means is provided by the cathode rays, the use of which for this purpose is so natural that it is idle to quarrel about who was the first to attempt television by means of them. Since the cathode rays consist of moving electrons, (i.e., of almost massless particles) they operate without the least inertia.

In the well-known Braun tube, the cathode rays strike on a screen inside the tube, and it lights up brightly where the rays reach it, so that by the motion of the luminous spot one can follow the influences acting from without. For deflecting the rays one can first employ electromagnetic forces by placing near the side of the tube a coil with an electric current flowing through it. The magnetic field of the coil deflects the luminous spot perpendicularly to the axis of the coil. If the magnetizing current is changing, the luminous spot is moved in a circular path. The second method of deflecting the cathode rays consists in influencing them electrostatically. For this purpose the tube is put between two plates, and it is best to have the plates fused into the glass to which an electric potential is applied. The negatively charged electrons of the cathode rays are then deflected toward the positive plate in the electric field existing between the two plates.

While in the case of the electromagnetic process a fairly powerful magnetizing current is needed to produce a deflection, for the electrostatic method only potential is required but no appreciable electric power, at least no more than is necessary for charging the very low capacity condenser formed by the two deflection plates.

In its original form the Braun tube was provided with a cold cathode. A very high potential, at least 30,000-50,000 volts, was needed to produce the cathode rays. A sharp spot on the light screen, a screen with a fine opening was put in the path of the cathode rays. In manufacture the tubes were put to a pressure of about 1/1000 mm. of mercury. However, in use the vacuum changed. Consequently after some time the tubes were no longer serviceable and had to be pumped out again.

Latest Improvements

The improvements made recently in the United States and Germany in the old Braun tube consist first in the use of a glowing-cathode. With this are combined the advantages that one has disposal over a very much greater number of electrons than with a cold cathode and that considerably lower anode potentials may be used. There are already tubes which give a very bright light spot with an anode potential of only 200 volts. However, to attain the great brightness required for television, where, of course, the luminous spot necessarily has to be distributed over a fairly large surface, much higher voltages are needed. In the case of such tubes anode potentials of 2000 or even 3000 volts are customary. However, these are comparatively simple to produce by means of a transformer and a rectifier, since the tubes have only an extremely small current consumption, namely less than 1 milliamper. Here we do not at present need to go into other technical details of these modern cathode ray tubes, which in Germany have been produced in especially good form by several workers, including Von Ardenne and the research staff of the Allgemeine Elektrische Gesellschaft (Gen. Elec. Co.).

If one wishes to develop a television system consisting with cathode rays, one will first try to produce a cathode ray receiver, i.e., make the luminous spot run through a certain surface on the screen of the tube and at the same time control its brightness that a complete picture is seen. But it soon appears that such a receiver can give forth its full efficiency only if the transmitter is equally without inertia. Accordingly, the very first television system using cathode rays, which was devised by the English physicist Campbell-Swinton, had not only a cathode ray receiver but also a cathode ray transmitter. Since the transmitting tube developed by Swinton was taken over with only slight changes in the cases of all later cathode ray television systems thus far made public, a short description may be given on the basis of Fig. 1.

Construction of Tube

The tube represented in Fig. 1 consists of a cylindrical part of large diameter with a likewise cylindrical but considerably narrower neck attached to it. At the end of this neck is the cathode C and at a short distance from it the anode A, which is pierced in the middle and is grounded to prevent disturbances. If one applies to the cathode a high negative potential, cathode rays originate and fall through the opening in anode A upon plate P. This plate consists of numerous photo-electric elements, which are arranged mutually insulated in the form of a network. On the other side of the plate is put the grid G, through which a picture of the object to be reproduced is cast upon P by means of the
TELEVISION NEWS

A second and each image consists of 100 lines. Thereby a very fine texture can be obtained, always presupposing that each photo-sensitive cell is on hand in the transmitter. If their number is too small, the analyzing of the picture would be determined by the size of the individual cells.

Fig. 4 shows the receiver tube used by Swinton, which again contains the cathode-ray tubes of Fig. 3, but a couple of deflection plates K, to which the transmitted potential is conducted. On the way to the screen the cathode rays here pass through two crossed coils, which are also shown in Fig. 4. By means of these the cathode rays, exactly as in the manner indicated, are conducted 10 times a second over the entire surface of the screen. The brightness of the luminous spot on the screen is controlled in a somewhat primitive way, by keeping a greater or larger part of the electrons from passing through the field between the coils by means of the changing potential on condenser K and by means of screen P.

The Swinton tubes, which were presented as early as 1911, had the disadvantage of possessing cold cathodes and therefore required a potential of some 50,000 volts to run the apparatus. The photo-sensitive plate P was composed of little cubes of rubidium. It fitted the wall gas-tight, so that a somewhat higher gas-pressure could be used on the grid side, to increase the flow to the grid.

Improvements of Zworykin

A considerable improvement in the Swinton apparatus was suggested and worked out technically by Zworykin, an American engineer. Above all, Zworykin used glowing-cathode tubes. Also, he made the photo-sensitive screen out of potassium cells. Finally, aside from some technical improvements, he used a three-color luminous screen to attain television in natural colors. As yet, nothing exact has been reported concerning the details of this apparatus, particularly concerning the way the scanning of the three-color screen and the synthesis of the image out of the three-colored rays takes place. It is perfectly conceivable that one gets at least approximately natural pictures, for the colors in which mineral substances light up when struck by cathode rays are very different, according to the kind of substance in question, and it is perfectly possible that Zworykin has found substances which light up red, green, and blue. At any rate, Zworykin has a good name in radio technology, and even if his apparatus is at present still in the laboratory stage, it is conceivable that not too distant a time he will succeed in producing a serviceable television based on this principle.

A third cathode ray television has been developed by P. T. Farnsworth of San Francisco. Farnsworth started out with the purpose of making up a television image of 200,000 elements, because he considers such fineness necessary, in view of the character of the human eye. He also uses two crossed coils for scanning, these having a saw-tooth alternating current flowing through them, one coil having a current of 12 cycles, the other one of 4800 cycles. Thus for picture transmission Farnsworth arrives at a frequency of 1.2 million cycles. It is to be understood that such high frequencies offer considerable difficulties in amplification. The Farnsworth system has not yet reached a practical stage.

The Farnsworth Tube

As a transmitter Farnsworth uses, it is remarkable to say, a tube with a cold cathode and high vacuum. There is a further difference from the designs previously discussed in that Farnsworth uses in place of the large net-shaped photo-electric plate P in Fig. 1 only a single small tube-shaped photo cell, which is screened against the electron discharge except for a very small opening. Opposite the cathode lies a flat window of plate glass, through which the image to be reproduced is formed on the cathode. The cathode consists of a brilliantly polished material, which, under the influence of the light falling on it, emits electrons. Close before the cathode lies a lattice-shaped anode, which is given a potential of 500 volts. Hereby Farnsworth means to attain the formation of an "electric image," the nature of which he explains as follows:

If one should put a fluorescent screen in the plane in which the photo-cell is located, the electrons leaving the cathode under the influence of the light falling on it, would reproduce, faithful to nature, the image cast on the cathode. What physical processes take place we cannot exactly recognize

(Continued on page 151)
Single Side Band
More Image Detail With Lower Frequency Range Possible
With This Method

By R. D. LE MERT

StATION W6XAH, Bakersfield, California, is the first station in the West to use single sideband suppressed carrier transmission. This system permits the transmission of more detail and of course a better picture within the limitations of the frequency channel allocated by the Federal Radio Commission, which is 100 kilocycles at this time.

W6XAH is licensed to transmit 96 lines, 20 picture frames per second, (1200 R.P.M.) and scans left to right and top to bottom in continuous sequence. (R.M. A. Standard.)

It was quite interesting, during the development work, to note the amount of increased detail which was available between the 60 line picture and the one using 96 lines, both pictures being transmitted at 20 picture frames per second.

In the 60 line picture, small objects were not seen at all! In the 96 line picture even the shading under trees was easily seen, as well as the details of the facial features of individuals.

Halving the Frequency

It is also possible when using the ninety-six line picture, in the transmission of moving picture film, to use practically any kind of film, the darkest type coming through with good fidelity.

If one attempted to transmit 96 lines without the use of single sideband transmission the channel width would be more than 184 kilocycles, which, of course, is out of the question. Its advantages are many compared to other methods of transmission, and will be shown in a latter part of this article.

By the use of the increased detail obtained by 96 lines, it is possible to take outdoor scenes of tennis games, boxing matches, etc. In the studio the scenes televised show the artist and the furnishings of the room, windows and other details which go to increase the atmosphere for a stage setting.

The transmitter is housed in a building consisting of two rooms, each 24 feet wide and 48 feet long. One room houses the main transmitter and the power control panels, and also the speech input panels and monitors. The main transmitter faces the front. Among the left side of the main transmitter is seen the single sideband equipment, which is housed in a separate screened-in panel. On the right side of the room are the generator and control panels, consisting of 3 panels.

In the rear of the room on the right side are two banks of power transformers (each 15 kilowatt), supplying the power for the rectifiers. Both generators and rectifiers are used to supply the power in transmission. The filaments are operated by a direct current generator. On the left of the room is shown the speech input panel, the sideband panel being shown at the right.

In the room adjoining are the main television amplifier, the projection machines, and the pre-amplifiers, the picture which is transmitted actually passing through 17 stages of amplification.

Complete Laboratory Equipment

Great care in building these amplifiers was necessary, as the frequencies involved vary over a wide range. The main amplifier, having eight stages of specially designed amplification, has a frequency range from 30 to 95,000 cycles. Its characteristics are practically flat from 50 to 80,000 cycles.

In this room also is the machine shop, which is well equipped for this type of research. It also contains the usual testing equipment, oscillographs, low-frequency oscillators, frequency measuring apparatus, etc.

The studio building is located approximately 50 feet from the first building. It contains the direct pick-up cameras and associated amplifiers, two condenser microphones, piano, studio furniture, etc.

An underground line connects the studio with the transmitter rooms.

The two towers are each 150 foot in height, and were made of wood to keep down absorption and re-radiation. They are separated 150 feet. The antenna itself is a large single wire, fed by a transmission line.

Lower Power Consumption

Even disregarding the previously mentioned advantages possessed by the single sideband system, that there is less interference due to the sharper tuning permissible in the receiver and that the received signal strength is subject to less variation due to changes in the ether conditions, this system has the advantage of lower power consumption for given results. The maximum power required is one-fourth of that for the usual transmitter. It is important to remember that the power output of a single sideband transmitter is zero when no speech or picture is transmitted and that the output varies from zero to full load each time a word is spoken.

This is one of the reasons for the large size of our power supplying apparatus and generators.

Fig. 1: layout of the transmitter equipment at W6XAH. Fig. 2: position of the side bands in the double modulation process. The transmitted sideband is separated sufficiently to be free of all harmonics of both oscillators.

www.americanradiohistory.com
It is quite interesting to note the different methods employed in the production of the single sideband.

It is well known that, when alternating carrier current is modulated by voice or picture currents, the resultant wave is distributed over a frequency range which may be considered in three parts: (1) The carrier frequency itself, (2) a frequency band extending from the carrier upward, and having a width equal to that of the frequencies appearing in the modulation wave, and (3) a band extending from the carrier downward, and having a similar width. The products of modulation are spread over a region comprising the original carrier frequency and the two bands, known as the upper and lower sidebands. These two bands have the same width and each transmits power which contains all the elements necessary to reproduce the original speech or picture transmitted.

The ordinary transmitter transmits all of the products of modulation (carrier and two side bands). It also sends out the carrier continuously and adds the two sidebands when they are impressed, as when a word is spoken.

The total transmission or frequency range is from the peak of one side band to the peak of the other or from top to bottom. In the single sideband, elimin-

(Continued on page 152)
The Dalpayrat System of Dynamic Scanning

By Henri F. Dalpayrat

This proposed new method of television scanning is interesting because it acts directly on the subject, almost like a camera. Its possibilities are worth your study and consideration.

The writer does not condemn all mechanical systems, but believes that it would be beneficial to many readers and experimenters to become acquainted with their weak points and difficulties in order to do them justly and to anticipate them as inevitable.

The perforated disc and neon tube arrangement, which is elementary in theory, will not be discussed here. Suffice to say that this system is the most economical and gives very good results when well designed and adjusted properly. The main objection is that the image is too small and indistinct and that due to the insufficient illumination it cannot be magnified optically. There is also the disadvantage that only one person at a time can comfortably see the picture.

Mechanical Scanning Systems

The two most popular televisions used at present are evidently the crater tube or crater arc tube and lens disc or mirror drum combinations. The objections often cited against these systems are that they are heavy, cumbersome, noisy, and somewhat dangerous to handle and difficult to keep operating properly. The apparatus used both at the receiver and the transmitter is simple, compact and easily adjusted.

Details of Dynamic Scanner

The DYNAMIC SCANNING system which will now be described has none of these objections and in fact has many new and interesting advantages.

Fig. 1 shows a typical "direct pick-up" camera transmitter. Part 1 is the image of the subject to be televised which is illuminated by a photographer's violet-ray lamp, 2. Parts 2, 3 and 4 are sources of light, one of which may be yellow-white and the other orange-red. These colors are suggested as an example only, as pure white light would do just as well. However, with colored lights it is possible to alter the quality of the light reflected from the subject and thereby correct or neutralize the inefficiency of certain photo-electric cells for certain colors. The light from the subject is reflected forward and reproduced in full picture within the reducing camera. This camera consists of a folding or collapsible dark box, 5. Part 6 is a pair of...
condensing lenses which receive light from a large lens, 7, and transfer the picture in the shape of a bundle of parallel rays. These rays reproduce an image upon the surface of a slotted diaphragm, 8. Another slotted diaphragm, 8a, is placed behind and very close to the first one. One slot is cut vertically in one diaphragm and horizontally in the other. This will be better understood by examining Fig. 9. Part 8 vibrates up and down and has an horizontal slot; 8a vibrates sidewise and has a vertical slot. Returning to the camera in Fig. 1, part 8 is fastened to moving coils 9 of special dynamic units 10. These coils are connected in parallel and the other pair of dynamic units and at exact right angles to the motion of 8. The cross section of the beam of parallel rays projected from condensing lenses 5 being about 1/4 inch in diameter, the slots in 8 and 8a will be about 1/64 of an inch wide, for a 60-line picture, and a little over 1/4 inch long.

Diaphragm Construction

These diaphragms can be made of very thin, light, rigid material, like fiber, aluminum, etc. For best results it is necessary that the slots be stamped out very smooth, and with sharp edges, as burrs or irregularities would distort the picture elements transmitted. The picture element is squared and is produced by the superimposition of two slotted lines at right angles to each other.

The moving coils 9 are connected to a sine-wave oscillator which vibrates them at a frequency of 10 cycles, thus displacing the diaphragm 8 down on a half cycle then up on the other, or 10 times up and 10 times down. In this manner 20 pictures or frames will be scanned per second. To obtain a 60-line picture it is necessary that the other diaphragm 8a vibrate 60 times faster than diaphragm 8, or 600 sine wave oscillations (1,200 half cycles) per second. In this system, due to the vibrationary motion of the scanning element, and the use of both cycles of the oscillations, only one half of the usual scanning frequency, (as used in cathode ray tubes), will be necessary. This will be exact provided that genuine sine-wave oscillators are employed.

The dynamic units, although shown large in the drawings, would in practice be actually rather small, somewhat the size of loud speakers now used in midget sets. The displacement of the coils must of course be greater than those of ordinary speakers. This can be accomplished by units specially designed for the purpose. A few years ago the writer witnessed a demonstration of a new type of speaker, the moving coil of which had a total displacement of over an inch and a half at a frequency of 20 cycles. Taking this case as an example, the writer believes that with careful design, wider motions can even be possible.

Considering the scanning action, one may observe that the intersecting points of the two slotted lines always disclose a small square hole which is of the same size at all times. This hole sweeps over the whole surface of the reduced image in the camera, line by line, thus allowing a beam of light of variable intensity to reach the photocell, 11. The different values of light liberate corresponding values of electrons within the cell. These different voltage variations are then amplified by a special amplifier and transmitted by the transmitter, 12.

Fig. 3 shows the approximate general appearance of the direct-pick-up camera. The numbers indicated correspond with those shown in Fig. 1. Due to the vibratory motion of the diaphragms, at right angles to each other, a serpentine or zig-zag form of scanning is obtained, first back and forth going down, and then back and forth going up, going over each line always in the same direction. This may be better understood by studying Fig. 4. It is believed by many experts who have approved this system and its form of scanning that its action will be smoother and more uniform on account of the continuous double zig-zag motion involved.

An Induction Brake For Nipkow Discs

By Gerhart Goebel

If for any reason the number of revolutions of a Nipkow scanning disc is not regulated by a synchronizing (phonix) wheel coupled to it and controlled by the synchronizing frequency, then it must be managed by means of a brake. This is especially the case when there is available for driving the disc not an A. C. synchronous motor but only an induction motor, or even, as is still the case in many instances, a D. C. motor. In such cases mechanical brakes are frequently used.

The brake of a Nipkow disc fulfills its purpose only if it can be regulated within wide limits, wears out as little as possible, and operates gently and without impact. A mechanical brake satisfies these requirements only if it is very carefully built. Much better and more reliable in operation is the induction or eddy current brake. As the braking drum we use the Nipkow (scanning) disc itself. It is embraced at some suitable point on the circumference by the poles of an electro-magnet. Once the disc revolves in the field of this magnet, eddy currents form in the interior of the disc, which check the rotation of the condenser in which they form, i.e., the disc.

The arms of the braking magnet are (Continued on page 158)
Numerous laboratories in France have been for a number of years occupying themselves with the problem of television. In particular it is necessary to cite the work of Edouard Belin in his laboratory at Malmaison, going back more than ten years. On his part, Barthelemy has been at work on this problem since 1928 and gave his first public demonstrations in 1930. But it is only within the last few months that there have been daily television broadcasts in France. These take place every day, either in the morning or in the evening, from the P. T. T. station, which is using the Baird system with vertical analysis of the image and 30 lines. The disc revolves 750 times a minute. The program of the P. T. T. broadcasts generally includes lectures, bits of singing, piano, etc. The sound is transmitted by the Radio-Vitus station, which belongs to the Pathé-Nathan establishment. Numerous stations are expected to follow the example of P. T. T., in particular Radio-Toulouse.

No Wavelengths Available

What considerably checks the spread of television in France is the fact that there is no band of wavelengths reserved for transmitting, and it is necessary to use radio broadcasting stations, which are limited to a band of 9 kilocycles. The situation is the more delicate since no decision can be made in France on this subject until the assent is obtained of the states agreeing to the international radio convention. It is therefore necessary to await an agreement among those chiefly interested: Germany, England and France. At present it is necessary to get along with 30 line images while waiting to be allowed bands 50 or 100 kilocycles wide.

French amateurs have manifested a lively interest in television, and already a number have had good reception. The French amateurs use principally either the Baird (British) or the Telehor (German) material, but at present several French houses have put on the market discs, motors, phonic wheels, etc. Among the television lamp one finds the Phillips lamps, the Geco lamps, and one single French trademark, “Gelism”. As yet there are no commercial examples of the “crater” lamp, which exists only in the laboratory. This is not surprising, because in the actual state of things the French amateurs content themselves with the Nipkow disc (perforated) and the disc with lenses is not yet commercially used.

To make up for that, most amateurs wishing to receive on a screen construct Weiller wheels. It seems that making the Weiller wheel is easier for the amateur than making the disc with lenses. Nearly all amateurs synchronize by the phonic wheel, but there are very varied ideas about how to control it. In general, the direct connection recommended by Baird in England does not give good results, and they prefer connecting with an independent amplifying stage (as in the American Baird method). Some amateurs use a local oscillator adjusted to the frequency of the phonic wheel, i.e. to 375 cycles a second. The hook-up of this oscillator is borrowed from the German Telehor system.

The oscillating circuit is made up of a coreless induction coil of about 7000 turns of wire with a fixed capacity of 3 microfarads and a variable condenser of 3000 mfd. With sensitive sets one can get London television in Paris. There were some French amateurs who used to receive it before the P. T. T. station commenced its first broadcasts.

The public is awaiting with impatience the first broadcast of Barthelemy. Barthelemy regularly uses in his laboratory 60-line analysis for true television and for transmitting films. However, these first broadcasts, intended for amateurs, will content themselves with 30-line analysis and 16½ images a second (i.e. exactly 1000 revolutions). The television broadcast will take place on 200 meters with 15 kilowatts, and the sound will be transmitted on about 180 meters but with weak power. Barthelemy uses horizontal analysis with an image having the proportions of 3:4.

The synchronization can be done by the 50-cycle sector or the phonic wheel with frequency 500.

System Uses 60 Lines

Actually Barthelemy has attained excellent results with 60-line analysis and is now sending films with several characters, those of auto races, etc. The reception is done on a ground glass screen 12 x 16 inches, the analysis taking place by means of a mirror wheel, and the source of modulated light being a crater neon lamp. The Barthelemy set will not be on the market for some months.

Most of the characteristics of the Barthelemy system are known from a description which already appeared in Issue 4 of Television News. In the present article we are going to describe the latest invention of this engineer.

It is well known that to increase the fineness of the image, it is necessary to increase the number of lines of scanning. But the more the number of lines is increased, the more the difficulty mechanically; in particular, a Weiller wheel for transmission with 30 mirrors is already very cumbersome. If it is necessary to (Continued on page 152)
The frequency requirements for television, by Ivan Bloch, E.E.

**AN extremely important factor in the design of television receivers and transmitters is the frequency range over which the amplifying system should respond linearly. This range has not always been clear to certain investigators and hence this article purports to explain clearly how the frequency limits are obtained for any system, any number of "lines" and any number of frame repetitions.**

To visualize the problem, let us assume that the object which is being scanned is made up of square picture elements, each of which is tangent on four sides to other elements. For example, let us take a checkerboard pattern, such as shown in Fig. 1A, and let us further assume that the scanning spot of light is of such dimensions that it equals a picture element in area and shape, and that the time required by the spot of light to traverse the pattern from left to right along one line is one second. Thus this scanning spot of light passing over the first line horizontally, would cause the photo-cells to respond to three maximum and three minimum reflections of light.

**Shape of Response Curve**

We may assume the response to be of the shape as shown in Fig. 1B, although actually, as is obvious, the response takes a shape more like that shown in Fig. 1C. This response-wave form is due to the fact that as the spot passes from a maximum to a minimum reflecting surface, the photo-cell integrates the total light emitted or reflected, so that for instance on the dividing line between squares, the total light received would be half of the possible maximum.

From Fig. 1B it may be seen that the cyclical changes are equal to one-half of the total picture elements traversed. Or in this case, the time for three cycles being one second, the frequency is three cycles per second.

**Generalizing**

- No. of Picture elements per line

\[ f = \frac{N}{2} \]

- Time for line Scanning

\[ f = \frac{1}{10} \]

Maximum frequency is obtainable with a checker-board pattern, where each square equals the area of the scanning spot of light. The maximum frequency for a sixty-line picture, six by five image ratio, twenty frames per second, can be found as follows, if we remember that each line contains 6/5 X 56 picture elements, and that each line takes 1/1200 second:

\[ f = \frac{20}{1200} = 0.0167 \] cycles per second.

From the preceding, the formula for maximum frequency can thus be written down as:

\[ f = \frac{1}{2} \times \frac{N}{2} \text{ Picture ratio} \times \frac{N}{2} \text{ No. of Lines} \times \frac{N}{2} \text{ Frames per second} \times \frac{N}{2} \text{ (No. of Lines)}^2 \]

Thus for a 120-line, 24-frame system (supposedly the N.B.C. transmission scheme), we have:

\[ f = \frac{1}{2} / 6/5 (120)^2 24 = 207,360 \text{ cycles per second.} \]

**Obtaining Minimum Frequency**

To obtain the minimum frequency, we must remember that the lowest cycle of response of the photo-cell is when the received light varies from a maximum value for one-half a frame to a minimum value for the remaining one-half a frame or vice versa, as shown in Fig. 2. Hence, for the minimum frequency, the answer is that it equals the number of frames per second.

It is possible that the photo-cell be called upon to respond to even lower frequency variations. For instance, with an evenly illuminated field, the photo-cell response is continuous. However, as a rule, if a circuit responds to 20 cycles, the lower frequencies will be taken care of. Other interesting figures can be obtained by analysis. For instance, what frequency is represented by a black square on a white background, the area and shape of the square being the same as that of the scanning spot? The response of the photo-cell will be once per each frame, but the frequency is more than that. Frequency is the reciprocal of the time interval. That is \[ f = \frac{1}{T} \] and since \( T \) in this case (sixty lines, twenty frames)

\[ f = \frac{1}{43,200} \text{ seconds, the frequency is 43,200 cycles.} \]

From this discussion, which does not consider harmonics, an amplifier should respond linearly from about 0.0167 to 43,200 cycles per second in sixty-line, twenty-frame scanning. If the response is far from linear at the lower frequencies, then all contrast will disappear, blurring and blending the image into the background. Failure of linear response in the higher frequency range will diminish the detail.

Although the explanations given were taken from the point of view of the flying-spot transmitter, they apply as well to direct-pick-up transmitters and, of course, also to receivers.

**Ultra-Short-Wave Hints**

Since high-frequency or ultra-short wave reception requires coils of few turns and "midget" condensers space-saving immediately becomes evident.

This is highly important, as it means short interconnecting wires, a factor in eliminating stray effects that might tend to increase the capacity and inductance, and thus lower the over-all efficiency of the receiver.

Careful shielding is absolutely essential, and even with its elaborate use some of the signal may be lost, due to the fact that the tremendously high frequency, on the order of from 40,000 to 60,000 kilocycles compared with 550 to 1,500 for sound broadcasting, doesn't seem to stick to the electrical laws obeyed by lower frequencies.

For instance, two comparatively short wires, if run parallel for an inch or so, may give a condenser effect that will rob the signal of much of its strength. Tuning coils, with the turns spaced too close together, will produce the same effect and may raise the wave length range above the point desired. The remedy, of course, is wide spacing of turns, even up to a quarter of an inch.
TELEVISION IN
NATURAL COLORS

To transmit or receive a ray of white light from an image, analyzed into all its colors, there will be necessary an apparatus seven times as large, as complicated, and as expensive as normal television sets, which will put it beyond the pocketbooks of the great majority.

I think it impossible—given the case that you receive a ray of light composed of seven colors coming from a ray of white light, at one time, and transform them into seven electric impulses—to transmit them one after the other, since they all come to the transmitter at the same time and while one is being transmitted the others are lost. I do not see how we can hope to do it. To transmit them all together would occupy seven wavelengths, complicating both transmission and reception.

We know from physics that when a pencil of white light is passed through a prism, it breaks up into seven elementary different colors, each with a specific wavelength.

According to the learned Helmholtz, there exists in the retina of the human eye three different classes of nerves whose sensitive fibres, stimulated by light of different colors, give the illusion of color to the brain.

If a cardboard disc is divided up by various radii and if each division is colored alternately yellow and blue, and if it is put on a phonograph disc and made to revolve rapidly, the eye will receive the sensation of green, though neither of the colors contains it and though the wavelengths of the three are all different. If we paint the disc red, yellow and blue in certain proportions, it will appear white. If we paint it with the seven colors, it will appear white all the same. If with yellow and red, orange. If with red and blue, violet. And if with yellow and blue, green.

With only three of the seven colors, red, yellow and blue, we can, by mixing them, produce in the eye the sensation of every other color, simple or composite.

We have a practical example in trichromatic printing plates, which are composed of dots of yellow, red, and blue, mixed according to the tone of the color whose sensation is to be given.

If we manage to convert the seven colors, into which the white light is broken up on passing through a prism, into merely three electric impulses of the photo electric cell, and light with them three television glow lamps colored red, yellow, and blue, there will be the appearance of white, though we have dispensed with the other four colors. Then we only have to convert these electric impulses of the photo electric cells into radio waves of different frequencies or wavelengths and to separate them in the receiver, to have the problem solved in the most practical and economical manner possible.

Dispensing with indigo, which has no great practical application, and which moreover does not affect results which we obtain, we cause the six colors into which the white light is decomposed on passing through a prism to distribute themselves in the three cells of the photo electric cell E (Fig. 1) in such a way that each one contains a fundamental color, either yellow, red, or blue, and half of the color above and below.

Therefore, the problem would be solved in the following manner:

1. The photoelectric cell E contains three cells, red, yellow, blue, which are arranged according to the colors which they contain.

2. The electric impulses from the photoelectric cells will be transmitted over the radio waves of the correct frequency and wavelength to the receiver, which will have a yellow, red, and blue light source, and will receive the white light by combining the red, blue, and yellow lights.

3. The receiver will then be able to reproduce the colors as seen by the original photograph, without the need for a large and expensive apparatus.

In the receiver the lamp painted red (Fig. 2) will receive all the red and half of the orange above, and since the half corresponding to the violet cannot be obtained as it is the top of the whole spectrum, it is necessary to pick it up with the lamp painted yellow above the red, giving the impression of white.

Layout of the author's proposed television transmitter, which is intended to televise objects in natural colors. The object to be transmitted is a leaf, "a"; B is the scanning disc, C a collecting lens, D a prism, E is the special color sensitive photoelectric cell. Three wavelengths are required for the actual radio transmission.

Three Wavelengths Used

When a ray of red light reflected by an object is directed by the disc through the dispersing prism, then according to its natural position in the spectrum, it is going to impress the lower part of cell 1 of the photoelectric cell, permitting the passage of an electric impulse, which then on being amplified and transmitted on a definite wavelength is caught by the receiver. There it is amplified and directed through three "wave-traps," or "filters," each adjusted to a certain wavelength corresponding to those lengths on which the impulses corresponding to the colors have been transmitted. The trap adjusted to the wavelength on which the electric impulse of the red ray has been transmitted diverts it toward the lamp which has been painted red. On lighting it emits a pencil of light, which a lens focuses on the disc which directs it toward the screen where the eye sees it.

If the pencil is yellow, it affects the central part of the photo-electric cell 2, whose impulse, on transmission and re-
ception, is then directed toward the yellow lamp by means of another wave-trap. If it is blue, the central part of cell 3 will convert it into radio waves which will either go to the filter of the receiver whereupon it will direct toward lamp painted blue, whose light the observer will receive on the screen. (See Figs. 1 and 2.)

To transmit orange, the prism locates it between the red and the yellow, stimulating photo-electric cell 1 in the upper part of cell 2 in the lower part, causing two currents at the same time, which will light up the red and yellow lamps in the receiver, which will produce the sensation of orange. Equally, in the case of green, being located between the blue and yellow, it will stimulate cell 2 in its upper part, and cell 3 in its lower, their currents lighted up at the same time the blue lamp and the yellow lamp in the receiver, which on blending, will produce the illusion of green. (Fig. 2.)

Blending the Light

As the violet is dispersed by the prism toward the upper part of the spectrum, it will stimulate a part of part of cell 3 which corresponds in the receiver to blue, and since for giving the sensation of violet to the eye it is necessary to mix red with the blue, and since the red is originated in cell 1, which is at the lower end of the spectrum, we could not pick up the other half of the violet dispersed by the prism only for the fact that we place another small photo-electric cell 1 on 3. Picking up this half, it adds it to the current produced by 1, which gives red light in the observer. This is blended with the blue which cell 3 has brought, and on the screen the observer gets the sensation of the color violet.

Let us study the operation of the transmitter and receiver working together. See Fig. 1.

Suppose green leaf "a" be the object whose image we are going to transmit. On being illuminated by a stream of white light, it will absorb all the colors except its green, which will reflect on the scanning disc "B," through one of whose holes a pencil of light is allowed to pass. Lens "C" will focus it on a point, determined for all the colors, on a dispersing prism "D," which will spread or bend them according to the angle of dispersion corresponding to each color in the spectrum. On entering photo-electric cell "E," it will illuminate cell 2 and 3, which are so designed as to permit the passage of an electric current, only to be stimulated by a light, notwithstanding the color, giving us two currents, which are then amplified and transmitted to the ether in the form of Hertzian waves, both at the same time, on different wavelengths.

Example: 200 meters wavelength for the current coming from cell 2, and 150 for that from 3. On transmission, cell 1 will operate on 100 meters. The receiver (Fig. 2) by its antenna will receive the waves transmitted, and once amplified, the currents will be directed through the three wave-traps adjusted to 100, 150 and 200 meters wavelength, in such a way that when the electric signals of 200 and 150 meters length cross the traps adjusted to these values, they are diverted toward the lamps. That of 200 meters will light up the lamp yellow, and that of 150, the blue lamp. As the white light, on traversing the colored glasses, will get the color from them, the yellow and blue light of the lamps, after being blended, are focussed by lens "m" on the scanning disc "1," exactly synchronized with that of the transmitter "B," and will cause a ray to pass which, on being reflected on to the screen, will appear to the observer to be "green," identical with the color of the leaf "A" which is being transmitted.

—Ciencia Popular.

How to Use a Lathe in Laying Out Discs

EXPERIMENTERS wishing to lay out a television disc and not having access to precision machinery, but who can obtain the use of a machinist's lathe, with thread-cutting attachments, will find the following instructions as an accurate job can be done. The diameter through the outside hole may be drawn; also this circle can be divided into the proper number of divisions, with the aid of dividers sharpened to a needle point. This is best done after the hub and shaft have been mounted, using the shaft as the center to work from.

Phonograph Needle for Marking

Next fasten the lathe chuck, face up, to the lathe bed to the right of the carriage. Next put the disc shaft through the chuck and tighten all four chuck screws until the disc can just be turned with ease. For a hole layout "marking tool," solder a phonograph needle to a six-inch piece of square brass rod and clamp in tool holder, adjusting the same so that needle is located on the center of division of an inch. Adjust the lathe carriage and disc so the needle will follow one of the degree marks toward the center when started at the intersection of this mark and the outside diameter circle.

For a scale as a revolution guide on the lathe-head, use a six-inch square piece of white pine divide a circle drawn on one side into twenty-five equal divisions. Bore a quarter-inch hole in the center of this circle and mount the board edgewise on the lathe bed, so that the hole lines up with the center hole in the chuck holder. For a pointer on this scale bend a heavy piece of wire and mount as illustrated, by putting through a hole in the board and into the small drill chuck, with tapered shaft, which goes into center hole in head.

Next set thread-cutting gears to cut forty threads per inch. This will make a micrometer of your lathe, for when the head is turned one revolution the carriage will move one forty or twenty-five thousandths of an inch.

Beware of "Backlash"

For example, if a .015 inch spacing is wanted, move the marking tool to the first hole position and set the pointer on number one mark on the revolution guide, and fasten securely in it holder. Now move the pointer 16 divisions and the marking tool will move .015 of an inch. Care should be taken not to overrun your guide, as the "backlash" in trying to back up will cause an inaccurate marking of your disc.—Contributed by R. A. Mes-sick.

![Diagram of a television disc layout](https://www.americanradiohistory.com/tv-disc-diagram.png)

**By employing this set-up, the owner of any standard screw-cutting lathe can lay out the holes of a scanning disc with great accuracy. The lathe acts as a micrometer and does the job quickly and neatly.**
Television Reception with a SHORT WAVE CONVERTER

By FLOYD FELLOWS, E.E.

Everyone says it can't be done, but Mr. Fellows has done it. Using a converter with a regular broadcast receiver, he obtains satisfactory images from several stations.

A shift connection can be made by wrapping the wire around and replacing the tube in the socket. Care should be taken, however, to make sure the uninsulated portion of the wire does not touch the chassis.

Now that the receiver and converter are tuned in to the television station and the neon tube connected, the image is ready to be received. The scanning disc motor is started and when it comes up to speed a picture pattern will start to run across the frame opening. As the disc comes into synchronous speed with the transmitter the picture will slow down and become stationary.

An arrangement should be made on the dynamic speaker to cut off the voice coil as the constant singing of the television signal becomes unpleasant.

Clearing the Image

To clear up the image the volume and tuning control knobs should be adjusted on the broadcast receiver and also the tuning controls on the converter. If the broadcast receiver has a tone or "static" modifier it should be left in such a position as to give the sharpest audible sound when the signal is heard on the speaker.

By chance it may be that the image when first viewed, is negative; that is, white objects are black and vice versa. This can be corrected by moving the plate prong connection on the 245 tube to the plate prong on the other 245 tube.

The image may be out of frame, that is the right half of one image and the left half of the adjacent picture is seen in the frame opening. This can be corrected by moving the frame opening either to the left or right or possibly by momentarily cutting off the scanning motor power, which will cause the image to drop back several frames.

When the television station is off the air the neon glow lamp should give a bright red uniform glow over the whole surface of the frame opening. When any station is being received this red glow will resolve itself into the image, which may be cleared up by operating the receiver controls.

This complete layout was used by the writer on several makes of super-heterodyne broadcast receivers. Programs were received from W2XAB, W2XR and W3XCR. Sometimes the station's images will oscillate slightly back and forth in the frame opening. This is caused by the scanning disc motor not being in exact synchronism with the motor at the transmitter end. The reason for this is that the motor contains a spring so that the power supply at the transmitting end swings in and out with the supply at the receiving end.

The advantage of this set up is that it provides for the reception of images without the added expense of purchasing a short-wave television receiver and permits the use of a present broadcast receiver and converter.

R.C.A. Shows Television

Experimental work in television reception was demonstrated in New York on May 16th, 1932, to its licensees by the Radio Corporation of America. About one hundred executives and engineers, representing approximately fifty radio set and radio tube manufacturers, attended the demonstration, which was not open to the press. The greatest secrecy was maintained.

Although continuous progress has been made with television, this development is still in the laboratory stage. The demonstration was held for the purpose of showing RCA licensees the present state of development being carried on by the RCA and its subsidiary companies in this field.

Radio engineers stated that television can best be brought into practical application on its own band of ultra short waves, thereby providing ultimately a service additional to the established service of sound broadcasting. Much work remains to be done toward the improvement of receiving equipment and the creation of transmission facilities for practical television broadcasting.

LeNNON Resigns

Walter S. Lennom, formerly vice-president and director of the Short-wave and Television Corporation of Boston, Mass., is no longer connected with that organization, according to a statement issued by A. M. Morgan, general manager.
How to Make Accurate Scanning Discs

By MARCEL MARRET

Making an accurate scanning disc is a test of your mechanical skill and patience. If you make this machine first, you will be able to punch out usable discs at a much faster rate than if you attempted to mark them out by hand.

The Divider

The divider has been designed in the most simple manner. I bought a gear wheel, of the type used in clocks, having 120 teeth. (1 paid no attention to the pitch), and made a small ratchet that is held engaged in the teeth by means of a spring. The wheel itself has been mounted on a brass hub that runs on a small vertical shaft, which has been turned out of a piece of steel. The diameter of the hub is the same as the hub of the driving motor that rotates the disc. In my case it was 3/8 inch in diameter. On the gear wheel there are three studs which hold the blank disc in place when threaded on the hub. It threads at the same time on the studs, on which screw three brass terminal units. Fig. 1 shows the assembly of this part of the machine.

I have chosen a 120 teeth gear wheel because it enables me to divide in 30, 40 or 60 holes at will, by simply jumping the number of teeth necessary for the division.

On this side, (France), no experiments have yet been carried out with (7) .032" thick, which is equal in thickness to the metal used for the disc. In our case it is aluminum, which has proven to be sufficiently rigid for this use.

The punch head 8 bears in its front part a square groove 3/4 x 3/4" square, in which slides a punch holder of the corresponding size. This cannot be seen in Fig. 2, because it is covered by the front plate 10, but the protruding screw 9 can be seen easily. This screw holds the punch tight (that is inserted in the sliding bar). This bar is terminated at the top by a knob, on which the flat strikes, to push the punch through the metal; 11 is the knob, and 12 is a lever that catches the sliding bar when depressed downwards, and pulls the punch out of the counterbore where it fits exactly. This latter condition is essential if clean holes are to be obtained in one operation.

How It Works

The working of the machine will be readily understood, now that we know how it is made. The first thing to do is to bring the perforator backwards by turning the knob 5 from left to right in a screwing motion; then place the blank disc on the 120-tooth gear, and fasten it by means of the three brass nuts (terminal nuts). Then advance the perforator on the disc until the first hole will be driven through by knocking on the knob 11, and punch withdrawn by pressing lever 12 downwards. After this first operation, turn the disc the number of teeth required for the division in either 30, 40 or 60 holes, and advance the punch head the necessary tenths of a millimeter (or inch equivalent) and drive the second hole through, and so on, until finished. The discs are then ready for use; be sure to be in the correct position, which can be readily checked by placing the disc on the motor shaft and running it at the usual speed. With a little practice, these operations will be done quickly, and only a few minutes will be required to make a really useful disc.
PHASING THE TELEVISION IMAGE

An Explanation of Why Television Images Sometimes “Pass Out of the Picture,” and Some Suggestions On Curing This Annoying Trouble

By C. H. W. NASON

The fact that a perfectly-framed image may suddenly slip out of frame (in the horizontal “sense”) has caused much argument and discussion. Those who recognize the true cause of the effect are few and far between. This behavior on the part of an otherwise well-educated synchronous motor is rather puzzling, for it can be used. Now it is possible to obtain a square hole without actually cutting the hole in the disc. Suppose, for instance, that we cut a narrow strip in two discs and place one slot over the other at right angles to it. The result is a square hole! That is exactly the principle used in the Double Disc Scanner being described. It is much easier to cut a good, clean slot than to punch square holes in a disc. The slots do not have to be arranged in a spiral; therefore if one of the slots happens to be a little off, there will be no cracks to make it impossible to go over the same strip of picture twice before the slot moves.

(Continued on page 151)

A Double Disc Scanner By Jess M. Reed

A rheostat in the motor line provides one of the simplest means of framing television images.

A more complicated but also more effective method of making television images “stay put” in the receivers of the holes in a disc. The scanner takes its name from this fact.

FIG. 1

FIG. 2

A rheostat in the motor line provides one of the simplest means of framing television images.

The System for Lateral Framing:

Since a variation in the applied voltage will cause a change in the angular relation between input and back e.m.f., we can see that a certain amount of framing can be accomplished by means of a rheostat connected in series with the motor’s supply. Fig. 1 shows a method of accomplishing this end which has been employed in many commercial television sets. The motor in this particular case has been designed to operate at eighty volts, rather than at 110. The rheostat can be used to frame the image quite readily, since a change in the series resistance will result in a change in the applied voltage, and hence in the angular relationship between the input and back e.m.f. Where the specially-wound motor is not used, a simple series resistor may be employed, either as a continuously variable device, or as a fixed element shunted by a push switch. A mere touch on the switch would be enough to shift the position of the image through a small angle.

Many methods have been shown by which the image can be framed mechanically. The greatest number of those which can be applied, practically, involves the rotation of the motor’s stator winding by means of a special cradle. This is an expensive proposition and the writer has been led to devise the following scheme to simplify the mechanical structure.

A 3,600-r.p.m. motor is required—this demand being rather easy of fulfillment since 3,600-r.p.m. motors are over standard character, whereas 1,200-r.p.m. motors have only come into demand since the advent of television. Where proper gears are available, an 1,800-r.p.m. motor may also be used. The gear reduction for shifting to a disc speed of 1,200 r.p.m. has a 3:1 ratio and employs a worm-and-gear arrangement as shown in Fig. 2. The motor is so mounted as to be movable through a small distance by means of a knob and screw—also shown in the illustration. It can readily be seen that, if the motor’s shaft is at rest, any motion of the motor, and consequently of the shaft and worm, will result in a slight angular motion of the disc. This is the motion which, when applied with the disc in rotation and in the direction of the arrows, will result in a slight shift of the angular position of the disc and a consequent correction of the lateral framing of the image.

It is essential that the motor “endplay” be taken up by means of shims placed between the bearing and the worm, as shown since otherwise the shaft’s play will result in “hunting” (swinging of the image). Gears, such as those here shown, may be readily purchased from manufacturers in various proportions, as well as in number and sizes which permit of accurate assembly and of noiseless operation.

HERE is a scanner which “picks the picture to pieces” by means of slots instead of the customary holes. Impossible? Not at all! Let me tell you how it is done, and I am sure you will agree that this system has certain inherent advantages not found in other systems.

We all know that a square hole will pass more light than a round hole of the same cross section. Therefore, if we are going to use holes at all, we want to get all the light possible through them, and square holes should be used. Now it is possible to obtain a square hole without actually cutting

of the synchronizing network, will exceed this limit where a six-pole motor is employed. Exhaustive study of this situation will show that a motor having 150 or more poles would be required for acceptable synchronization; but a motor of this character would require an exceedingly high excitation or driving frequency, and thus can only be achieved where a separate synchronizing component is transmitted, together with the image signal.

The fact that this pessimistic attitude is based upon thoughts concerning the ideal system only is evidenced by the excellent images to be obtained under present circumstances. We can deduce from the foregoing remarks, however, the fact that a change in the power factor of the load, or in the line-voltage, can effect a de-framing of the received image, such as to require adjustment from time to time during reception. The re-framing can be accomplished by either mechanical or electrical means.

By C. H. W. NASON

The System for Lateral Framing:

Since a variation in the applied voltage will cause a change in the angular relation between input and back e.m.f., we can see that a certain amount of framing can be accomplished by means of a rheostat connected in series with the motor’s supply. Fig. 1 shows a method of accomplishing this end which has been employed in many commercial television sets. The motor in this particular case has been designed to operate at eighty volts, rather than at 110. The rheostat can be used to frame the image quite readily, since a change in the series resistance will result in a change in the applied voltage, and hence in the angular relationship between the input and back e.m.f. Where the specially-wound motor is not used, a simple series resistor may be employed, either as a continuously variable device, or as a fixed element shunted by a push switch. A mere touch on the switch would be enough to shift the position of the image through a small angle.

Many methods have been shown by which the image can be framed mechanically.
SYNCHRONIZING D.C. MOTORS WITH
THE THYRATRON TUBE

By M. Rappaport, E.E.

The thyatron tube is essentially a three-element rectifier tube into which, after an instant, mercury is inserted. The presence of the vapor performs the function of changing the pure electronic discharge into an arc, thereby making the thyatron an electrostatically controlled mercury arc rectifier. Due to its controllable rectifier characteristics, the thyatron naturally falls into the category of the pure electrical relays. It is instantaneous in operation and may be kept under absolute control. The electrical relay characteristics of the thyatron depends largely upon its inherent nature, as represented in Fig. 1. In this diagram the abscissa is given as the grid potential, and the ordinate as the plate potential at which the electrical breakdown of the tube occurs. When the plate voltage is raised to a critical value which depends upon the grid potential, an arc will appear. In other words, the grid performs as a trigger which sets off the arc.

The grid control ratio of the thyatron tube, which is its only characteristic constant, is defined as the ratio of positive anode voltage to negative grid voltage that will just allow current to start. This ratio assumes a constant value for thyatrons whose glass walls do not exert a grid effect, and may be expressed by the equation

$$\varphi = \left( \frac{\Delta E_p}{\Delta E_g} \right)_{i_p = 0}$$

Where $E_g$ is measured with respect to the most negative emitting point of the cathode and must be corrected for contact potential differences between the grid and the cathode and for initial velocities of the electrons. The contact potential may assume as much as two volts and the initial of about one half volt.

The maximum amount of current a thyatron tube may carry has two limitations. That is, the current must not exceed the pure electronic emission of the cathode. This limit is accomplished by means of an impedance in the plate circuit, because the thyatron has no appreciable internal resistance. If the load resistance does not limit the current then the thyatron develops a pseudo-internal resistance taking the form of a high cathode drop which disintegrates the cathode. The other limitation is that the current must be sufficiently low so that its passage will not heat the grid to an electron emitting temperature. If this condition should occur, the grid circuit will have current flowing through it and the tube will have no control characteristics.

Now that we have an idea of the operation of a thyatron tube, we may apply it to the operation of a synchronous propelling force for a television scanning disc. What we use in this system is a dynamotor, that is, a motor-generator wound on the same armature. The motor winding is operated off direct current, while the generator produces alternating current. This dynamotor may be purchased at a price not much in excess of a good synchronous motor.

When the dynamotor is rotating at a certain speed, say 1200 revolutions per minute, it can be used as a dynamotor. (Continued on page 159)

---

Graph showing the characteristic curve of a Thyatron tube.

A fundamental circuit for regulating the speed of a dynamotor by means of a thyatron.

Tuned alternating current bridge method for running a dynamotor at synchronous speed for propelling disc in television reception.
IN THE previous article mention was made of the fact that all "A" and "B" batteries had been eliminated in the design of the amplifiers used in the Trav-Ler experimental television transmitter. There are three amplifiers used, two of which are mounted on the rack shown in the photograph. They are the main amplifier, which consists of five stages, and one of two stages, which is contained in its own shield can, and mounted on the shelf behind the photo-cell rack.

Separate "B" Supplies

For the P.E.C. (photo-electric cell) amplifier and the main amplifier, two individual "B" supply circuits are used, each employing a type 80 rectifier tube. The power stage is supplied by a rectifier circuit utilizing two type 872 half-wave mercury rectifiers. The filaments of the power stage and of the last two stages of the main amplifier are heated with A.C., while all the other filaments are supplied with D.C. from two special "A" power-packs. These "A" supply units, which are a recent development of the B-L Electric Mfg. Co., consist of a dry metallic rectifier supplied by a stepdown transformer, and a suitable filter circuit, connected as shown in the diagrams. The condensers used in the filter circuits are of the dry electrolytic type, and are exceptionally compact. Each "A" pack occupies less space than a storage battery and provides an unfailing supply of D.C. so well filtered that the ripple component of the output, under full load, has been shown to be less than one-half of one-thousandth of one per cent.

To insure a good frequency response, it was deemed desirable to use a large number of comparatively low gain stages rather than a few high gain screen-grid stages. The P.E.C. amplifier consists of two type 227 tubes, resistance-coupled, and mounted in a sheet metal shield can, which is supported by four sponge rubber biscuits. The tubes are mounted on an aluminum panel which is suspended within the metal box by eight coil springs to insure against mechanical vibration of the elements of the tubes, which would result in microphonic noises. The input and output terminals are bakelite binding posts mounted on opposite ends of the box, while the "A" and "B" power is supplied through a shielded cable from the packs which are contained in the main amplifier rack. The cable terminates in a multi-prong plug at each end, to permit of easy dismantling of the equipment, to facilitate transporting it from one location to another.

Each tube has its own aluminum shield over the tube and to the protection afforded by the steel box which encloses the amplifier. It will be noted from the diagram that the "C" stage has its own "C" battery, and that a 90-volt battery is used to "polarize" the photo-cells. The use of individual "C" batteries avoids common coupling between stages and provides a better frequency response than can be obtained with automatic biasing arrangements. The variable condenser shown in the P.E.C. amplifier diagram is used to provide a certain amount of audio-frequency regeneration, which has a remarkable effect in increasing the pictorial detail of the image at the receiver. Excessive regeneration, however, will result in persistent oscillation which will completely obliterate the image.

Five Audio Stages

The main amplifier consists of four 227 stages and one pentode stage in which two 247 tubes are operated in parallel. This amplifier is located behind the middle panel in the rack shown in the photograph. Above it is the modulator stage and below it are the several "A" and "B" power supplies. The meters on this panel, from left to right, show A.C. line voltage, plate voltage and pentode plate current respectively. The knobs control the filaments, volume level and "B" supply. A pilot light indicates that the amplifier has been switched on.

The meters on the top panel indicate plate current, filament voltage, and plate voltage of the fifty-watt tubes. The small knobs are used to switch on the filament transformer and plate supply, while the two large knobs are for the power rheostats which control filament and plate voltages. The diagram and description of the modulator and oscillator circuits will be given in the next article.

The lower panel contains a meter to...
show the P.E.C. amplifier plate voltage, and switches and pilot lights to control the "A" and "B" power packs. The rack is divided into five sections, each consisting of a large conduit supported on four rubber-tired ball-bearing rollers. The four decks behind the front panels support the amplifiers and power supplies and a steel conduit running from top to bottom of the rack carries all connecting wires between decks.

Shielding Is Thorough

The main amplifier is divided into five sections, each containing one stage, and each of these stages is completely enclosed in an aluminum shield can, which contains the individual "C" batteries, resistors, condensers, etc. Connections are made through the walls of adjacent shield compartments.

For convenience, jacks are provided on the front panel for input and output, and for plugging in a pair of phones on any stage for monitoring and testing. Connection between the main amplifier and the power stage is effected with a short cable equipped with plugs at both ends to fit the output and input jacks, respectively.

It is somewhat of a task to build a multi-stage resistance-coupled amplifier, to operate it from A.C., and to prevent motor-boating and oscillations with the use of the proper isolating circuits, consisting of resistors in the plate circuits, by-passed to ground, permits its accomplishment. In some cases quite large by-pass condensers may be required to prevent low frequency "motor-boating." A certain amount of patient experimenting is usually required to stabilize a resistance-coupled amplifier with a gain in the neighborhood of 135 decibels.

There is nothing very complicated about the circuit diagram. Upon examination, it will be seen that the stages are alike, each consisting of a cathode ray tube, a filament, a control grid, a plate, plate resistor, by-pass condenser, and a special air core choke. This choke has a broad resonance peak at the higher super-audible frequencies encountered in television, and serves to bolster up the high end of the fidelity curve.

The main audio amplifier of the television transmitter, which follows the photo-cell amplifier shown at the bottom of the preceding page. The filaments of the first three '27's are heated by direct current, while the fourth '27 and the two '47's work on raw alternating current from a secondary winding on the power transformer.

Cathode Ray Tubes Now Available to Experimenters

CATHODE ray tubes are now available to the experimenter. This is welcome news, for these fascinating electronic devices, which have many potential applications other than the electrical scanning of television images, have heretofore been limited to professional workers and the largest laboratories because of their elaborate construction and high cost. Developed by Allen B. DuMont, chief engineer of the Globe Television & Phone Corporation of New York City, the new cathode ray tubes are characterized by simplicity and moderate cost. The first type of the series is designed to demonstrate the principle of the cathode ray tube, thereby introducing experimenters and students to the new art at a very small investment. In outward appearance, this smallest cathode ray tube is similar to the usual 45 power tube, with a glass bulb of the same shape and size, fitted to a standard five-prong base. A glance inside the bulb, however, discloses the cathode "gun" which sprays a stream of electrons against the fluorescent screen on the inside of the bulb's rounded top, as well as the single set of deflection plates which control the electronic stream in accordance with the voltage impressed upon them. The sensitivity of this device is such that for every volt impressed on the deflection plates, the electronic stream or beam is shifted one tenth of a millimeter, as measured on the fluorescent screen. The tube filament operates on 0.5 to 1 volt, with a drain of 5.0 amperes. From 250 to 300 volts is impressed on the accelerating electrode for the creation of the electronic stream.

A step ahead is represented in the 8-inch cathode ray tube with two sets of deflecting plates, so as to obtain an additional control of the stream or beam at right angles to the first. The glass bulb in this case is funnel shaped, with a six-prong base at the end of the long neck, and a flattened window at the front, carrying the fluorescent screen. Because of the distance from the cathode to the screen, as well as the positioning of the two sets of deflecting plates, a far more sensitive device is obtained than in the case of the smaller type. The various voltages and current characteristics remain the same, but the sensitivity is increased to 0.5 millimeter per volt impressed on each set of plates.

Although the main interest in cathode ray tubes might seem to center around electrical scanning for the reception of television images, there are more immediate and practical uses. Such electronic devices may be employed as voltmeters, ammeters, and resonance indicators, utilizing the sweep of the spot of light. Again, the gyrations of the light spot may serve to study the wave form of the most intricate electrical variations, such as speech or musical modulation.
Television Transmission on a Narrow Wave Band

by Lieut. George Wald
Q.M.C., U. S. Army

THE object of my invention is to permit television transmission within a narrow wave-band. It is a well-known fact that if the grid of an oscillator is made highly negative in relation to the filament, the tube will cease oscillations. Likewise, if the grid potential is made highly positive, the oscillations will cease, since the flow of current from the filament to the plate will stop at the grid.

The image to be televised is scanned by a special light-quantitative scanning device that selects from the image areas of equal light strength. If, for instance, we choose to divide the image into six classes of light strengths, a scanning device is used like the one shown in Fig. 1, with five partially transparent sectors. Each sector, "a," "b," "c," "d," or "e," is less transparent than the other. The speed of the disc (66 or 77) is such that each sector "a," "b," "c," "d," or "e," intercepts the image beam during the time the regular scanning device scans the image one complete sub-frame. Thus, as the regular scanning device scans that area of the image which is of a certain class of light, a current of a certain magnitude results. This current is passed through a rectifying tube, the characteristics of which are such that a certain critical voltage is required before rectification will take place. Thus, any voltages existing below this critical voltage will not affect the transmitting oscillator.

How CurrentVaries

When the scanning devices pass the area of a class of light corresponding to the light-quantitative scanning sector, or brighter than that, a voltage is produced which is either equal or higher than the critical voltage, thus making the grid of the oscillator tube (19, Fig. 2) either highly positive in relation to the plate or highly negative in relation to the filament (according to what we choose), which stops the oscillator, the critical voltage as passed by the tube (19) being of such magnitude as to accomplish the latter. In Fig. 3 a light curve of a part of an image line is shown. The vertical lines show what part of light each light-quantitative sector will permit to pass through it. The oscillator will be stopped during each sub-frame for the length of time the scanner is passing that part of the image falling below the light curve (78), while it will operate at the normal frequency when above the curve (78). Thus, in the sub-frame "e" there will be only two brief interruptions, while in sub-frame "a" the station will remain silent during the entire time the line is scanned, except for a brief duration marked "o." At the receiver the reverse takes place. There a commutator (39, Fig. 4) may take the place of the scanning disc (77). Class six light (the darkest areas) is not scanned at all at the transmitter and the corresponding areas remain dark on the receiving image screen.

Eliminates "Key Clicks"

Interruptions of the oscillator which are not caused by any change in the impedance of the circuit will not produce a broad band. In fact, this method provides excellent means for the transmission and reception of wireless telegraphy without "key-clicks." If a photo-electric cell be placed in a light-proof compartment in which there is an aperture covered by a shutter, the operation of this shutter in the same manner as a telegraph key will produce signals which may be transmitted on a narrow wave-band without causing interference to neighboring stations.

When the grid of the oscillator is held highly negative in relation to the filament, the antenna reaction will be free and the antenna current and produce a broader band per interruption than if the grid were held highly positive in relation to the plate of the oscillator. It can further be noticed that the sum of the interruptions for all five sub-frames is less than the number of dots per frame as now scanned. Furthermore, a 1" x 1" image with sixty (60) elements per inch, and ten (10) frames per second, now produces a wave-band of thirty-six thousand (36,000) cycles. If the same image is transmitted as a 10" x 10" image there will be ten times ten times thirty-six thousand (10 x 10 x 36,000), or a wave band of three million six hundred thousand (3,600,000) cycles.

In my method of transmission, each line will have nearly the same number of interruptions per line (for the same image) whether the line is one inch long or ten inches long; thus, to transmit an image ten times the size will require but the square root of ten times ten (10 x 10), or the square root of one hundred, which is ten times as many interruptions as the 1" x 1" image could have. In other words, the wave-band will be proportional to the square root of the area of the image, as I stated in RADIO-CRAFT, November, 1930 issue.

This can easily be verified by taking a photograph 4" x 4" and enlarging it to a 12" x 12" photograph. In your mind, divide the shading of this photograph into six (6) classes, then lay off on both photographs red lines encircling each class of shading in the

Fig. 3: Current variations corresponding to light fluctuations. Fig. 5 and 6: arrangement of the Wald transmitter and receiver apparatus.

Schematic diagram of the narrow band television transmitter devised by Lieut. Wald.
Radio Manufacturers Association Issues Statement on Television

FOLLOWING its policy to advise the public accurately regarding progress in television, an authoritative statement was issued recently by the Radio Manufacturers Association, the national industry organization. The statement follows:

"From a confused mass of conflicting statements and data regarding television, only by picking out the pertinent facts from the work that has been done in the past and the facts that are presented in the present situation, is it possible to draw any conclusions regarding the future of television. These facts have been many times oversold, at times maligned and altogether misunderstood, not only by the public but by the leaders of the radio industry itself, which must sponsor this new art.

"This statement regarding television is only intended to array the facts of the past and present to point out some of the future possibilities thus made apparent.

"As far back as 1884 there was recognized by Nipkow, a German experimenter, that to transmit visual images it would be necessary to resolve those images into elements, each element to be faithfully transmitted and re-converted into a corresponding light value at the receiving end. To do this Nipkow employed scanning discs, and later in 1894 Amstutz, an Illinois experimenter, carried on the work in this country even further. In 1913 Jenkins of Washington started his work on the development of television which culminated in 1925 in the showing of animated motion pictures by television. In England, John Baird, after several years of work, showed his first pictures in 1926. In 1928 the Bell Telephone Laboratories transmitted a picture from Washington (D.C.) to New York. Since that time several other experimenters have been carrying forward the development of television. Prominent among these have been the RCA-Victor Company in Camden, N. J., the Jenkins Television Corporation of Passaic, N. J., Philo Farnsworth, now with the Philadelphia General Electric Company, the General Electric Laboratories in Schenectady, N. Y., and U. A. Saba of Chicago.

"The problems encountered in accomplishing television transmission and reception have in the past been manifold.

First—the problem in the method of scanning which started with the stationary disc was followed later by a disc with lenses which greatly increased the efficiency. Then came the drums and discs with mirrors. Starting with a Russian named Rosing, twenty years ago, several experimenters have been using electrical principles of scanning which are utilized in the cathode-ray oscillograph tube.

Second—the problem of transmission has proven to be very difficult. The light values of the elements of the transmitted picture must be converted to electrical values and then transmitted faithfully either by wire or by radio. This is successfully accomplished only by employing a frequency band of several hundred thousand cycles. This becomes of interest when compared with the width of a band for present day radio voice transmission, which is approximately 5000 cycles. Modulation of the high carrier frequencies for these picture transmissions becomes very difficult.

Third—the reception of television signals has presented still more complicated problems. The radio-television signals must be received, amplified, de-modulated and again amplified to operate a light source. Demodulations above 30,000 cycles has presented many engineering difficulties. Much work has been done on the light sources, the most common of which have been the neon discharge glow lamp, the Kerr cell and the cathode-ray tube.

Fourth—the great problem has been that of securing finances. Unfortunately, companies have resorted to over-statements, lured prospects with the possibilities of television in order to sell stock, and often in these statements misrepresentations were made, with the result the public has been very much confused as to the actual state and present possibilities of the television art.

"The present facts of television which are available are as follows:

First—for scanning, mechanical features using rotating parts are in wide use and offer a practical means of securing passable television pictures.

Second—a direct pick-up system which has come to the front rapidly this year is that of the camera idea. This system can be used for television pick-up in a

(Continued on page 155)
THE USE of the synchronizing wheel or phonie motor in television is always represented as something very simple, yet mishaps are the regular thing. Why? Because most amateurs are not aware of the trick behind synchronization of a synchronizing motor, the dimensioning of the phonic wheel coils, and the right distance of the magnet pole faces of the synchronizing rotor. There are liable to be failures when the amateur, for instance, ventures to construct a local generator of the synchronizing current. First we shall consider the theoretical basis of synchronizing with the phonic wheel and finally the production of the synchronizing current by a vacuum tube oscillator.

Many televisions today are provided with a synchronizing phonic motor, with the synchronizing current taken from a very steady local generator utilizing either a special tuning fork oscillator or a tube oscillator (European practice). Generally the former is preferred, because it can be kept very constant by heedig special precautionary measures (installing in thermostatically controlled ovens, etc.).

Methods of Operation

At the receiving end one can operate a phonic wheel by the pictorial line alternating current furnished by the radio receiver, after it has been filtered out of the so-called picture signal current and sufficiently amplified, (American system). This method was proposed in theory by the Telehore Company, but has been abandoned, because with the advent of “fading” there would be no synchronizing current at all, and the motor would act according to “its own sweet will.” Moreover, if the number of revolutions of the receiver disc varies altogether too much in the period of fading, it can happen that when fading ceases the receiver disc cannot be brought to synchronous speed. This becomes especially troublesome if the synchronous motor or synchronizing phonic wheel is rigidly connected with the receiver disc, as for example in the case of the Baird system or the televisors of the Fernseh Company, (which makes Baird receivers for use in Germany). The great momentum of the receiver disc prevents the synchronizing current from being able to get the synchronizing phonic wheel back into the right number of revolutions, after the slightest deviation of the number of revolutions from the synchronizing frequency. The Telehore Company has recognized this failing and has therefore adopted the following method.

Separate Driving Motor

It uses the phonic wheel for synchronizing in its television receivers, but only for that purpose alone; the scanning disc or “mirror screw” is operated by a special motor, which is not a synchronizing motor. Unlike Baird, however, the Telehore Company does not place the disc or mirror screw rigidly on the axle of the synchronizing wheel, but instead allows this to turn loosely on the shaft. By means of a tension spring laid over the shaft, the Nipkow disc or mirror screw is pressed against a disc also placed on the shaft (but rigidly fixed there). The tension spring is just sufficient after several revolutions of the shaft so that the Nipkow disc (or mirror screw) is carried along, until in consequence of friction on the fixed disc and corresponding to its inertia, it comes to the right number of revolutions. The disc (or mirror screw) must have “play,” which is absolutely needed for perfect operation. Small deviations of the synchronizing frequency from its supposed value no longer matter now. If such a change sets in, then the picture in the television receiver will swing back and forth a few times, but the disc will not get entirely “out of step”, as is easily the case with sets having no “play.”

If the synchronizing current actually does cease for a short time, the synchronizing (phonic) wheel is at once again brought back to the right number of revolutions, each new circuit, provided the speed of revolution occurring during the time of interruption does not vary too much from the desired speed. Conversely, if the number of revolutions of the running motor may harmless flare; still the wheel always remains at the right revolution frequency, which is determined by the synchronizing frequency, because toward side a (Fig. 2) an acceleration of the wheel by the synchronizing alternating current always sets in immediately, and toward side c a checking of it.

Now for the construction of the oscillator (Figs. 3 and 4): As already said, the Telehore Com-

FIG. 1

The synchronizing motor reacts better if the current through it has the pointed wave form (2), rather than the smooth form (1).

FIG. 2

This curve shows that if the synchronizing frequency is changed, at first there is no force exerted by the synchronizing alternating current.
pany operates on the plan that the pictorial current is first conducted to the oscillator and carries this along with it (in frequency), and then the oscillator current is amplified and conducted to the phonic wheel.

In the case of the following arrangement I have adhered to that of the Telehor Company, because I consider it the best one. Fig. 3 shows the hook-up, and Fig. 4 a section through the oscillator circuit of Fig. 3.

Details of Connections

We see that at 1 the connection to the radio receiver is made without any special transformer, i.e., directly. A switch 2, makes possible the switching of the receiver current to a loudspeaker 3, or to transformer 4 of the television. However, the current coming from switch 2 is divided. Only a part, the larger fraction, of the receiver current is conducted to transformer 4. Transformer 4 gives its current to neon tube 5, which current is limited by a fixed resistance 6 and regulated by variable resistance 7. In reality resistance 7 regulates the direct closed circuit current conducted to the neon tube, i.e., the background brightness, and therewith also the contrast of the image. The second partial current is conducted via resistance 16 to transformer 17, whose secondary potential is conducted to the grid of the oscillator tube 18. The potential, which of course has the pictorial line frequency of the transmitter, therefore controls the oscillator.

Resistor Is Adjustable

The resistance 16 serves to conduct to the oscillator more or less pictorial line potential, at the expense of the pictorial line current flowing to the neon lamp. One must select resistance 16 large enough, so that the oscillator is just barely carried along (in point of frequency), which may be recognized by the fact that the image remains stationary, not moving about, when a television broadcast is received.

The oscillator has a three-point connection. The oscillator circuit coil, 24, is sufficiently represented in Fig. 4. The oscillator circuit condensers are marked 25 and 26. It must not be forgotten that the oscillator circuit self-induction depends on the neatness of the winding of the oscillator circuit coil. Furthermore, one recognizes the attainment of the correct frequency by the fact that in the case of too small capacity the image hurries ahead; in the case of too great capacity it lags behind. Therefore the image in the former case moves in the direction of the rotation of the disc, in the latter case in the opposite direction.

In the plate circuit of oscillator tube 18, there furthermore lies the primary side of a small transformer, 27. Since the plate current of tube 18 fluctuates in rhythm with the oscillator current, the oscillation is transmitted by the transformer to the amplifier tube 19, in whose plate circuit there directly lies the synchronizing (phonic) wheel coils 31.

It is to be noted that the amplifier tube must have a negative grid bias, high enough so that in its plate circuit there forms the pointed wave form current which is illustrated at 2 in Fig. 1.

Resistances 21, 22, 29, and 30 serve to produce the right grid bias for tubes 18 and 19. The values of the resistances vary with the tubes and the plate potentials chosen.

In operation the adjustment of the oscillator is made by turning the rotary condenser 26. One can recognize approximately by the oscillator tone (the synchronizing phonic wheel magnets give a soft tone) when the correct synchronizing frequency is attained. That is the case when one gets a perfectly even, gentle tone. A requisite for obtaining a quiet tone is to be sure, that the phonic wheel rotor is perfectly centered in running. If the synchronizing frequency does not suit, then the tone becomes impure, and then one also sees, by “looking at the image,” whether it is stationary or not!

Holding The Scanner at Constant Speed

W HEN the receiver is located at a distance of a few hundred miles from the television transmitter, it would seem far better to employ some means of holding the scanning disc or drum at a constant speed, rather than to use a phonic wheel. The reason for this is that, when the signal fades, it is generally necessary to re-frame the picture when a phonic wheel is employed for synchronizing.

The writer has employed a unique “constant-speed” method for considerably over a year, with excellent results. It has been found possible to hold synchronization for as long as one hour. Of course, when the speed of the transmitting motor varies, it is necessary to compensate for the variation at the receiver.

A schematic diagram of this “constant-speed” method is shown in the accompanying sketch. The motor M may be any type capable of being controlled as to speed. The speed control R should have a resistance of approximately 150 ohms or so, depending upon the size and type of motor.

The scanning disc is mounted on the motor shaft in the usual manner. In front of the disc, a small toothed rotor is attached to the shaft; this may be almost anything with 6 or more teeth. The one (Continued on page 154)
How STANDARD MOVIE FILM Is Used for Television Broadcasting

Difficulties Experienced with 24-Frames-Per-Second Pictures Eliminated by New Scanning Method and Use of Duplicate Films

ONE of the greatest difficulties encountered in the adaptation of sound motion-picture film to television projection is caused by the difference in the rate of speed with which the pictures are taken on the movie lot and that with which they are scanned in the television studio. The moving-picture camera exposes 24 sections of the film each second, whereas television laboratories have experimented with scanning system that project a maximum of 20 pictures per second.

The consequent slowing down of the film results in “slow motion” of the characters in the picture. What is more important, the slower movement of the sound track past the photo-electric cell creates a sound distortion such as that occasioned by rotating the turntable of a phonograph at a speed slower than that at which the recording was made.

About eighteen months ago, Armando Conto, research engineer for Western Television Corporation, of Chicago, set about to perfect apparatus that would not only broadcast pictures with the figures moving at normal speed, but that would also permit the sound to be taken from the film undistorted.

Three-Spiral Disc Used

The three spiral scanning system with which Conto worked divides any area to be broadcast into 45 horizontal parts at a speed of 15 times per second. This leaves a considerable gap between the 15 pictures per second as broadcast by the television station and the 24 pictures per second projected in the motion picture house.

Conto looked with disfavor upon the method by which the film is kept in motion as a part of the scanning process. He decided that better results could be obtained if the film remained stationary, as it does in the projection of moving pictures, moving forward at a predetermined time. Consequently, it was necessary to design a disc that would combine the effects produced by an ordinary scanning device and the shutter on a moving-picture projector.

Physical layout of the apparatus used in the Conto system of transmitting sound motion picture film. Note that two duplicate films are used, turning in the directions indicated by the arrows.

The resulting disc is so constructed that the apertures through which the light penetrates are placed on radii that are four degrees apart instead of eight degrees, as in the ordinary three-spiral, 45-aperture disc. Thus, the 45 apertures occupy a 180-degree segment of the disc, leaving the other half blank to act as the shutter.

Conto uses two identical films. Film number 1 is located at the upper diameter of the scanning disc and number 2 at the lower. The movement of both films is toward the center of the disc. The films are placed in the same position in each Geneva movement, (the device which moves the discs forward). The two Geneva movements and the scanning disc are interconnected mechanically in such a way that when the first aperture of the first spiral is in a position to scan picture No. 1 in film No. 1, frame No. 1 remains motionless for the duration of the entire scanning operation. While picture No. 1 in film No. 1 is being scanned, the blank segment of the disc is passing before film No. 2, shutting off the light. This interval is used to move picture No. 2 in film No. 2 to a stand-still position so that it will be scanned immediately after picture No. 1 of film No. 1 is scanned.

So, of the two identical films, the pictures of film No. 1 which will be scanned are Nos. 1-3, 5-7, 9, etc.; while pictures Nos. 2-4, 6-8, 10, etc., will be scanned in film No. 2.

Conto’s real difficulty came in broadcasting standard sound films taken at a standard rate of 24 pictures per second without sound distortion and without slowing down the movements of the actors. But he made provision for that, too.

He held the opinion that the continuity of the picture would not be broken if part of the pictures in the film was eliminated, for it must be remembered that the movement registered on the two duplicate films is that which takes place in 1/24 of a second, a shorter period of time than that required to create an impression on the human visual system.

Some “Frames” Are Eliminated

To maintain such unbroken continuity, the inventor controls the operation of the two Geneva movements by means of a cam which automatically selects certain frames out of each unit of 48 consecutive pictures so that the film runs at its normal speed of 24 frames per second.


Because the film moves forward at the regular rate of speed, 24 frames per second, the sound recorded on the film is reproduced without distortion by using the ordinary photo-cell system.

This drawing shows the special three-section scanning disc used in the Conto system. It has three spirals of 15 apertures each, the holes being 4 degrees apart and all located on one half of the disc. The blank half of the latter serves as a shutter.
In a television transmitter one of the factors of utmost importance is that of isolating the electrical impulses from the converted light impulses to a sufficient high level to modulate a transmitter.

Since 1908 vacuum tube amplifiers have been known, but the requirements for these amplifiers have been limited to voice and music frequencies, which at most did not exceed 10 kilocycles. In fact, the highest quality today is only between 7 kc. and 8 kc. When it became necessary to amplify frequencies as high as 100 kc. and more for television, investigators immediately started out along the old line of amplifier design which would result in high quality voice transmission, and there the troubles grew apace.

Frequency Discrimination

First of all, the photo-cell possessed discrimination against the high frequencies, which are desirable for good television. The available tubes possess a cut-off frequency which again discriminates against high frequencies. The accepted methods of mounting and wiring also discriminate against high frequencies. Accepted practices in biasing and in by-pass condensers and in filtering power-supply units discriminated against the necessary low frequencies, with the result that it became a definite problem to build an amplifier for television that would supply the high frequencies that are inherent in the steep electrical wave form inherent in the television signal.

We have found in designing a transmitter amplifier that the passing of signals from the amplifier to the transmitter offers possibilities for losing detail or for conserving it. For this reason the use of a low-impedance output is highly important. This low impedances may be secured by paralleling output tubes, in which case the level is reasonably high but the tube capacities themselves become very objectionable. Another method is to use a small portion of the resistance drop of the plate circuit of the output tube, which great reduces the volume but does conserve high frequencies.

We have found that the development of special tube with low capacities between elements has been of great assistance. With these tubes, for frequencies up to 100,000, an amplifier can be built with almost no frequency corrections, if real design engineering is put into the construction of each stage. Uncontrolled feedback between stages is another point which must be carefully controlled in the design of such an amplifier. For this reason shielding in each stage is highly important. It has been found that frequencies present in television signals fed back very readily and hence the shielding must be of a quality equal to that approaching radio frequency.

The circuit shown uses regular tubes. It will be noted that in the second stage a net-work is employed that secures the frequency response.

The use of specially constructed tubes obviates the necessity of the network and permits the use of an amplifier to secure frequencies of an order of 300,000 to 400,000 cycles!

"Junior" Television Scanner for Amateur Use

Advanced television experimenters who wish to investigate the transmitting end of the art will be interested to learn that a complete scanning unit is now on the market. This consists of a three-spiral, 45-hole disc, driven by a 100 r.p.m. synchronous motor, a 1000-watt projection lamp with a suitable condensing lens system, and two 6-inch photoelectric cells.

As shown above, the mechanical and optical parts are mounted rigidly in their proper relative positions on a special frame. In view of the fact that the unit may be placed on the same table with other experimental apparatus, the chassis is rubber insulated to prevent the transmission of vibration.

This instrument is made by the Western Television Corporation.

*View president in charge of Engineering, Jenkins Television Corp.
THERE is no doubt that when working on a 60-line basis, a mechanically driven disc is in many ways superior to a cathode-ray tube. However, when detail of higher order is required, the difficulties in using a disc system increases so rapidly as to become practically insurmountable in the neighborhood of 120 lines per picture. How this happens will be shown now in detail.

To simplify the reasoning, we will consider first a scanning disc with punched square holes not using any overlapping. The factor of overlapping will be easily introduced into our discussion later.

Let us choose, as a basis, a square aperture with side dimensions of .010" x .010". For a 60-line picture, whose width is — of its height, and for zero overlapping, the disc diameter at the point of the extreme aperture will be

\[ D_{60} = \frac{.010 \times .010}{\pi} \approx 13.5 \text{/ approx.} \]

Using the same size of aperture for a 120-line picture, the diameter of the disc becomes

\[ D_{120} = \frac{.010 \times .010}{\pi} \approx 54.6" \]

and for a 180-line picture

\[ D_{180} = \frac{.010 \times .010}{\pi} \approx 122" \]

Comparing the diameters of these three discs with their corresponding numbers of apertures we get

\[ \frac{122}{54.6} = \frac{180}{60} = \frac{120}{2} = 2^n = 2^2 = 4 \]

We note that the effective doubling or tripling the number of lines increases the disc diameter four and nine times respectively. In other words, the diameter increases in a square proportion with the number of lines per picture. This looks like a bit of usury on Nature’s side, but it is not so. The reason is that when increasing the number of lines in a picture for example twice only, the detail increases four times; in other words, also with the square of the number of apertures. Therefore, the square function with which the diameter of the disc increases is quite justifiable.

Let us return to the 120-line disc. Using a .010" aperture, which is quite small, one must have a 54.6" scanning disc. The overall diameter will, of course, be larger and about 56". It is obvious that this size of disc is large and out of proportion and cannot be considered for practical purposes.

The only available means of reducing the diameter of the scanning disc is by using a smaller aperture, as the size of pressed by the factor, which we will call hereafter “FORM FACTOR.” It is evident that D, the disc diameter, is directly proportional to the form factor. Therefore, by decreasing the value of the form factor, we may also decrease the magnitude of D. Let us consider, for a while, the meaning of this factor.

It indicates the relation between the width and height of the picture frame, and the smaller the form factor, the more oblong the picture frame will be. The existing system uses a frame whose width is 6 units of length and height 5 units. This form is taken from the standard motion picture film, a reason which should not outweigh other more important considerations.

Let us figure out the disc diameters for few different form factors, using the 120-line basis, and an aperture of .010". Keeping in mind that the disc diameter is directly proportional to the form factor, we get

![Diagram of scanning disc and aperture](image)

The use of a large disc in preference to a small one results usually in a brighter image, because the size of the apertures may be increased.

We notice that by making the picture form oblong, we arrive at disc diameters of reasonable size, and when using this principle in conjunction with small apertures (.005"), as indicated in the third column of our table 1, the proposition becomes very promising. For example, a disc having a form factor

\[ \frac{1}{2} \]

instead of the present form of \[ \frac{5}{6} \]

and using an aperture .005", has a diameter of 11.375" and in finished form an overall diameter about 13". It is, of course, understood that the use of such small apertures imperatively commands lamps of high brilliancy, so as to compensate for the effect of small apertures.

### Effect of Small Form Factor

It must also be said that a small form factor, i.e., an oblong picture frame, will have the effect that the transmitting station, which of course, will have to use a disc of identical form factor, will not be able to scan as many persons at the same time as before. Also, when transmitting scripture, the type of letters will have to be of slim character, so as to crowd a sufficient amount of letters into the narrow light field.

The small form factor can be effected in two ways, as it is expressed by a ratio of two numbers. One way is to decrease the disc diameter and keep the aperture size small, the other way is to keep the disc diameter large.

---

Table 1

<table>
<thead>
<tr>
<th>Disc Diameter</th>
<th>Form Factor</th>
<th>Aperture</th>
<th>Aperture Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>0.010&quot;</td>
<td>0.005&quot;</td>
<td></td>
</tr>
<tr>
<td>60/5</td>
<td>0.010&quot;</td>
<td>0.005&quot;</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>(6/6)</td>
<td>22.75&quot;</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>(4.5/6)</td>
<td>18.95&quot;</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>(3/6)</td>
<td>17.65&quot;</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>(5/6)</td>
<td>11.375&quot;</td>
<td></td>
</tr>
</tbody>
</table>

---

By WOLF S. PAJES
and increase the step down, i.e., the size of the aperture. The first method will result in a small disc diameter and a weak light field. The second method will effect a large disc diameter, but at the same time a light-field brilliance much greater than normal.

For us, the first method is to be commended, as we are concerned more with a small disc diameter than high field brilliance. In Fig. 1, both methods are presented. It is easily seen from the picture that in A, the fraction $r_2/r_1$ is greater than $r_1/r_2$ in B, which will result in the first case in a light field much more curved at the border than the light field in the second case.

The high number of lines per picture necessitated us to use small apertures as well as small form factors, in order to keep the size of the scanning disc within reasonable limits. The decrease in the size of the aperture has, however, a very detrimental effect upon the amount of light passed. It is true, as a general proposition, that the amount of light passed through an aperture is proportional to the area of the aperture, and therefore, to the square of its linear dimensions. In other words, if we use a .005" aperture instead of a .010", the amount of light passed will be four times smaller, and not twice. We are, therefore, limited in this respect very sharply, unless we have at our disposal a lamp of intrinsic brilliance.

Angular Separation

There is another factor connected closely with the 120-line basis which tends to decrease the light field intensity. This is the angular separation of the apertures. It is evident that the angular separation for a 120-aperture disc will be 360/120 = 3°. Suppose, further, that we continue to use the old picture frequency of 20 per second, then it is quite obvious that the time slotted the field will be of one aperture across the field will be only half of the time required by a 60-line disc. The impression left upon the eye in case of identical apertures and lamp brilliances will be in the first case only ½ of that in the second case. If we now combine both light diminishing factors, i.e. that of the smaller aperture and the time effect, the result will be the product of both effects. So in case of a twice smaller aperture, the brilliancy of the 120-line picture in comparison with the 60-line picture will be $2\times2=8$ times weaker and in the case of three times smaller aperture $3\times2=18$ times weaker. Again our only hope and salvation lies in an intense modulated light source.

Everything said before retains its validity in the case of a lens scanning disc, with the variation that the center of the disc is used by the center of the lens and that the properties of the aperture are transferred into the crater of the neon lamp (Fig. 2).

The last question I intend to raise is that of overlapping. When using square apertures, no overlapping is required. When, however, round apertures are used, a certain overlapping is necessary in order to create the impression of uniform illumination, although real uniformity with round apertures can never be obtained. When working with round apertures, the way to figure out the disc diameter is to substitute in the above formula the real step down from aperture to aperture for the size of the aperture itself. For example, if the 120-hole aperture is to be used, we compute the overlapping problem for a lens scanning disc, but now with the crater size and its form are the objects of our attention.

Television System Planned for Canada

The people of Canada will shortly have the opportunity of seeing television in operation. A new company, known as Canadian Television Limited, has recently been formed and has secured the exclusive rights for the operation of Canadian Television. Of the well known Jenkins Television Corporation of Passaic, N. J. According to information received from Mr. Douglass Jenkins and Chief Engineer, Canadian Television Limited, the company intends to develop and exploit every phase of the television field. Extensive research facilities are being organized and completely equipped laboratories installed in Montreal.

Entering the field at this time, Canadian Television Limited will have the benefit of the years of endeavor spent on research and will also receive adequate protection and support from the early pioneer patents of Charles Francis Jenkins.

The new film is now making arrangements to demonstrate television in most of the principal cities of Canada, a latter demonstration will be used and the demonstration can be viewed by an audience of several hundred viewers. The film will be transmitted, either by radio or by wire, and observers will have the opportunity of seeing the complete system in operation, including the broadcasting studio and the method of staging the productions.

It is also planned to install a number of television broadcasting stations throughout the country.

Mechanical Problems

The lens scanning disc, of course, brings up the various problems of lens mounting, lens centering, lens diameter and proper focal length. Of no slight importance, also, is the question of how to minimize in the lens the effect of spherical aberration. This may mean the shaping of the lens properly and also to determine the optimum relation between $r_1-r_2$ (in Fig. 1) and the spherical angle of the cone of light emerging from the crater of the neon lamp (Fig. 2).

The last question I intend to raise is that of lens overlapping. The step down from aperture to aperture is .004". Substituting these values in our equation we get 21.84°. The overall diameter of the disc will be slightly larger, or about 23.5°. Figure 4 is a detailed diagram of this layout. The angular separation is 3 degrees. A 1/6 horsepower motor is sufficient to bring the disc into synchronism. As material for the disc .01" thick duralam will be best.

Details of Holes

In the lens disc the holes for the lenses are drilled about .45" and counterbored to .5. The stepdown is again .004". The overall diameter is larger than in the case of the aperture disc to make allowance for the lenses, and is 24.5". The lenses are ½" in diameter and have a focal length of 1 ½". The metal used for the disc is duralamium 5/64" thick. The thickness of the shoulder is 3/64"; the remaining part of the metal is to hold the lenses, and the rim of the lens is .015". The diameter of the crater of the neon lamp to be used is .017".

The power of the motor must be not less than ½ horsepower and a spring coupling must be provided.
Single Control Super- Heterodyne
For Television Reception

The single control super-heterodyne has long been the acme of perfection in the broadcast receiver. Unfortunately, this is not true in the case of the television receiver, unfortunately, I say, because of the inherent characteristics with which the "super" is endowed.

The first problem in the design of a television receiver is the attainment of a satisfactory numeric or overall selectivity. In the super-heterodyne this is readily accomplished through the use of an intermediate frequency sufficiently low to admit of the use of high values of "Q" in the coils employed. The value "Q" establishes the figure of merit for a coil and is given by the expression \( v/f \). With high values of "Q" large gains are also possible.

The more technical reader. Those not inclined to "theory" may stand aside for the time while we proceed to elucidate.

Single Control in the Television Super

The choice of 175 kc. as the intermediate frequency for the broadcast super-heterodyne receiver was not one of chance nor of trial-and-error. The demands upon which the choice is based are briefly as follows:

1. It must be low enough that the advantage of the high gain per stage attainable at low frequencies be attained.
2. It must not be so low that "image frequency" interference results; i.e., it must not be of such a value that a station removed from the desired one by twice the intermediate frequency be capable of creating sufficient voltage on the grid of the first detector tube to result in a second and spurious 175 kc. component which no end of selectivity in the intermediate frequency amplifier can remove.
3. It must be low enough that no harmonics of lower order than the third lie within the desired frequency range.

In the case of the short-wave or television receiver the intermediate frequency must be high enough to make the tuning of oscillator and signal-frequency stages be divergent to the point that minor deviations from "true ganging" cause little percentage difference in the frequency of the beat chosen for intermediate amplification.

The three considerations determining the intermediate frequency in the case of the broadcast "super" hold also in the case of the short-wave or television design but with the added proviso that the signal and oscillator frequencies must be far enough removed, one from the other, to permit of slight irregularities in tuning with but little percentage change in the beat or intermediate frequency.

The frequency range required of the television receiver extends from the lower edge of the broadcast band, 1500 kc., to about 3000 kc. This range may be frequently covered by means of a 00025 mf. condenser and a coil having an inductance of 45 microhenries. If we decide upon an intermediate frequency of 500 kc., the oscillator constants must be such as to tune at all positions of the dial to a frequency just 500 kc. above that of the signal frequency circuits.

Calibration Curve Furnished

In Fig. 1 there appears a curve showing the frequency of the signal tuning elements for various capacities of tuning condenser. It will be seen that the designations along the right hand edge of the curve correspond to the oscillator settings corresponding to the frequency curve of the signal circuits. Now it is not possible to attain perfect single control in a "super" by the simple process of employing a smaller inductance for the oscillator tuning, despite the fact that with straight-line-frequency condensers such a condition might be expected. It is possible, however, to so proportion the inductance and a series condenser acting in conjunction with the tuning condenser, that the oscillator and signal circuits will track in a manner as to produce a constant 500 kc. beat.

Fig. 3: Complete schematic diagram of the single-control super-heterodyne suggested by Mr. Nason for television reception.
In the lower three groups of figures we have the tuning capacitance giving a desired frequency, the oscillator capacitance giving a frequency 500 kc. higher and the capacitance required values and those actually obtained for the oscillator. The values may be altered by varying the capacity of the coupling condenser, remembering that the band width decreases as the value of the coupling condenser is increased. For the purposes of variation a Hammarlund MlC-1000 condenser is employed in this circuit.

Transformer Output

In order to avoid the necessity for a high-voltage transformer, the coupling between the output tube and the neon or crater lamp has been taken through a special transformer so devised as to operate in the plate circuit of a '45 tube with a frequency response characteristic flat from 20 to well beyond 40,000 cycles. It is but recently that the art of transformer design has progressed to the point where such frequency ranges are possible. It is only through the use of an entirely new basic theory of transformer design, in which the transformer is considered as a band-pass filter, that the results are achieved.

In constructing the receiver the chassis assembly of any standard super-con was used. The front panel of the neon tube brilliancy control can be used to replace the tone control knob.

Parts List

C—.00025 mf. Triple Gang Condenser

C1—(Fixed variable) .0005 mf. "padding" condenser (Hammarlund)

Constructional details of the special I.F. transformers used in the Nason television "super."
An Effective Television Synchronizer

By C. H. W. NASON

There are many methods which are practicable for the synchronization of remote mechanical systems such as often appear in the communications art (telephotography) or in television. In cases common to the field of communications engineering there is usually no difficulty in accomplishing the synchronization of such rotating members, since a separate signal or low-frequency synchronizing wave may be transmitted as a part of the signal. By means of filters this may be removed from the actual signal at the receiver and thus has no influence upon the actual communications circuit.

Although in television there is nothing to prevent the transmission of such a synchronizing signal, none of the active television bodies has seen fit to do so and no attempt to force the transmission of a standard synchronizing influence has been done. There is, however, one saving possibility which has been employed in many receiving systems with small or greater success.

Picture Component Exists

There is a component of the television signal which represents the number of scanned lines transmitted per second. The frequency of such a component depends upon the number of scanned lines per image and the number of images per second, and in the case of the present 60 line-20 images per-second transmissions is 1200 cycles per second. By means of a tuned amplifier it is possible to isolate this component from the balance of the receiver and to obtain a signal of sufficient amplitude at that particular frequency to actuate a small synchronous motor of the correct characteristics. While in systems heretofore employed in television service the synchronizing influence thus obtained has never sufficed to actually drive the synchronizing mechanism, a fairly positive synchronization has been achieved through the use of a second motive device supplying sufficient power to overcome the frictional and windage losses—leaving to the small 1200-cycle synchronous motor the single function of maintaining speed. Unfortunately, when the station is not transmitting an image, as when announcements are being made, the synchronizing influence is removed and some difficulty is experienced in getting the scanning mechanism back into step with that at the transmitter. This is solely a matter of the differential existing between the power required for maintaining the disc in rotation and that available for the maintenance of synchronization.

The writer has recently described in Radio Craft a novel system of amplification permitting the attainment of a high power output from small tubes. This system is known as PUSH-PUSH amplification and involves the use of two tubes in a push-pull connection but biased in such a manner that a slight plate current flows when no signal is impressed. The system is described quite thoroughly in the January 1932 issue of that publication and there is no necessity for repetition of the theoretical aspects of the matter at this time.

It is possible by this means to obtain from two type '10 tubes with a plate voltage of 600 and a negative bias of 50 volts an output of about thirty watts. This power output is far in excess of any heretofore employed in a television synchronizing system for receivers and the tubes used and their contributing apparatus are not such as to stagger the experimenter where costs are a large consideration.

In Fig. 1 there is shown the schematic circuit of the tuned input stage and the Class 'B' or "Push-Push" output stage together with the power supply. Inasmuch as the current drawn during the signal peaks is quite high, a mercury-arc rectifier tube has been used. The circuit is not such as to require any great explanation except in the case of the plate circuit of the '47 tube, where the transformer primary has been tuned to resonance at 1200 cycles. The constants of the circuit are such that this single circuit will serve to isolate the 1200-cycle scanning component from the image signals of higher and lower frequency. The transformers are designed throughout for this specific purpose and are thus of a specialized character.

The Driving System

The driving system as outlined in Fig. 2 consists of a simple variable speed motor together with its controlling rheostat. It is essential that the motor be controllable in the range about 1200 r.p.m. The synchronous motor designed for operation at 1200 r.p.m. from a 1200-cycle source is connected to the motor shaft through a simple mechanical filter consisting of a clock spring. This increases the synchronizing effect at the moment of coming into step and prevents hunting.

In designing a synchronous motor of (Continued on page 155)

These curves illustrate the difference in excitation effects between A.C. and D.C.
Points in Lens Disc Design

By SAUL SCHILLER
Television Optical Equipment Co.

The accompanying table is a handy guide for lens disc constructor.

Starting with column 1, the factors influencing the choice of the small or large disc should be weighed as follows: When it is necessary to build a compact television set, it is obvious that the 12" or 16" disc must be used. This is the tendency at the present time. Besides, the small disc decreases the mechanical difficulties, such as vibration and synchronization, and requires only a small motor. However, these mechanical features are sacrificed for the optical efficiency. For an equal size picture, the projected image of the 24" disc is not only closer to the disc by \( \frac{1}{2} \) the distance of the 12" disc, but it is 4 times as illuminated. This follows because the area of the aperture of the crater tube (see third column) used in conjunction with the 24" disc is greater by the ratio of

\[
\frac{\pi \times \left( \frac{.02}{2} \right)^2}{\pi \times \left( \frac{.01}{2} \right)^2} = 4
\]

Now the intensity of the arc in the crater tube is measured in candle power per square millimeter of the emitting surface. For example the Speed crater tube has a high intensity of .65 candle power per square mm. Then,

\[
\pi \times \left( \frac{.02}{2} \right)^2 \times (25.4)^2 \times .65 = \frac{12 \text{ candle power}}{12}
\]

represents the intensity of the .02" crater; and \( \frac{4}{4} \) of this \( = .03 \text{ candle power} \) the intensity of the .01" crater.

In column 2, only the diameters of the lenses are listed because in each case the focal length may fall within \( 1 \frac{1}{4} \) to 4" from the vertex of the lens. Either a bi-convex or a plano-convex lens may be used, but to facilitate mounting it is preferable to use the latter.

When specifying lenses, bear in mind that for a given image distance, the short focal length lens, e.g. \( 1 \frac{1}{2} \), will project a larger picture. This increased magnification which results from a powerful lens (25 dioptries) means that the screen is brought up closer to the disc than the 4" focal length lens (10 dioptries). However, in justice to the focal length lens, it must be stated that these lenses cut down a great deal of distortion (coma) which is caused by severe lateral magnification.

Fig. 1: how the lenses are ground away. Fig. 2: the ground lenses are mounted in this manner.

New Combination Broadcast-Television-SW Receiver

A COMBINATION receiver that may well be called the radio experimenter's ideal has been brought out by the Gold Seal Appliance Corporation, of East Newark, N. J. In a single handsome console cabinet are contained the following units: a television receiver, tuning from 160 to 200 meters and including a scanning disc, a synchronous motor and a framing device; a regular broadcast receiver tuning from 200 to 550 meters, with volume control and selective tone control; and a short wave converter tuning from 150 to 200 meters in conjunction with the broadcast chassis.

The television receiver occupies the lower right corner of the cabinet, the broadcast receiver the lower left section, and the short-wave converter the space just under the television screen, which our artist has embellished with the image of a pretty girl. When the television apparatus is not being used the screen is protected by a pair of hinged doors.

Needless to say, many interesting hours can be spent with this three-purpose instrument. Its owner can certainly never complain about not having something to hear or see at any hour of the day or night.

Correction Notice

The experimental cathode ray television receiver pictured at the bottom of page 70 of the May-June issue of TELEVISION NEWS was constructed by M. Rappoport in the laboratories of the Television Manufacturing Company of America, Brooklyn, N. Y. Mr. Rappoport is television research engineer for this company, to which the photograph should have been credited.
THE desire to see over some intervening distance is probably as old as time itself, although for our purposes we must discount the earlier claims as based upon necromancy. The present era of television can be well traced forward from the German patent granted to Paul Nipkow in 1884 (German Patent No. 30105) and which is the basis of most of the systems employed today. Nipkow's original specifications involved a system as shown in Fig. 1, where the overall arrangement will be seen not to differ widely from that as employed in the present-day "direct pick-up" apparatus. Nipkow employed a selenium cell which was connected by wire line to a windings which rotated the plane of polarization of light traversing a gas within its magnetic field. The similarity is obvious to those familiar with modern systems. Nipkow also covered the field quite well as regards the lens disc, both as used in projection apparatus and as used by the Bell Laboratories in their latest equipment, where a crater lamp rather than a flat plate lamp is employed, but where no attempt is made at a projected image.

As early as 1877 Sawyer proposed the use of an oscillating lens in the manner indicated in Fig. 2, where a photo cell of wide area is scanned by the light received from various points on the scanned scene.

Later, in 1880, Maurice Leblanc proposed the use of a pair of oscillating mirrors for the scanning motion (Fig. 3), one mirror providing the vertical scanning component at a rate of 500 cycles per second and the other the horizontal or image frequency component at a rate of about 12 cycles per second. Both these inventors were prior to Nipkow as far as their disclosures were concerned.

Marcel Brillouin in 1890 disclosed a lens disc which is almost identical with that in use today, as shown in Fig. 4. He also employed a system similar to that disclosed by Baird in England, in which the Nipkow disc was replaced by two parallel discs operating at different speeds, as shown in Fig. 5.

In the early 1900's Lazare Weiller developed the mirror wheel, as indicated in Fig. 6, in which the horizontal component of the scanning is provided by the axial motion of a series of mirrors and the vertical component by a slight angular offset of the successive mirrors in a manner outlined and used by both such modern investigators as Karolus and Alexander. In 1907 Boris Rosing developed a system such as is shown in Fig. 7, which is a combination of the Leblanc and Weiller ideas. Here the scanning is accomplished by utilizing cylinders of regular polygonal cross section, as indicated. The relative speeds of the drums depend upon the aspect ratio of the image and its structure as to number of scanned lines and frequency of repetition.

In all the foregoing the idea has been to floodlight the individual and to concentrate the reflected light on the photo cell, analysis of the scene being accomplished by the scanners as indicated. In 1910 in Sweden Elstrom put forward the idea of the "flying spot," the scanner being used to cause a minute spot of light to traverse the scene, reflected light being picked up by photo-sensitive devices. Elstrom's scanner followed closely the ideas of Leblanc as already indicated, but his device was a single mirror caused to oscillate in two planes at the required frequencies.

As we have noted briefly above, many of the modern investigators have produced little of novelty to add to the systems described. The advances of today are more along the lines of subsidiary apparatus. In recent issues of TELEVISION NEWS there have appeared descriptions of the cathode ray scanners as proposed by Zworykin, Farnsworth, Sabbath, von Ardenne and others. There is little actually new in this use of the cathode-ray tube, for both Rosing and Campbell-Swinton disclosed systems not unlike those now in process of development in so far as basic details are concerned.
Digest of Television Patents

This section does not pretend to be a complete review of the patent situation, as it changes from month to month. The patents chosen for review or for comment are those having the greatest value to the amateur or to the independent investigator from the standpoint of instructive value or general interest. Some are highly technical as to content while others are based entirely on constructional methods adaptable to the uses of the amateur.

Increased Image Size

Patent No. 1,800,057—Issued to H. P. Donle of Meriden, Conn. Issued April 7th, 1931.

In Fig. 5 there is shown a standard Nipkow disc in which the size of the received image (as formed in the plane of the disc) is governed by the circumference passing through the first aperture. In the Nipkow disc a thirty-inch disc is required for the reception of an image 1.5 inch wide. Figs. 6 and 7 give Mr. Donle's idea of a disc combination quite similar in some respects to the Jenkins drum and shutter. By dividing the total of 48 apertures into twelve groups of four each and by employing an eccentric shutter as shown in the latter figures it is possible to obtain an image having any dimension four times that of the original disc and thus having sixteen times the area. The shutter rotates at one-twelfth the speed of the scanning disc.

Film Scanner


This patent covers a special type of film scanner in which an enlarged image of the film is projected onto a scanning disc having correspondingly enlarged apertures. This permits of a greater distance between film and disc than was hitherto possible and allows a greater degree of image detail, since the aperture effects so pronounced with a tiny scanning aperture are removed. The disc has apertures arranged about a single circumference rather than in the usual spiral, since the vertical scanning component is provided by the continuous downward motion of the film. A light source and the requisite concentrating devices are shown together with the projection lens "D" which forms an enlarged image of the film in the plane of the scanning disc.

Slotted Disc

Patent No. 1,801,756—Issued to Frank Morse Robb of Belleville, Ontario, Canada. Patented April 21, 1931.

This invention relates to a substitute for the usual form of television scanning disc such as to permit the reception of a much larger image for a given diameter disc than is possible with the usual Nipkow disc. In this respect it has much in common with the usual drum-and-shutter arrangements and their ilk. Fig. 8 shows a driving motor, a mechanical transmission or speed reduction such as to permit the two discs shown to rotate at differing speeds, a light source and a viewing lens. Figs. 9 and 10 show the two discs and the manner of their construction.

It will be noted that slots are provided rather than apertures and that the number of slots is fewer than the number of apertures normal to a scanning disc. In the figure eleven slots are shown. The angle subtended by each slot is therefore 36° and the distance on the circumference cutting the outer end of each slot subtended by adjacent slots gives the upper dimension of the received image. From this we may determine the height of the image and at the same time the pitch of the spiral slot cut in the disc shown in Fig. 9.

The rotational speed of this disc (Fig. 10) is determined by the picture frequency (assumed as 30 per second) and is 1200 r.p.m. The slotted disc, having but one sixth the slots as compared with the number of desired apertures, must rotate at six times this speed—or 7200 r.p.m.; if the disc be given 20 slots a speed of 3600 r.p.m. may be used. We have thus obtained by means of the two discs and the rotational difference an equivalent of the Nipkow disc which permits of a much greater image size within a small space.

Improved Drum Scanner


This is an improvement on the patent wherein a great deal of light was entailed by the small size of the neon tube plate relative to the size of the image obtained. As shown in Figures 1 and 2, small quartz rods are brought to the center of the drum from each aperture on the drum surface. These rods have the property of transmitting undiminished, along their length, light produced at one end. Do not be misled into the idea that light may be concentrated by a cone shaped quartz arrangement as many investigators have claimed; this is a fallacy of the first order. The commutation arrangement as shown in Fig. 3 is such as to short circuit the two unused portions of a triple element neon discharge tube. This system was developed commercially by the Jenkins interests prior to the adoption of the drum-and-shutter which was finally marketed.
Increasing Motor Power

E. C. Burr,
376 Springfield Ave.,
Summit, N. J.

Thanks for your reply to my questions regarding scanning discs. Instead of the motor you suggested I made another type which consists of a \( \frac{3}{2} \)" wood wheel \( \frac{3}{4} \)" thick. Six slots \( \frac{3}{4} \)" deep around the circumference are filled with silicon steel laminations and the whole runs in the field of a "U" shaped laminated pole piece. Each field coil is wound with 600 turns of No. 22 enamel wire. When brought to speed this motor will run at 1200 r.p.m. but will not carry a 16" disc. Can I modify the design to give more power?

Answer:
If you will experiment with various coupler values across your motor until you find the value giving resonance at 60 cycles, the effective "ampereturns" of your magnet will increase sharply. This will give the desired power increase.

Lofin-White Amplifier for Television

Mr. Frank Simon,
Ford du Lac, Wis.

Please inform me if the accompanying Lofin-White modification based on the circuit in the March-April issue of Television News is O.K.

Answer:
No! The Lofin-White amplifiers have their intermediate filament circuits (your first 10 tube) high with respect to ground by an amount equal to the desired plate voltage of the first tube plus the grid-bias of the second tube. This cannot be accomplished save where one tube is of the "heater" type. Your circuit is ingenious but not workable unless you wish to substitute some of the new automobile tubes (heater type) in the circuit or float one filament into the circuit on a separate battery.

Gas Engine Drive

Ben Benson,
Inwood, Manitoba, Canada:

I have learned a lot about television through Television News, but because of my present situation I must ask for special assistance. I intend building a television receiver and scanner but we have no A. C. or D. C. power supply here. I have no current to drive a motor but have a 4 1/2 horse gal. gas engine which could possibly be geared to 1200 r.p.m. Would this be O.K. for driving the disc? If not, how can I possibly receive television images?

Answer:
You are not as lost as you might be. I know of one television fan in England who drives his disc from a water wheel. The only possible chance I see for you, however, is to use your gas engine with a 32 volt generator and storage batteries. That will give you a home lighting plant to start with. Your television motor can then be used either to drive the disc through a friction drive of the type shown on page 22 of the March-April 1932 issue. To go further you can use a converter to give 110 volts A.C. from 32 volts D.C. so as to have a power source for an A-V type. I'm sorry, but it all runs into big money.

Photo Cell Control Circuit

R. A. Dickinson,
West Somersel, N. Y.

I would like a list of material and diagrams to construct experimental apparatus whereby a photo cell will serve to control the output of an induction coil.

Answer:
I presume that by an "induction coil" you mean a transformer. This can be done by employing two transformers in series—one feeding the equipment you wish to control and the other a pair of 50 vacuum tubes having a photo cell so arranged as to vary the current drawn by the tubes in proportion to the light incident upon the cell. The plate transformer will then act as a rheostat in series with the transformer you wish to control—that is, within limits. The circuit arrangement is given herewith.

Screen Material

A. Willman,
490 Madison Ave.,
New York, N. Y.

Please tell me what type of screen is best suited to use with a lens. A glass supply house informs me that several kinds of ground glass are available. One is the usual form ground or one side only and the other, a better type, ground on both sides. Would a thickness of \( \frac{1}{8} \)" be correct?

Answer:
Use glass ground on one side only and as thin as can be obtained. Shoot the ray at the ground side of the glass.

A Hint to Lens Users

The small lenses used in lens scanning disc unavoidably pick up many fine marks while they are being handled. Many experimenters neglect to clean them off, and as a result are troubled with weak or diffused rays of light. Use only very soft cloth for wiping the glass. The best thing is an eyeglass wiper such as every optician gives away with the dozen.

Edited by C. H. W. Nason

John Englefield,
Larchmont, N. Y.

Please give me the information regarding the tuning coils in the Traveler Television Receiver as shown in the February issue of Television News, also the value of the small coil in the detector plate circuit and the value of the resistance between the detector cathode and ground. What are the tuning coils in the Pioneer Television receiver shown in the April issue?

Answer:
As I have seen neither of these receivers I can give you is my own "dope" for similar usage. For the detector biasing resistance use about 25,000 ohms, and for the plate circuit choke a Hammond 0.45 millihenry. The capacity-coupled circuits in the Traveler set would use trick honeycomb coils which you could not duplicate, so forget about them. For the Pioneer job using 0.0015 condensers wind 32 turns of No. 22 silk enamel wire or \( \frac{1}{4} \)" tubing for secondaries. For the primaries use about 15 turns for the antenna coil and 35 turns for the interstage coils wound over the secondary and separated by glassine paper.

Mr. Simon's Lofin-White amplifier, which he built for television work, but which is not suitable for the purpose for the reasons given by Mr. Nason.
Cathode Ray Television
(Continued from page 121)

from the descriptions thus far given; but it is by no means impossible that such an action takes place. At any rate the most prominent novelty of the Farnsworth process seems to lie in this cathode.

In Fig. 5 is depicted a Farnsworth transmitting tube. At the left end we recognize the wires leading to cathode C and anode A, while at the other end is placed a plane closing disk, in front of which is the small photo cell, the wires leading from which are in the little tube put on at the side. The cylindrical part of the tube is surrounded by a sort of cage, which is made of coils through which saw-tooth alternating currents flow. The coils are almost rectangular in shape. Under the influence of these currents the entire electric image moves away through the opening in the small photo cell. In this manner the scanning is obtained.

In the receiver Farnsworth uses a similar glowing-cathode tube, of the kind previously described. The most important parts, the cathode and anode, are represented in Fig. 6, much enlarged. The tube is operated with about 1500 to 2000 volts. The tube-shaped anode is closed in front of the cathode, but between the two lies a ring-shaped grid R, which serves for controlling the brightness of the cathode rays and to which accordingly the flowing fluctuations in potential are conducted. In general the electron ray is guided over the luminous screen of the tube in the manner already described.

Synchronizing Means

For synchronizing the currents effecting the scanning in the transmitter and receiver Farnsworth uses the impact of potential on the pictorial frequency circuit. The impact sets in through the sudden going back of the current; e.g., in Fig. 5 and arranged in such a way that the light spot being returned from bottom to top is cast completely outside the picture field, so that no loss of interference sets in.

For transmitting the pictorial currents Farnsworth has used both telephone connections and also 4-meter radio waves. In the wave experiments distances up to 50 miles are said to have been bridged. Up to this distance serviceable television is possible with cathode rays, presupposing that all transmitting disturbances are avoided and that the ground wave, which also enters into question here, is strong enough. Here use of an ultra-short wave is absolutely necessary, as on account of the high number of radio elements in a very great breadth of frequency band is required, namely, no less than 300,000 cycles. Such a band, however, is impossible in the field of ordinary radio waves. It is available only in the quasi-optical waves.

Farnsworth in this connection is (Continued on next page)
st. Charles

on the Boardwalk
An Entire Block
ATLANTIC CITY

A Smart Hotel in America’s Smartest Resort

Our platform "points with pride" to the comfort and satisfaction enjoyed by guests of the St. Charles. It "views with alarm" your failure to take advantage of the attractive rates, superior meals, daily radio concerts, and good fellowship, which have won a world-wide vote of approval from St. Charles guests. "Vote early" for your summer coast of tan and surf bathing direct from the St. Charles. Here's your summer visit to this famous hotel as often as you can.
Television In France
(Continued from page 126)

have 60 or 100 mirrors, its dimensions become prohibitive. Barthelemy has found an ingenious solution which permits great reduction of the number of mirrors; e.g., in place of 60 mirrors, Barthelemy gets the same result by using 10 revolving mirrors and 6 stationary mirrors. Of course the same system can be used for transmitting or receiving. In transmitting he uses indirect analysis in receiving, a crater lamp.

Let us see how the optical analyzer works:
The luminous ray first meets a revolving mirror, say mirror No. 1, and next it meets a fixed mirror, A. The arrangement of mirrors 1 and A is such that the luminous point describes on a screen (now the subject to be televised) a horizontal line 1. Next, the luminous ray, still reflected by revolving mirror 1, meets fixed mirror B, whose inclination and position are such that it traverses on the screen a second line 2, and so it goes down to mirror F.

Arrangement of the parts in the Barthelemy television

At this moment the luminous ray is taken up by revolving mirror 2 and fixed mirror A. The point traces then line 7. Still reflected by mirror 2, it traces line 8, to fixed mirror B.

To sum up, revolving mirror 1 traces the first six lines, revolving mirror 2 lines 7 to 12, mirror 3 lines 13 to 18, etc., until mirror 10, which traces lines 85 to 90.

At this moment the whole image has been analyzed and the cycle begins again.
A turn of the moveable wheel equals a complete analysis of the image.

Induction Brake
(Continued from page 195)

bent out of carefully heated soft iron about 1/4 inch thick and 3/4 inch wide according to the illustration. The connection bolt of 1/4 inch round iron is turned down on both sides to .36 inch diameter, at the right at .8 inch length, at the left .24 inch. The right part is given a 1/4 inch thread. With the short end the bolt is riveted to the left arm of the magnet while the right arm with a 3/4 inch thread is screwed onto the core, putting in between a washer .04 to .08 inch thick. This serves to adjust the distance of the poles to .04 or .08 inch, according to the more or less even course of the disc. The length of the core depends entirely on the winding to be put on it, and the dimensions of the large mirror depend again on the strength of the braking current available. From 100 to 200 amperes-turns will suffice.

The brake operates perfectly free from impact, elastically, and without any wear. The heating of the Nipkow disc produced by the eddy currents is so slight that in practice it can be neglected.

Cathode Ray Tubes

The untold possibilities of cathode ray technique are now thrown open to you. For the first time there is offered a line of practical, efficient cathode ray tubes well fitted in reach of any pocketbook. For example:

S-14 Type in glass envelope similar to usual 45 power tube. Single set of deflecting plates. Suggested for such uses as voltmeter, ammeter and resonance indicator, or any form of wave analyser.

Price: $7.50.

Globe line of cathode ray tubes also includes silver anode type in 5" and 9" sizes, and deflecting plate type in 5" and 9" sizes. Special types and sizes built to order.

Write for literature describing the complete line of Globe cathode ray tubes, as well as television receivers, lens discs, cathode ray plate lamps, and motors, for living room, experimental and laboratory uses.

Globe Television & Phone Corp.
185 Devonshire St.,
Boston, Mass.

PRECISION

THE field is ripe now for television and Short Wave inventions. Why not take advantage of this popular interest and cash in on any inventions that you now have.

For 25 years this company has specialized exclusively in development work and production of precision apparatus, instruments and light equipment. Close cooperation gives clients developing experimental designs a call at our plant and discuss your requirements. Or, if you live outside of New York write us, and we will be glad to help you.

Manufacturers' & Inventors' Electric Company
225 West Broadway
New York City

Cathode Ray Tubes
Photo Electric Cells
Light Sources

Experimental Vacuum and rare gas tubes for any requirement made to your specifications.

Inquiries solicited.

Soles Light Company
Research Laboratories
5064 Broadway, New York, N. Y.
What Wouldn’t You Do for Them

Yet you may be overlooking the most vital thing of all for their future security and happiness—Money! If you were taken away tomorrow, what would they have to live on? Could the children go on through school? Could mother earn enough for them?

Life insurance is now sold by mail at so small a cost NO ONE need be without its splendid protection. We now offer a special old line, legal reserve life policy for as low as $4.13 at age 35 (other ages in proportion)—a policy paying you $1,000, with an additional $5,000 special travel accident benefit; disability benefits, loan values, and other advantages. Think of it! No family can afford to be without such protection, at so trifling a cost.

We sell entirely by mail, hence these savings—no agents’ commissions, no medical fees, no extras, no red tape. YOU save the difference.

Mail the coupon below. We will send you a free sample policy which you can judge for yourself. If you like it, keep it. If you don’t, there’s not a cent of cost or obligation.

For your own peace of mind, for the security of those you love, get this low-cost protection while you CAN.

Mail the coupon now.

FREE! Mail this coupon TODAY for sample policy and complete details.

Union Mutual Life Company of Iowa, (Box 214)
Des Moines, Iowa.

Send me above described Free sample policy and complete details—this is not to obligate me in any way.

Name __________________________
Address _________________________
Age ______ Occupation _______

CALL or SEND your SKETCH or Simple Model for Confidential Advice

TELEVISION

As pioneers in experimental and development work in every branch of the television field, including lens-disc projection equipment, cathode ray apparatus, ultra short-wave receivers, etc., many of our products are now available to the public at moderate cost.

Many new products in process will be marketed as rapidly as developed.

TELEVISION MFG. COMPANY
OF AMERICA, NEW YORK

Constant Speed Scanner

(Continued from page 139)

employed had 8 teeth. A pair of magnet coils are mounted on an iron core and placed, with respect to the rotor, as shown in the diagram. The magnets are energized by a direct-current source supplied by means of a transformer, rectifier and filter. The filter need not be large; a 10- to 30-henry choke at CH and 1 mH at C will be more than sufficient, since the ripple in the D.C. is of little importance. The amount of current flowing in the magnets is controlled by a 20,000-ohm resistor R1.

The magnet coils may consist of 1000 turns of No. 32 enamelled wire on each leg. The size of the core will depend upon the diameter of the rotor which, however, should not be too large. The rotor employed had a diameter of 1 1/2" and was 3/8" thick. The core should be of a size which allows a very small clearance between the core and rotor teeth; 1/8" in the case of the model.

It should be possible to procure a core from a defunct audio amplifier transformer and cut it with a hacksaw to get the proper size and shape.

The adjustments are simple. First adjust the speed of the motor slightly greater than synchronous speed, then bring the speed down by an adjustment of the magnet resistor R1. If the line-voltage should rise, the speed of the motor will increase. At the same time the current through the magnets will increase, causing a greater breaking action upon the shaft; thereby automatically holding the disc at a constant speed. If the line-voltage should decrease, the motor speed also decreases as well as the energy through the magnet coils, again keeping the disc at constant speed.

A few trials will determine just where to set the controls to obtain constant speed at varying line-voltages between 100 to 130 volts.

—Ralph William Tannen.

Double Disc Scanner

(Continued from page 132)

down to the next level. Double scanning!

The speed at which the picture is scanned, that is, the width of the "slice" covered by each slot, may be controlled. To give a comparison, we know that with the usual round hole scanner the next hole to go over the picture is set the width of the hole below the preceding one; therefore the width of each slice is definitely fixed. With the slot scanner, the width of the slice may be controlled by varying the speed of one of the discs.

Figure 1 shows the construction of the discs. Both discs are made exactly the same; when they are being used, reverse one so that the slots pass each other at right angles.

The front disc must be turned at a speed sufficient to give persistence of vision, while the rear disc does the scanning. The discs should be mounted as close to each other as possible without touching; otherwise the light will spread between discs, and the diffused light will produce poor delineation.

TELEVISION NEWS

July-August, 1932
lighted studio, for outdoor pick-up, etc.

Third—a great deal of successful development has been made with the cathode-ray tube system for transmission and reception. This system has proven technically sound and shows the greatest possibility. Its chief difficulties are in the production of large quantities of these systems at a reasonable cost.

Fourth—the television broadcast transmission spectrum allows only for five channels, namely: 2000-2100 kc., 2100-2200 kc., 2200-2300 kc., 250-2850 kc., and 2860-2950 kc. This frequency spectrum is not adequate for good picture transmission on account of the very wide frequency band necessary for picture detail, so in addition to these bands, on the extreme short waves 6-7 meters, frequencies from 38000-80000 kc. have been requested for television service. Most of the present transmitters are operating in the first mentioned bands, but a few operate in the neighborhood of 46,000 to 48,000 kc.

Fifth—the reception of television has been made possible by tuning with either a superheterodyne or a tuned radio frequency receiver designed for television reception. Synchronized sound very often accompanies the picture transmission and it is common practice to receive the voice transmission on the standard broadcast receiver. This requires two receivers for receiving synchronized sound and picture transmission. In the television receivers, mechanical scanning and cathode-ray electrical scanning have been employed. The cathode-ray type of scanning has been capable of excellent results and shows great possibilities for further development.

Sixth—with the present economics of broadcasting it has been impossible to secure much data on the entertainment value of the subjects that can be broadcast due to the cost in presenting programs. The Federal Radio Commission has up to the present time considered television only experimental and will grant no commercial rights. This means that all broadcasting must be done for the experimental value only and no paid programs can be transmitted by television. This ruling has made impossible the receipt of any money in staging television programs. With commercial rights granted by the Federal Government, the problem will be complicated as to whether advertisers will continue to assume the increased costs that television imposes for its successful operation, or whether the public can satisfactorily be taxed to bear this burden.

"Many problems appear which must be overcome before television can be a satisfactory means of home entertainment. The most important of these are listed as follows:

An Effective Synchronizer

The "phonie wheel" type, the number of poles depends upon the frequency of the supply and whether or not a direct-current energizing force flows in the motor field windings. In this particular case it seems advisable to supply A.C. alone to the windings, as no particular benefit will accrue from the use of a D.C. energizing force. The number of poles is obtained by dividing the number of current impulses per second by the rotational speed expressed in revolutions per second.

1. Greater detail should be obtained in received picture.
2. Television transmission equipment should be portable and as easily used as present day sound picture pick-up equipment.
3. Transmittings systems must be evolved which will have a satisfactory and reliable service range.
4. Receivers as simple in operation as our present radio receivers must be designed and built at a reasonable cost.
5. Quiet and satisfactorily illuminated picture equipment for the home must be designed and built at a reasonable cost.

"Regardless of the present problems that confront the industry there has been enough work done to justify some predictions which can be conscientiously made. With the development of the new short-wave channels at frequencies higher than 35,000,000 cycles, reliable transmission of television can be predicted. Ample room for an adequate number of transmitting stations can be visualized in this short-wave region. It is perfectly conceivable that a sight and sound service can be worked out to be received on a single receiver with a simplified tuning and control mechanism."

FOR EXPERIMENTAL PURPOSES

PARTICULARLY DESIGNED FOR MODULATION WITHOUT CHANGE OF FOCUS.

AVAILABLE FOR EITHER CAPACITIVE OR MAGNETIC DEFORMATION.

PROMPT DELIVERY

PRICES ON APPLICATION

Shortwave and Television Corporation

70 Brookline Avenue
Boston, Mass.

Owners and Operators of

Television and Sound stations WIXAV and WIXAU.

Ultra Short Wave station WIXG.

Operators of

International Short Wave station WIXAL.

Cathode Ray Television Tubes

4½ inches 6 inches
7 inches 9 inches
From The SIMPLE To The Intricate

From a 1-Tube Receiver to a 3-Tube Super-Het. This book covers none of the popular Short Wave Receivers now in operation by Short Wave enthusiasts.

Every Short Wave Enthusiast Should Have a Copy

MAIL COUPON NOW!

SHORT WAVE CRAFT
86-98 Park Place,
New York City.

Gentlemen:

I enclose herewith fifty (50c) cents for which please send me a copy of your book, HOW TO BUILD AND OPERATE SHORT WAVE RECEIVERS. (Send money order, check, or cash, or new U. S. Stamps. Register letter if it contains currency or stamps.)

Name
Address

The book has been edited and prepared by the editors of SHORT WAVE CRAFT, and contains a wealth of material on the building and operation, not only of typical short wave receivers, but short wave converters as well.

Dozens of short wave sets to be built will be found in this book, supplemented by hundreds of illustrations; actual photographs of sets built, book-ups and diagrams galore.

Small Ideas May Have Large Commercial Possibilities

If you hope to realize profits from your invention, you must protect it with a U. S. Government Patent. Otherwise you may find that all your time and labor have been lost, because it often happens that other inventors are working on the same idea. IF YOU HAVE AN IDEA, TAKE STEPS TO GET A PATENT AT ONCE! Your first step is to get my FREE BOOK. It is written in simple, plain language just what you must do, how you must proceed in order to secure Patent protection.

I Serve You in Secrecy

You can communicate with me in perfect confidence. Any drawings, sketches or letters you send me will be kept in strict, steel, fireproof file, that is accessible only to authorized members of my staff.

I have served inventors located in every state in the Union. My service is prompt, careful, efficient. Your first step—the more you should make today—is to SEND THE COUPON FOR MY FREE BOOK.

Clarence A. O'Brien
Registered Patent Attorney
WASHINGTON, D. C.

Partial List of Contents

- How to Operate a Short Wave Receiver
- How to Build Various Types
- How to Build the 6-W. Superregenerate
- How to Use a Separate Regeneration Gate
- How to Tune Less Plug-in Coils
- How to Use Radio Frequency Chokes
- How to Make 6-W. Superregenerative Receivers

FREE, if you act promptly I will send you this valuable Record of Invention, blank and sheets, that will help you to preserve your right to your invention later on.


Please send me your free book, "How to Obtain a Patent," and your "Record of Invention" (form without any cost or obligation on my part)

Name
Address

(Important—Write or print plainly)

the device is far superior to the usual models available.

Parts List

- L1 Special 250 m.a. choke
- T1 1200 cycle input transformer
- T2 Special 1200 cycle output transformer
- T3 Special Mercury 80 Power transformer Polymet
- C1 1 mf. 1000 volt Condenser Poly C-971
- C2 Special Resonating Condenser in Transformer case
- C3 1 mf. 1000 volt Condenser Poly C-972
- C4 1 mf. 200 volt condenser Polymet C-904
- C5 1 mf. 20 volt Condenser Polymet C-904
- R1 500,000 ohm gain control Electrad
- R2 400 ohm Resistor Electrad
- R3 1000 ohm adjustable tap resistor or Electrad

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of Television News published Bi-Monthly at New York, N. Y., for April 1, 1932.

Robert D. C., Secretary
Clarence O'Brien, Treasurer

Sworn to and subscribed before me this 1st day of April, 1932.

(Signed) J. D. CURTIS

Editor and Publisher.

Sworn to and subscribed before me this 1st day of April, 1932.

(Signed) JOSEPH H. KRAFTS

(My commission expires May 30, 1933.)

NOTARY PUBLIC

Queens County Clerk No. 2206.
Queens County Reg. No. 7475.

Y. County Clerk No. 35987.
N. Y. County Clerks No. 601.

www.americanradiohistory.com
TELEVISION TIME-TABLE

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

<table>
<thead>
<tr>
<th>Location of Transmitter</th>
<th>Lines and F.P.S.</th>
<th>Call Letters</th>
<th>Frequency in kilocycles (meters in parentheses)</th>
<th>Power (watts in antenna) Licensee and Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>California:</td>
<td></td>
<td>W6XAH</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>1,000 Pioneer Mercantile Co., 1525 Twentieth St. Don Lee (Inc.)</td>
</tr>
<tr>
<td>Gardens (near)</td>
<td></td>
<td>W6XS</td>
<td>2,100 (142.9) to 2,200 (136.4)</td>
<td>500 Don Lee (Inc.)</td>
</tr>
<tr>
<td>Los Angeles</td>
<td></td>
<td>W6XAO</td>
<td>43,000 (6.97) to 46,000 (6.52)</td>
<td>Don Lee, Inc.</td>
</tr>
<tr>
<td>Illinois:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicago</td>
<td>45-15</td>
<td>W6XAF</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>1,000 Chicago Federation of Labor.</td>
</tr>
<tr>
<td>Downers Grove</td>
<td>24</td>
<td>W6XAO</td>
<td>2,100 (142.9) to 2,200 (136.4)</td>
<td>500 Western Television Corp., 6122 W. Armitage Ave.</td>
</tr>
<tr>
<td>Illinois:</td>
<td></td>
<td>W9XG</td>
<td>2,750 (109.1) to 2,850 (105.2)</td>
<td>1,500 Purdue University, 400 Northwestern Ave.</td>
</tr>
<tr>
<td>Iowa:</td>
<td></td>
<td>W9XAZ</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>500 State University of Iowa</td>
</tr>
<tr>
<td>Maryland:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver Springs</td>
<td>50-20</td>
<td>W3KX</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>5,000 Jenkins Laboratories, 1511 Connecticut Ave., Washington, D. C.</td>
</tr>
<tr>
<td>Massachusetts:</td>
<td></td>
<td>W9XJ</td>
<td>1,600-1,700 kc.</td>
<td>1,000 Shortwave and Television Laboratory.</td>
</tr>
<tr>
<td>New Jersey:</td>
<td></td>
<td>W6XAD</td>
<td>2,000 (142.9) to 2,200 (136.4)</td>
<td>500 R. C. A. Victor Company (Inc.)</td>
</tr>
<tr>
<td>Pennsylvania:</td>
<td></td>
<td>W6XAD</td>
<td>43,000 (6.97) to 46,000 (6.52)</td>
<td></td>
</tr>
<tr>
<td>Passaic</td>
<td>60</td>
<td>W6XCD</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>5,000 De Forest Radio Co.</td>
</tr>
<tr>
<td>New York:</td>
<td></td>
<td>W6XDR</td>
<td>2,750 (109.1) to 2,850 (105.3)</td>
<td>500 United Research Corp., 6 Van Pelt Ave.</td>
</tr>
<tr>
<td>New York:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York:</td>
<td>45-15</td>
<td>W6XRF</td>
<td>2,100 (142.9) to 2,200 (136.4)</td>
<td>500 Radio Pictures, Inc., 2194 Northern Blvd.</td>
</tr>
<tr>
<td>New York:</td>
<td></td>
<td>W6XRS</td>
<td>2,000 (142.9) to 2,200 (136.4)</td>
<td>5,000 National Broadcasting Co., (Inc.), 711 Fifth Ave.</td>
</tr>
<tr>
<td>New York:</td>
<td></td>
<td>W6XRS</td>
<td>15,000 (6.97) to 46,000 (6.52)</td>
<td>2,000 Jenkins Tel. Corp., 655 Fifth Ave.</td>
</tr>
<tr>
<td>West Lafayette</td>
<td>W9XG</td>
<td>2,750 (109.1) to 2,850 (105.2)</td>
<td>1,500 Purdue University, 400 Northwestern Ave.</td>
<td></td>
</tr>
<tr>
<td>Wickliffe</td>
<td>45</td>
<td>W9XJ</td>
<td>1,600-1,700 kc.</td>
<td>1,000 Shortwave and Television Laboratory.</td>
</tr>
<tr>
<td>Wisconsin:</td>
<td></td>
<td>W5KD</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>28,000 General Electric Co.</td>
</tr>
<tr>
<td>West Lafayette</td>
<td>W9XG</td>
<td>2,750 (109.1) to 2,850 (105.2)</td>
<td>1,500 Purdue University, 400 Northwestern Ave.</td>
<td></td>
</tr>
<tr>
<td>New Jersey:</td>
<td></td>
<td>W5KD</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>250 Jenkins Television Corp.</td>
</tr>
<tr>
<td>New Jersey:</td>
<td>60</td>
<td>W5KD</td>
<td>15,000 (6.97) to 46,000 (6.52)</td>
<td>500 The Journal Co., (Milwaukee Journal Co.)</td>
</tr>
<tr>
<td>W6XAD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PORTABLE</td>
<td></td>
<td>W5KD</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>250 Jenkins Television Corp.</td>
</tr>
<tr>
<td>Bound Brook</td>
<td>W6XAK</td>
<td>2,100 (142.9) to 2,200 (136.4)</td>
<td>500 National Broadcasting Co., Inc.</td>
<td></td>
</tr>
<tr>
<td>New York State:</td>
<td></td>
<td>W6XBT</td>
<td>43,000 (6.97) to 46,000 (6.52)</td>
<td>750 National Broadcasting Co., Inc.</td>
</tr>
<tr>
<td>United States:</td>
<td></td>
<td>W6XBG</td>
<td>2,000 (150) to 2,100 (142.9)</td>
<td>250 Jenkins Television Corp.</td>
</tr>
<tr>
<td>United States:</td>
<td>60</td>
<td>W6XBG</td>
<td>8,000 (5.97) to 10,000 (5.75)</td>
<td>250 National Broadcasting Co., Inc.</td>
</tr>
</tbody>
</table>

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

The DATAPRINT Company
Loch Box 322
RAMSEY, N. J.

“SESSIONS”
8 DAY ALARM CLOCK

A thing of charm and beauty. You or your friends will be proud to own one. A unique refinement in the conventional alarm shuts-off—merely tap the button at the top. Even on dark mornings you need never squeeze for the shut-off. The base is perfectly balanced. The bottom is cushioned to prevent scratching of polished surfaces.

Polished nickel case Metal dial with a glossy satin-silvered finish. Numerals are large, raised on the dial, in gold bordered black. 6½ inches high, 5½ inches wide. "Breaks the day, but not the peace of mind."

SPECIAL PRICE, Parcel Post prepaid, East of the Rockies $2.95 West of the Rockies $3.20 With Radium Dial $3.95

Gold Shield Products Co.
Dept. TN.
112 Chambers St.,
New York City

DATAPRINTS!!
ARRIVED AT LAST!

Blueprint Construction Data for Building Apparatus that many amateurs have longed to own, but lacked the Construction Data. How to build 1/16 H. P. 110 volt A.C. 60 cycle motor (recordable for Televisions) $1.50
How to build 60 cycle Phonograph Wheel $1.00
Data for a 1,200 volt Phonograph Wheel $1.00
Data for powerful battery electric motors $1.00
Data for 115 volt, D. C. motor to lift 50 pounds through 1 inch $1.00
Data for 110 volt, D. C. Solenoid to lift 50 pounds through 1 inch $1.00
Data for 12 volt, D. C. Solenoid to lift 50 pounds through 1 inch $1.00
Data for 30-36 inch spark rattle in many model cars $1.00
Data for 5 to 50 pounds weight (primary and secondary, capacity size and voltage $1.00
Data for 5 to 50 pounds weight (primary and secondary, capacity size and voltage $1.00

Home Refrigerating Machines $1.00
Electrical transformers (recordable voice or silent wire) $1.00
10 Volt operating lamps $1.00
10 Television operating lamps $1.00
10 Telephone operating lamps $1.00
10 Television operating lamps $1.00
10 Telephone operating lamps $1.00
10 Telephone operating lamps $1.00
10 Telephone operating lamps $1.00
10 Telephone operating lamps $1.00
10 Telephone operating lamps $1.00
10 Telephone operating lamps $1.00
10 Telephone operating lamps $1.00
10 Telephone operating lamps $1.00
Synchronizing With the Thyratron Tube

(Continued from page 133)

minute, the output of the generator portion is sixty cycles. If there should be a variation in speed from 1200 R.P.M., there will be a corresponding change in the frequency output of the generator. If we should use a thyratron operating as a rectifier to supply the field current of the D.C. motor portion of the dynamotor, the amount of this current being determined by a bridge circuit which is sensitive to small changes in frequency, we will have a good frequency control. Now let us consider the circuit in Fig. 2.

The grid voltage is supplied from the midpoint of an alternating current bridge, each of which are connected across the output of the generator. The lower two arms of the bridge are the coils of the secondary of a transformer, thereby utilizing an arm of the bridge to supply alternating current for rectification in the thyratron. The output of the thyratron is then connected across the field rheostat of the motor so that it supplies a portion of the field current of the motor.

In order for the thyratron regulator to operate, there must be a change in speed from normal. Let us say that the motor slows down, then the frequency of the alternator will decrease. This change in frequency changes the phase of the grid voltage and the output decreased, thereby decreasing the field current of the motor, which speeds it up immediately. This method, although quite simple, is not so very sensitive.

Second Method

Another method which I have found to be extremely sensitive is the one shown in Fig. 3. In this circuit, the grid voltage phase is shifted by means of an alternating current bridge with three resistance arms and an arm containing resistance, capacitance and inductance.

If the tuning arm is tuned to a frequency slightly above sixty cycles, then at sixty cycles the inductive and capacitive reactance drops will nearly annul each other and the voltage across the tuned arm will practically be an IR drop. If the frequency should decrease, there will result a large unbalance, capacitive drop thus changing the phase of the grid voltage considerably. This method of controlling the phase of the grid voltage is extremely sensitive. If the terminals of the bridge are properly arranged, then a decrease in frequency will retard the phase of the grid voltage and as a result decrease the thyratron output. The decrease of the thyratron output results in a diminution of the motor field current and the dynamotor consequently speeds up until the conditions are balanced. This balance occurs when the speed of the dynamotor is the least bit below normal, since the device operates on a change of speed.

By proper tuning of the bridge circuit and using the incoming signal from the television transmitter, a direct current motor may be run at synchronous speed and in synchronism with the transmitter.
GET A CONVERTER FREE!

HERE at last you have it—a highly sensitive short-wave converter, 15 to 200 meters, that works on any set and that has its own A, B and C supply built in and that does not use plug-in coils for band shifting.

Two separate tuning condensers and two dials are used, so there can be no possibility of sensitivity loss due to mistuning, as where ganging prevails. Also, any intermediate frequency may be used.

The little extra effort in tuning is well repaid by thousands of miles of extra reception. Stations all over the world have been tuned in, using this converter with a good broadcast set.

There are only three connections to make in teaming up the converter with a receiver.

Two coils are used, one for oscillator, the other for modulator, and two tube sockets are near these coils, underneath the top panel, not for tubes but so that you can move the flexible grid connecting wire of the two condensers to any one of four points for wave shifting. Simple, effective, inexpensive, infallible!

Three 227 tubes are used. These are of the automatic series and are most economical, the total consumption, A and B power being less than 10 watts, hence costing no more than one-tenth of a cent per hour to operate.

This converter works on superhetodynes as well as on tuned radio frequency sets, because IF ANY CONVERTER IS A GOOD ONE IT IS BOUND TO WORK ON ANY TYPE OF SET.

There are 16 mfd. filter capacity and a 15 henry B choke, in the B supply, as well as a husky line transformer.

Do not suppose just because the offer of these parts is generous that this converter does not perform efficiently, for it is a knockout! What sensitivity! What power! What results! Send $12 today for a 2-year (104 issues) subscription for RADIO WORLD and get the parts for this converter free (less tubes). Order PR-NCV. A clear diagram is furnished with each kit. Note the kit is not wired. Shipments made by express at your expense. Order Cat. R-CNV.

TUBES USED: Three 227, supplied extra at $3.50, if desired. No subscription offer attaches to the tubes.

PARTS FOR A MIDGET CONVERTER

No matter what type of broadcast receiver you have, you can get short waves by using a midget short-wave converter built of parts we can supply. The panel is only 5 x 6 1/2 inches. There is only one tuning control. No squelch, bowie or body capacity. This model is available for battery operation and uses three 227 tubes with heaters in series. Full details supplied with order.

All parts for the battery model (less three 227 tubes), free with a year's subscription for Radio World) @ $25.00. Order PR-3B.

The three 227 tubes can be supplied @ $2.00. No subscription goes with tubes. Converter shipping charges must be paid by you.

A set of three shielded coils on 1/4 inch diameter to cover the broadcast band, with a tap on secondary that enables going down to 80 meters. For screen grid tubes, including var-lux tubes. An aluminum cover (not shown) screws over the base. Send $3 for a 6 months' subscription, 26 issues, and order PR-TSC-3 for 0.00035 mfd. or PR-TSC-5 for 0.0005 mfd. We pay shipping expense on the coils.

YOUR CHOICE OF NINE METERS!

To do your radio work properly you need meters. Here is your opportunity to get them at no extra cost. See the list of nine meters. Hereinafore we have offered the choice of any one of these meters free with an 8-weeks subscription for RADIO WORLD, at $1, the regular price for such subscription. Now we extend this offer. For the first time you are permitted to obtain any one or more or all of these meters free, by sending in $1 for 8-weeks subscription, entitling you to two meters; $3 for 26 weeks, $6 for 52 weeks, entitling you to six meters. Return coupon with remittance, and check off desired meters in squares below. We pay shipping expense on the meters only.

RADIO WORLD (11th Year)
145-G West 45th Street, New York, N. Y.

NAME

ADDRESS

CITY STATE

RADIO WORLD, 145-T West 45th St., New York, N. Y.
(Print East of Broadway)

Enclosed please find $ for weeks subscription for RADIO WORLD and please send as free attachment the meters checked off below.

I am a subscriber. Extend my subscription. (Check off if true).

1.0 Voltmeter D.C. No. 326
1.0 Voltmeter D.C. No. 337
6-Volt Charge Tester D.C. No. 303
30-Ampere D.C. No. 310
25-Ampere D.C. No. 311
10-Ampere D.C. No. 312
100-Milliampere D.C. No. 390
500-Milliampere D.C. No. 391
1000-Milliampere D.C. No. 323
2000-Milliampere D.C. No. 324

Enclosed find $1 for 2 yrs. subs. Send PR-NCV.
Enclosed find $3 for 5 yrs. subs. Send PR-TSC-3.
Enclosed find $5 for 10 yrs. subs. Send PR-TSC-5.

RADIO WORLD, 145-T West 45th St., New York, N. Y.

Print East of Broadway

Enclosed please find $ for weeks subscription for RADIO WORLD and please send as free attachment the meters checked off below.

I am a subscriber. Extend my subscription. (Check off if true).

1.0 Voltmeter D.C. No. 326
1.0 Voltmeter D.C. No. 337
6-Volt Charge Tester D.C. No. 303
30-Ampere D.C. No. 310
25-Ampere D.C. No. 311
10-Ampere D.C. No. 312
100-Milliampere D.C. No. 390
500-Milliampere D.C. No. 391
2000-Milliampere D.C. No. 323

Enclosed find $1 for 5 yrs. subs. Send PR-NCV.
Enclosed find $3 for 10 yrs. subs. Send PR-TSC-3.
Enclosed find $5 for 15 yrs. subs. Send PR-TSC-5.
NEW! "LITTLE GIANT" DYNAMIC SPEAKER

Equipped with permanently magnetized long-life rare earth magnetic material, this speaker is especially suitable for use on modern recording and telephonic apparatuses. The light weight and small size are perfect for automobile receivers. Measures but 6 1/2 in. A.C., 6 1/2 in. H.T. and weighs but 4 lbs. The "Little Giant" has, under test, actually filled a room-corner apartment with faithfully reproduced music of virtually original tone quality. Price, $1.50. No extra charge for plugging in and setting. May therefore be controlled by a Home radio, or even by a household phonograph. The magnet is a real thing. It will survive a double duty. This last feature makes the "Little Giant" especially suited for portable A.C. sets, since it does away with the extra sets and thus with considerable weight. Equipped with built-in output transformer and the usual standard output power tube terminal, this speaker is excellent

List Price $2.50

*UAGH A.C. DYNAMIC SPEAKER—Only a Few Left

Light weight, small size, price, and cost, make the "Neptune" a real"deal. A.C., H.T. and weighs but 2 lbs. List Price $7.45

*FARADON 4-MFD. FILTER CONDENSER

These condensers come packed in convenient small sizes. Price, two pounds. List Price $5.20

World-Wide Short-Wave Set

A perfect radio shack for the man who wants to do competitive radio work. Has a built-in detector, not-to-be-attempted conversion, 15 volt, 1" and 2" "A" battery, power supply, with all leads, everything needed. Price, $35.00. List Price $45.00

FREE 76 Page Radio Directory No. 24

The new Winter edition of our RADIO SURVIVAL DIRECTORY, which sets forth our claim, has arrived! This is the greatest book in print—NOT JUST A CATALOG! Complete with all essential sections included in book with valuable information NOT ELSEWHERE AVAILABLE! No one interested in new technical information listed in the editorial reviews the following: 70 of the leading manufacturers of short-wave tuners and tubes and radio, as well as leading manufacturers of A.C. and H.T. filters, power units, A.C. and H.T. adapters, etc. How do you get it? It is not an ordinary catalog but a complete and valuable reference book and offers value to practically everyone. Write today!

6 MONTHS GUARANTEED NEUTRON TUBES

Sold on a 6 MONTHS FREE REPLACEMENT GUARANTEE! Proving absolutely tube-like! List Price $1.50. Send for catalog and prices. Ask to have these HIGH QUALITY tubes with other "new" power prices because they areVolume NEW!

R.C.A. LICENSED TRIAD AND SPEED TUBES

These tubes are exceptionally good. The prices are highly higher than our NEUTRONIC because these tubes are of much higher quality, manufactured under exceptionally stringent conditions. Price each: 75c. List Price $1.75

RCA VICTOR ELECTRONIC MICROPHONE

The most musically constructed, hand microphone of its type. It is a perfect microphone for any musical or professional entertainment. Buy after you have heard it! A solid state metal housing which breaks the dual purpose of a microphone. Thanks to its high line output, it is inordinately suited to all speech and is a thoroughly well designed microphone. It is designed by the only maker of such apparatus and may therefore be said to be the best. This is the finest microphone on the market. Price $10.00

List Price $7.95

Screen Grid Cap Connectors

New SCREEn G R I D CAT "S" Small, neat, simple and rugged. For the man who works in service work. Sold only connected. Price each $0.12

Robitronic Impedance Meters

These are designed especially for the radio work with various components in parallel. Price each $1.00

Radio Trading Co.

257 West Broadway
New York, N. Y.

ORDER FROM THIS PAGE. You will find special youre time in this magazine. Get our big FREE catalog for the greatest Radio Bargains. Should you like to ship goods by parcel post, be sure to include sufficient extra shipping for same. Any excess will be refunded.
CERTIFIED TRIAD TUBES are the result of many years experience. All the guess-work has been eliminated. They are designed, manufactured and tested by the most modern machinery. They are produced by skilled operators. No better tubes can be bought.

A complete study of the proper method of merchandising tubes, in order to protect the buyer as well as the seller has resulted in the adoption of an entirely new form of distribution. The CERTIFIED TRIAD SERVICEMAN is the key stone. You can become one of the agents, who are taking a handsome profit from these tubes, by filling in the coupon. The whole interesting story will come to you by return mail.

If you are selected to represent TRIAD, we will protect your territory, for you, every Tom, Dick and Harry will not be competing with you.

Write for full information.

This is a reduced facsimile of the Triad Radio Tube Certification Coupon, which is sealed in the box with tube to which it refers.

Even a good radio receiver will sound like "nothing at all" if it is equipped with poor tubes. Most people realize that the radio tube is the heart of their receiver. Ordinary tubes can be bought for a song, but you usually get what you pay for. No one looks to put Cadillacs or Lincolns service from an Austin. No one looks for custom-made shoes for three dollars. Those who expect the very best performance from inferior tubes are not logical and they are sure to be disappointed. No form of entertainment is as inexpensive as radio. Isn't it good business to keep it working at its best? You can be sure of doing so, by insisting on CERTIFIED TRIAD TUBES. A line to us will enable us to send you the CERTIFIED TRIAD SERVICEMAN, we have selected to serve your vicinity.

The TRIAD LINE is complete. It includes all types of standard Tubes as well as Photo-Electric Cells and Television Tubes.

TRIAD TELEVISION MFG. CO. Pawtucket, R.I.

Gentlemen:
Please send me full information and prices on the complete line of CERTIFIED TRIAD tubes. I am interested in Radio and Television.

Name
Dealer
Serviceman

Address
City State

EXPERIMENTERS

Many "batteries" of aging machines controlled by highly skilled workers make TRIAD great production possible.
Just out — PILOT CATALOG!

Just out — PILOT catalog!
Everything for the service man, set builder, and experimenter is to be found in the new PILOT catalog.

REPLACEMENT PARTS. All PILOT's replacement parts are listed. They include power transformers, all types of resistors, dry electrolytic condensers, loudspeakers, chokes, and other manufacturers' type parts for Service Men.

EXPERIMENTERS' PARTS. New instruments for experimenters have been added, making PILOT's line of parts the most complete offered by any Company.

SHORT WAVE EQUIPMENT. PILOT has always been headquarters for short-wave equipment. The new catalog and a supplement now in preparation include everything for building short-wave receivers.

S.W. TYPE 224-A TUBES. The PILOT 224-A tube is especially designed to reduce noises in S. W. receivers. It will improve your results.

WRITE TODAY. Send 5¢ in stamps for the PILOT catalog or, better, send 50¢ for a year's subscription to Radio Design Quarterly and the catalog and supplement will be sent FREE. Don't delay! Do it today!

9-COIL CIRCUIT
NEW TYPE SUPER-HETERODYNE
ONE CONTROL - 18 TO 550 METERS
FINEST BROADCAST RECEPTION
SUPER-SENSITIVE ON SHORT WAVES
NEW DESIGN - NEW RESULTS

THE NEW
PILOT DRAGON
4-BAND SET

POLICE ALARMS - AIRPLANES IN FLIGHT
PLUS REGULAR
SHIPS AT SEA - FOREIGN STATIONS
BROADCASTING

You'll put your O.K. on this set as the most beautiful piece of radio design you have ever seen. Ask your dealer to show you how the DRAGON wave-band switch changes from three coils for broadcast pre-selection to any independent pair of coils for each of the three short-wave bands. Notice how other sets using tapped coils, loaded with dead end losses, fail at high frequencies. Listen to the DRAGON's freedom from inter-band interference in contrast to results on makeshift tapped-coil circuits. Examine the precision construction of the 9-coil catacomb. Listen to the quality of the new amplifier and the acoustic cabinet. Then you'll say, "That's my idea of a Radio Set!" and you'll tell your B.C.L. friends so, too.

NO PLUG-IN COILS

This 9-coil catacomb and switch is built into the chassis of the new DRAGON all-wave receiver. This method of construction eliminates all dead-end losses.

Complete information about the DRAGON receiver will be sent to you free if you will include your radio dealer's name and address with your request.

PILOT RADIO & TUBE CORP.
(Short Wave Headquarters - Established 1908)

Factories - Lawrence, Massachusetts

www.americanradiohistory.com