THE SCANNER

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Mr. E. J. Risch

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THESE - AND MANY MORE, CONTRIBUTED TO BETTER WAR PRODUCTION METHODS

Vol. 7 MARCH 1942 No. 1

THE SCANNER

EDITORS

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Miss B. M. Smith

This issue contains in its "News of the Quarter" the announcement regarding Mr. Throckmorton's election as Chairman of the newly created Executive Committee and the election of Mr. Shannon as President of RCAM.

Mr. Throckmorton's qualities of executive efficiency combined with his genuine friendly interest in all the company employees have been major factors in the ever growing success which the company has achieved during his presidency. We are very glad that our company will continue to have the benefit of his wisdom, inspiration and comradeship.

We are also most happy to see Mr. Shannon elected to the company presidency. We are sure that the qualities of leadership of which he gave outstanding evidence in his position as Executive Vice President will enable him to lead our company to even greater achievements than those we have attained in the past.

To both Mr. Throckmorton and Mr. Shannon our congratulations. The opportunity to work with and for them affords us all much satisfaction and pleasure.

As in previous years, this first quarterly issue contains a summary of our engineering accomplishments for 1941.

Summaries of the technical papers presented at the Annual Convention of the I.R.E. are included in this issue.

Some of the loose data sheets which we gave out with previous issues have been so much in demand that we are reprinting some of them herewith. To these are added some new ones which we believe will be of general interest. The Impedance Chart has been expanded to cover the ultra-high frequencies and copies for both ranges are included.

Our thanks to H. N. Kozanowski for providing us with the chart on dissipation in standard resistors and the revision of the impedance chart.

In This Issue

REVIEW OF ENGINEERING PROGRESS FOR THE YEAR 1941

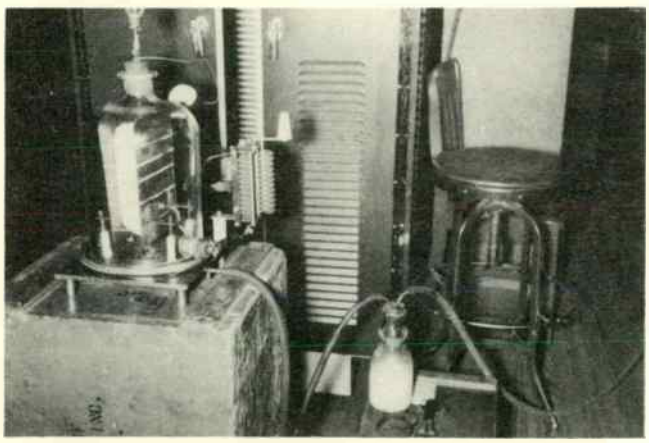
In assembling the material for this review your editors have had to omit many engineering developments made during the year. At the beginning of 1941 much of the engineering work was of a defense nature and toward the end of the period the great majority of the work was directed toward the war effort. The following account has therefore, of necessity, had to omit mention of many of the more important developments made during the year.

RESEARCH LABORATORIES

Camden

Industrial Applications

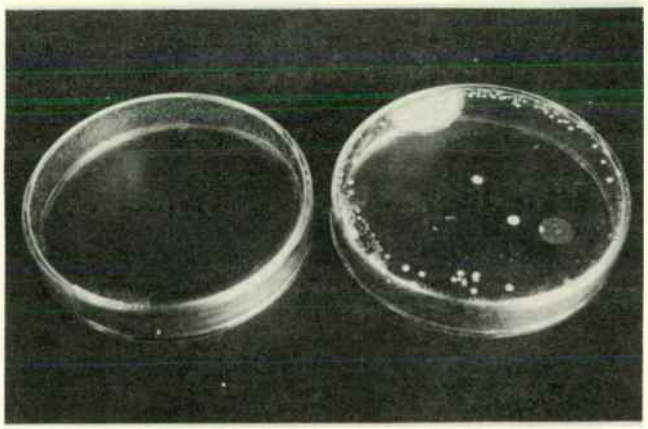
The application of r-f power to industrial processes was expanded during the year into new fields. A number of applications of r-f heating were developed successfully. One of these was the drying of the rolls or "cakes" of thread as they are called in the rayon industry. By the r-f process the cakes could be dried in about one hour whereas the commercial oven process required three or four days. Cloth woven from this thread had superior qualities of uniformity of dye absorption and richer appearance than that woven from the present commercial product.



EXPERIMENTAL SETUP FOR DRYING RAYON CAKES. BOTTLE AT LOWER RIGHT CONTAINS LIQUID EXTRACTED FROM THE CAKE

Another successful application of r-f power was to the gluing of wood, as in the manufacture of laminated-wood products. This process had the advantage of applying the heat at the joint where it was needed instead of applying it to the outer wood surfaces from whence it had to be conducted through the wood to the joint - as in the present commercial process. The r-f process was less critical of application and required less time.

Near the year's close promising experimental results were obtained on the application of r-f



PETRI DISH ON LEFT WAS TREATED WITH R-F

energy to the sterilization of glass surfaces containing bacteria. The action is illustrated by the two petri dishes shown in the accompanying photograph. Originally both dishes contained a large number of bacteria on their surfaces. R-f power was applied to the one on the left for 20 seconds. After a suitable incubation period no evidence of bacteria could be found on this dish while the untreated dish (on the right) showed a bacteria count of 100,000.

Television

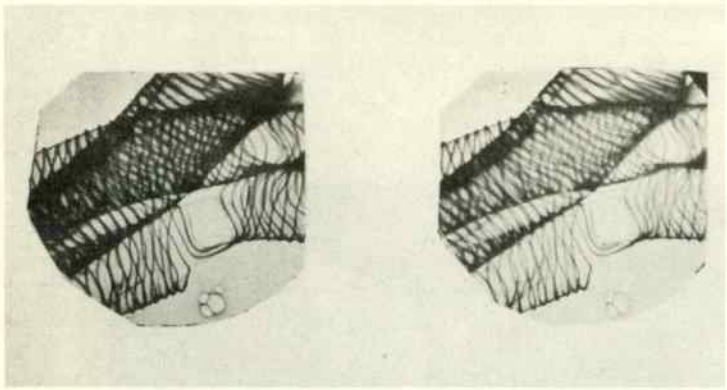
In connection with the presentation of the N.T.S.C. report to the FCC, we participated by showing a wide variety of advances in apparatus and cooperated with other RCA groups in a showing of theater television with a 15 x 20-foot screen image.

A receiver was developed for producing pictures in color by projection means with the image 13½" x 18". A definite improvement was made late in the year in the circuit utilizing the transmitted synchronizing signals through the use of an a-f-c circuit. Apparatus utilizing this circuit was demonstrated to industry groups and to the FCC. With signal strengths of such values that the picture detail was seriously affected on a standard receiver, the receiver employing the a-f-c circuit showed no loss of detail due to noise affecting the synchronizing. In the presence of extreme noise

peaks and weak signals, which made the standard receiver inoperative, the receiver having the a-f-c circuit continued to operate with only a slight vertical motion of the picture.

Electron Microscopes

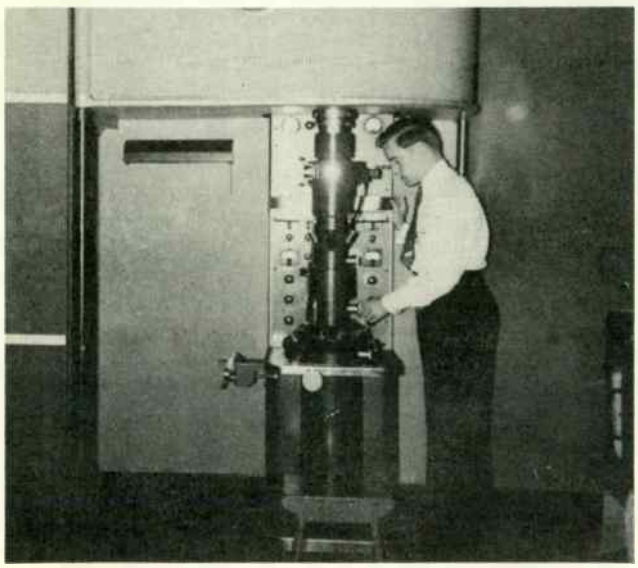
In the course of the year a number of improvements have been developed in the commercial-type electron microscope. A specimen holder which makes it possible to take stereomicrographs was worked out. These stereomicrographs, when viewed through a stereoscope, or when projected with a stereo-projector and looked at through polaroid glasses, show the object in three dimensions. Thus, it is possible to observe the spatial arrangement of the various component parts.



STEREO-MICROGRAPHS OF TRACHEAE OF A MOSQUITO LARVA

A new type of projection lens which permits a wide variation of magnifications has been worked out. In particular, it makes it possible to use the microscope at low magnification without too serious reduction of field. This new lens has not been put into production, but has been tested with the commercial model and found to give good performance.

To extend the field of usefulness of the instrument, a new projection system has been worked out which allows the microscope to be used as an electron diffraction camera. The design for this has been completed, and the device will be tested shortly.

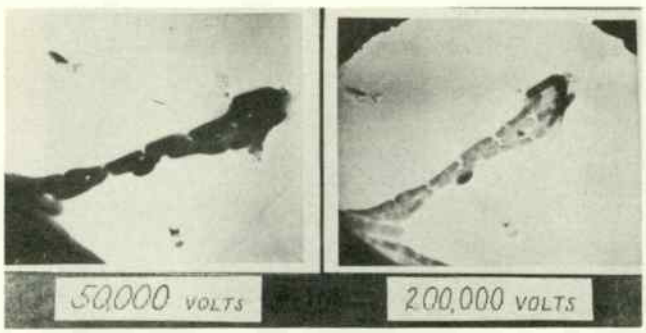


J. HILLIER OPERATING 300-KV MICROSCOPE

A new air-insulated 50-kilovolt power supply was developed. This voltage source, though having the same high degree of stability as that used with the commercial instrument, is much simpler and more easily manufactured. It employs only about half as many vacuum tubes and transformers as the present power supply. The new commercial microscope will use a high-voltage source of this type.

One of the outstanding developments of the year is the high-voltage microscope. Work on this instrument was started about a year ago and it was put into operation early last summer. The microscope column is similar to that used for the commercial instrument, but the gun has been redesigned to meet the high-voltage requirements. This gun is arranged to accelerate the electrons in three steps with a maximum overall voltage of 300,000 volts, that is, 100,000 volts for each stage of the gun. The 300-kilovolt generator which supplies the instrument makes use of a high-frequency resonant transformer, similar to that developed for the commercial instrument, but on a much larger scale. The voltage quadrupler is included in this circuit. A very high order of voltage constancy is required of this generator. It is obtained through feedback-regulator circuits which hold the voltage to one part in more than fifty thousand.

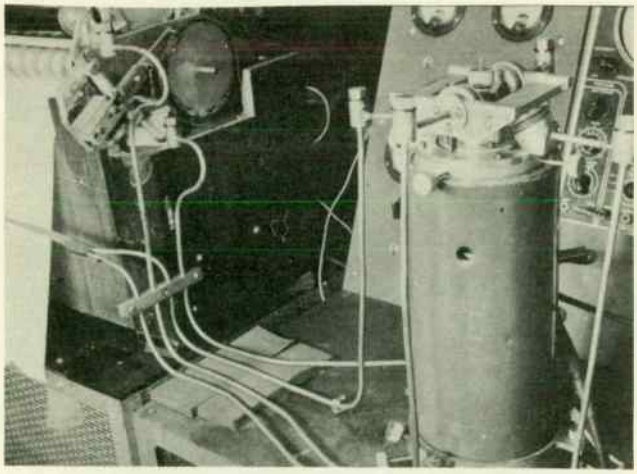
The 300-kilovolt instrument permits the investigation of much thicker, denser specimens than can successfully be studied with the ordinary electron microscope. For this reason it is of great importance where the structure of tissue sections, large bacteria, and similar objects are the subject of research.



ELECTRON MICROGRAPHS OF BACILLUS MEGATHERIUM TAKEN AT 50,000 AND 200,000 VOLTS

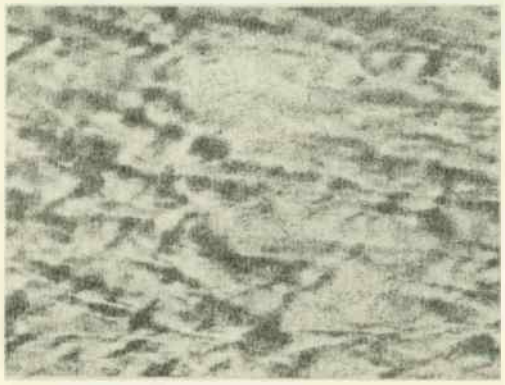
The scanning microscope has been the subject of investigation and development for more than two years. This work has resulted in the design and construction of a fairly satisfactory instrument. A number of micrographs have been taken of various metallic surfaces at magnifications up to 4,000 and even 10,000 diameters and having a resolution better than 500 Å.

Basically different principles are employed in the scanning microscope than those used in other electron microscopes. Instead of forming an electron image of the object, a fine electron beam scans the specimen. The secondary emission ratio from the surface varies according to the nature and geometry of the point under the beam. The secondary electrons are



SCANNING MICROSCOPE SHOWING HYDRAULIC SCANNING MECHANISM

used to actuate a facsimile recorder which is synchronized with the scanning pattern of the probe. The magnification is determined by the ratio of size of the scanning patterns of the recorder and the probe. The resolution, on the other hand, depends upon the fineness of the probe and the size of the pattern on the object (e.g., spacing of scanning lines).



SCANNING MICROSCOPE PICTURE OF POLISHED, COLD-ROLLED STEEL SURFACE, SLIGHTLY ETCHED WITH NITOL

A number of interesting electronic and mechanical arrangements are required to carry out this process. The electron probe, which is formed by a double-lens electron-optical system, employs electrostatic instead of magnetic lenses such as are used in the commercial microscope. To convert the secondary electrons from the sample into the signal, the electrons are directed onto a phosphor which luminesces under the bombardment. The light from this phosphor actuatee a secondary-emission multiplier, the output from which, after further amplification, operates the recorder. The signal is in the form of modulation on a 3,000-cycle carrier. The exploring probe is stationary, while the specimen is moved in two directions at right angles to produce the scanning pattern. This motion is effected by means of hydraulically operated bellows. Smooth motion, free from vibration can be obtained in this way. The main chamber of the instrument must be held at a low pressure and is consequently continuously pumped with an oil diffusion pump. The specimen head is demountable so that the specimen can be readily changed.

Tests made so far have shown this instrument to be fairly reliable, although requiring accurate adjustment of the parts to obtain maximum resolution. They have also shown that the preparation of surfaces for examination is not more difficult than that required in the case of ordinary microscopic examination.

Applications of the Electron Microscope

A great deal of work has been done with both the commercial and high-voltage microscopes in the field of biology. This type of research has been done under a Fellowship of the National Research Council and under the direction of a committee set up by that body.

Many new techniques have been developed for handling biological materials. Some of the outstanding are: methods of making sections which are suitable for observation under the electron microscope; a freeze-drying technique which makes it possible to study a variety of specimens which would otherwise be destroyed in the course of preparation and examination; a washing technique which separates undesired materials from the substance to be examined; and preliminary staining methods.

A complete discussion of the biological studies which have been carried out would be much too lengthy for a report such as this. However, a brief mention of a few of these will indicate the scope of the work.

Important work was done by Dr. W. M. Stanley of the Rockefeller Institute for Medical Research, in collaboration with Dr. T. F. Anderson, on viruses and the anti-bodies which deactivate these viruses. The size and shape of a number of plant viruses were determined and compared with corresponding indirect centrifuge determinations. The method of attack of antibodies could be clearly observed as well as the specificity of the anti-bodies to particular types of viruses.

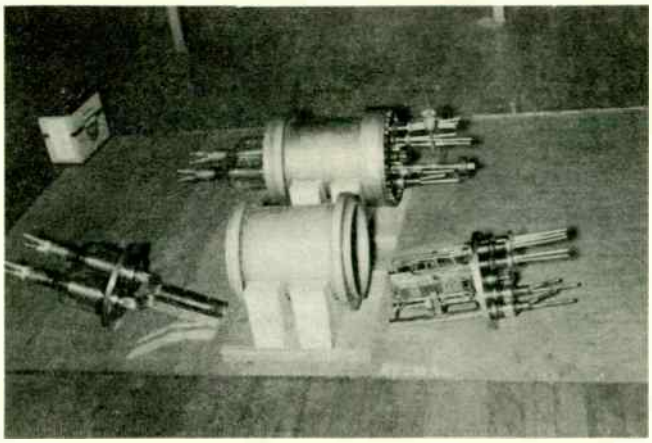
In connection with antibody studies, equally important investigations of the effects of these particles on such microorganisms as typhoid, paratyphoid, and subtilis, were made in collaboration with Dr. S. Mudd of the University of Pennsylvania.

A series of very interesting investigations was carried out by Dr. A. G. Richards of the University of Pennsylvania, together with the National Research Council fellow, on sections and fragments of insect materials. This work was particularly important because of the techniques involved. The application of stereoscopic methods greatly aided this work.

Dr. R. Boche of the University of Pennsylvania undertook an investigation which involved very skillful techniques and required the development of the freeze-drying procedure mentioned. This was the isolation and micrographic study of lampbrush chromosomes of salamanders and drosophilae.

A study of the microbodies which attack certain bacteria, which are known as bacteriophage was undertaken by Dr. S. Luria of Columbia University and Dr. Anderson.

Many other biological studies of equal importance were carried out. For example, the influenza virus investigations made by Dr. L. A. Chambers; the studies of Rous Sarcoma virus, which produces a cancer-like growth in chickens, by Dr. K. G. Stern; and the observations on bacteria stained by heavy element salts, made by Dr. Mudd.



Ultra-High-Frequency Power Tube (A-4247)

The development of the sealed-off demountable power tube now designated as A-4247 has proceeded. Early in the year the tube was brought to a point where a production group could take it over in order to learn the techniques involved, even though the development was not entirely complete.

This power tube operates at frequencies up to and slightly above 100 Mc, and is capable of delivering 25 to 50 kw of power. It is especially suited to applications where wide frequency bands are to be handled, as is required in television and frequency-modulation transmission.

In order to make the physical size of the electrodes small enough to meet the circuit requirements, and at the same time dissipate the power necessary, a new anode cooling system was developed. This permits a dissipation of 1200 watts/cm^2 instead of only about 70 or 80 watts/cm^2, as is the case with the conventional power tube. Furthermore, the cathode and grid configurations are such that they form an electron-optical system which largely prevents electrons from reaching the grid. This is essential in order to reduce grid heating. The elements are so arranged that they form a symmetrical pair of triodes which are operated in push-pull, with the neutralizing circuit within the envelope. In order to facilitate the use of the tube in a variety of circuits, the neutralizing is being made externally adjustable.

Optics Research

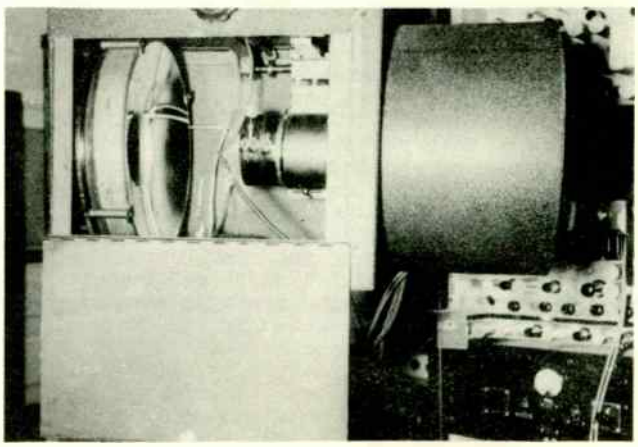
Considerable work in the field of optics was carried on during the year for eventual application to television equipment. A method was developed for molding the correcting lenses for reflective-type optical systems which will greatly reduce the cost of such lenses. Toward the end of the year a correcting lens for a 12-inch reflector was successfully molded with more than the optical accuracy necessary for use in home-type television projection receivers. The accomplishment of this result was due in large measure to the development of a special instrument for measuring the peculiar contour shape of the correcting lens to the necessary high accuracy. Since no instrument was available for this purpose, one was designed and built. By this means it has been possible to precisely determine the small corrections needed in the design of the mold to produce the exact shape of lens required.

Attention has also been given to reducing

I. G. MALOFF REMOVING PLASTIC LENS FROM MOLD

the cost of grinding the glass reflector for these optical systems. By a pre-forming operation the grinding time for the glass reflector blanks has been decreased to less than half of that previously required.

As a new point of attack on the problem of increasing the sensitivity of television cameras, a reflective-type optical system was developed and mounted in a camera. An Iconoscope especially designed for this optical system was mounted in the camera and preliminary tests show that a very high degree of sensitivity can thus be obtained.



TELEVISION CAMERA USING REFLECTIVE OPTICAL SYSTEM

EXAMPLE OF USE OF NON-REFLECTING GLASS

A new method of treating glass surfaces to reduce reflection was developed which avoids much of the complication of previous processes. It is applicable to large glass surfaces. The effectiveness of the treatment as applied to a sheet of glass about 20-inches square is illustrated by the accompanying photograph. This shows a picture, the right half of which is covered with ordinary glass while the other half is covered with glass treated to reduce reflection.

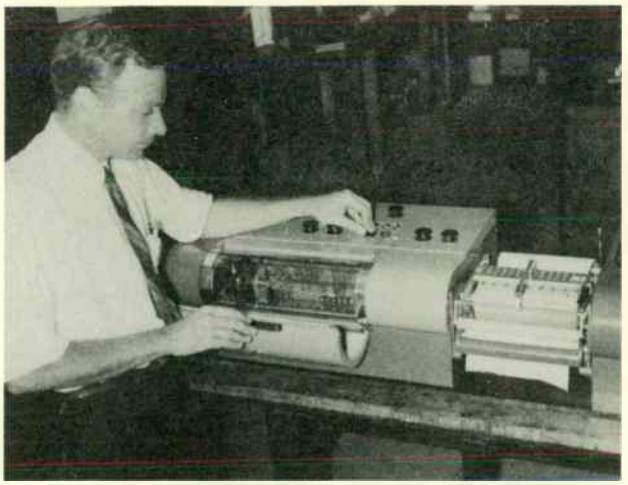
Facsimile

Early in the year a demonstration was made in New York City of multiplexed high-quality sound and broadcast facsimile on a single 45-megacycle channel, frequency modulated. Satisfactory results were obtained only when the modulation swings were reduced below the values set by the FCC specification for such multiplex operation. An article was prepared and published covering the results of these tests. Included in the article was a theoretical analysis which gave additional proof that the FCC specification could not be met with practical apparatus.

During the year we undertook the development, for possible commercial application, of a general-purpose-type duplicator using facsimile principles.

Much improvement has been made during the year in the design of the facsimile scanner unit. In this new instrument the subject copy is merely wrapped around a stationary half cylinder of clear plastic. This provides protection for the moving parts of the mechanism and a maximum of operating convenience.

During the year improvements have been made



M. ARTZT TESTING GENERAL PURPOSE DUPLICATOR

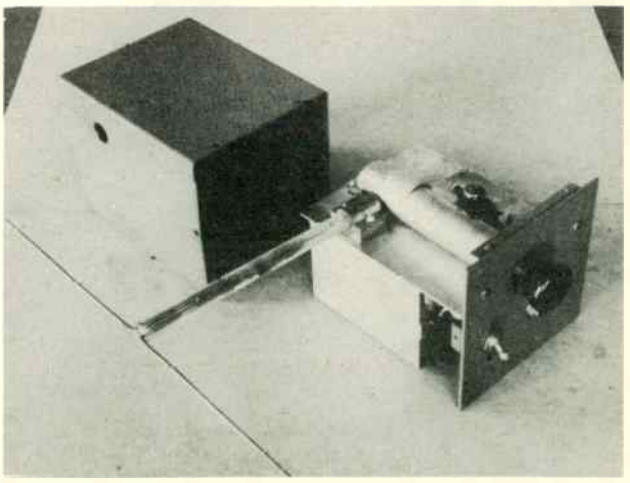
in the background of black-on-white copy from electrolytic recordings, and in the shelf life of pre-treated paper. A new amplifier has also been developed having greater stability of performance than any similar amplifier heretofore designed. Use has already been made of this amplifier in a new RCA oscillograph.

Alternative Materials

Of constantly growing importance, in parallel with the defense problems, is the quest for alternative materials. Curtailed imports, as well as increased domestic demands, have lead to certain new developments. Wherever possible we have assisted in solving this national problem.

500-Mc Equipment

Work on reception and measurement of ultra-high-frequency signals was continued with increasing effort during the year. A few of these developments will be mentioned.



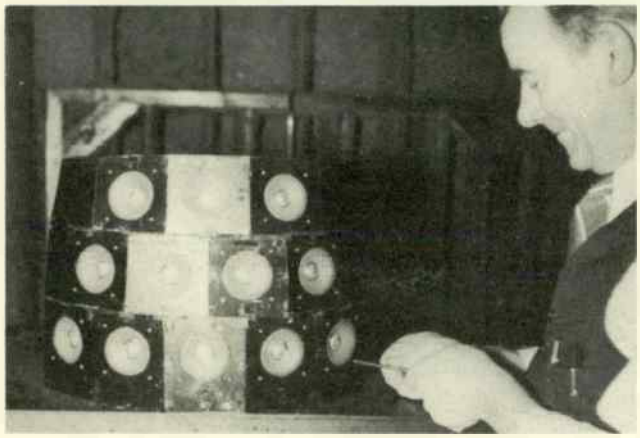
SUPER-REGENERATIVE U-H-F RECEIVER

The super-regenerative principle was found to provide an excellent means for obtaining high amplification in the ultra-high-frequency range. Super-regenerative circuits were used in receiving and field-strength measuring equipment.

Other pieces of ultra-high-frequency equipment which were developed were: equipment for measuring circuit characteristics up to 700 megacycles; a frequency-modulation test transmitter for checking "FM" performance at ultra-high frequencies; and a portable field-test transmitter for making propagation measurements at these frequencies.

Acoustic Developments

A new high-fidelity unit was developed for use in a monitoring loud speaker. It has characteristics of uniform response and low distortion with adequate power-handling capacity which tests have shown are superior to those of any such loud speaker previously available.



J. PRESTON ASSEMBLING HIGH-FREQUENCY UNIT OF MONITORING LOUD SPEAKER

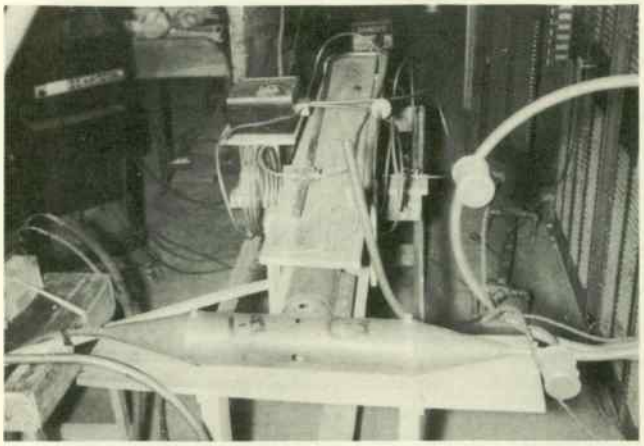
A method has been developed for quickly measuring the total sound output of a loud speaker. Previously this measurement has required about one day. The new method employing ten microphones on a spherical surface requires only two minutes.

In the small Personal type of portable radio receiver the available power from the output tube is naturally limited. High efficiency in the loud speaker of such receivers is therefore very important in order that the small electrical power may be transformed into the maximum possible sound output. During the year developments were completed on a small loud speaker for Personal radios which gives 100% more sound output with a given tube power than previous loud speakers designed for this use. The new design also gives somewhat less distortion than the existing commercial model.

A new self-supporting voice coil for loud speakers was developed which permits a saving of about 18 per cent in copper wire for the field winding. This is an important consideration during the present scarcity of materials. In addition to this, the new coil construction is stronger than the previous commercial design.

U-h-f Wattmeter

An Instrument was developed for accurately and quickly measuring the u-h-f power in an antenna or other r-f circuit. Even at the lower radio frequencies the measurement of power has been a somewhat tedious procedure and in the

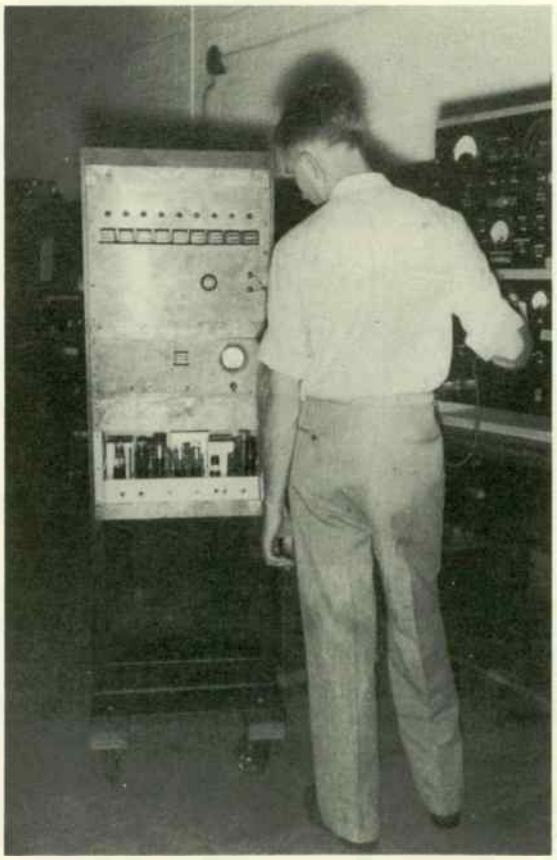


ULTRA-HIGH-FREQUENCY WATTMETER

u-h-f range there was an added undesirable element of uncertainty as to the measurement accuracy. Tests indicated that the new instrument is very accurate even under difficult circuit conditions.

Noise Measurement

Our study of phonograph record characteristics with the object of improving recording and reproducing techniques has progressed during the year. In this work it was necessary to develop an instrument for measuring the characteristics of record surface noise. This instrument has now been completed and is operating satisfactorily.



A. R. MORGAN TESTING PEAK DISTRIBUTION COUNTER

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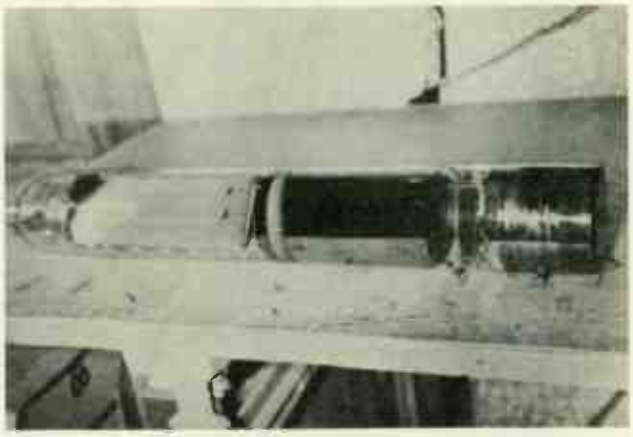
RESEARCH LABORATORIES

Harrison

Television

Work was continued on the development of more sensitive television pickup tubes using the principle of scanning with low-velocity electrons.

A theoretical study was completed which indicates the limiting sensitivities which may be attained with such pickup devices as photographic cameras, television cameras, and the human eye, and which shows how the sensitivity is affected by picture repetition rate (or exposure time) and resolution. It was found that the human eye is about 1000 times as sensitive as the best television pickup tube when compared on the basis of the same repetition rate, resolution, and f-number of optical system. The encouraging conclusion is that research workers can still make several successive major improvements in sensitivity of pickup tubes before the ultimate limit is reached.



EXPERIMENTAL ORTHICON

Ultra-High-Frequency Tubes

There was increased effort on the development of new types of ultra-high-frequency transmitting and receiving tubes.

Theoretical studies were completed which give a measure of the absolute sensitivity of radio receivers and an analysis of the internal factors which affect the absolute sensitivity. These studies are particularly pertinent to ultra-high-frequency receivers because such receivers are usually designed primarily for high sensitivity (high signal-to-noise ratio) and the limitations on sensitivity normally lie almost wholly within the receiver itself.

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PRODUCT ENGINEERING

HARRISON

General

This report summarizes activities at Harrison for the following engineering sections for the year 1941: Power and Special Purpose Tubes, Receiving and Cathode-Ray Tubes, Chemical Engineering, Standardizing, and Commercial Engineering.

As in previous reports, the presentation in the interests of brevity and simplicity is primarily on the new products produced by these sections. It should be mentioned, however, that since over 75% of the personnel of these sections is engaged in work on defense problems, many activities can not be covered at this time.

New Tubes

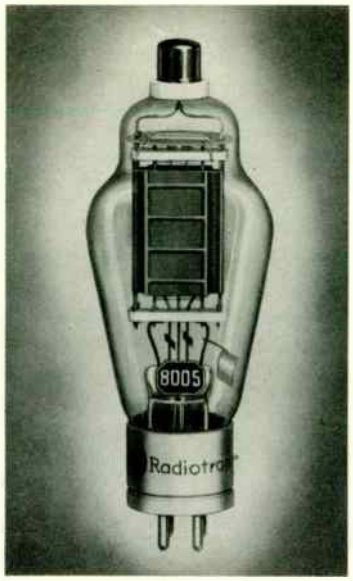
Thirty-three new tubes were added in 1941 and 15 tubes were dropped to bring the total number of tubes regularly listed and sold by RCA to 470. Of the new types added, receiving tubes including special purpose receiving tubes account for 26, transmitting tubes for 3 and special purpose tubes for 4. The 15 types dropped include 2 transmitting tubes, 2 special purpose tubes and 11 receiving tubes.

Receiving Tubes

The 26 receiving tubes announced in 1941 included 9 new metal tubes, 2 new miniature tubes, 3 midget tubes, 4 tubes for aviation equipment, 7 GT types and 1 G type. During the year, 17 GT types were made available as double branded GT/G types. In the process, 11 G types were eliminated. In general, the metal tube types announced during the year were of the popular single-ended design, and gave special consideration to the requirements of high transconductance and improved performance at ultra-high frequencies. The 2 miniature types added, the 45Z3 and the 3Q4, were a rectifier and a power amplifier for use in a-c/d-c battery-operated portable receivers. In the Receiving Tube Application group, activities shifted from contact with manufacturers for commercial equipment to contact with manufacturers and government agencies for defense requirements.

Transmitting Tubes

In transmitting-tube development, the em-



phasis during the year was on ultra-high-frequency tubes with particular reference to defense requirements. Three tubes, however, were announced for general sale. They were the 8000, 8001 and 8005. The 8000 and the 8005 are of particular interest to manufacturers of diathermy equipment, but for class C telegraphy service the 8000 has a power output of approximately 475 watts and the 8005, of approximately 220 watts.

L. E. SWEDLUND PLACING 7-IN.
PROJECTION KINESCOPE IN TEST COMPARTMENT

Cathode-Ray Tubes

Again in cathode-ray tubes, the emphasis has been on tubes for defense equipment. During the early part of the year, however, considerable work was done on projection Kinescopes for television use. A 7-inch projection tube operating at 70 kilovolts was demonstrated by RCA with a 15' x 20' picture of promising quality. A 4-inch tube was developed for home projection equipment. Three receivers were built and demonstrated using this tube to produce a 15" x 20" picture. Pickup tubes and Kinescopes for color work in television were partially developed and programs for their further advance were established.

Special Purpose Tubes

In special purpose tubes, 2 phototubes, a mercury-vapor rectifier, and a voltage regulator tube were announced. Of the phototubes, the 930 is a design similar to the 929 but employing an S2 photosurface, and the 931 is a 9-stage electrically focused multiplier type following in principle the design of Rajchman and Snyder. This tube employs the blue sensitive surface first used in the 929. The voltage regulator tube was the 9011 for 75-volt operation. Because of difficulties in manufacture, this tube was withdrawn from sale the latter part of the year. The mercury-vapor rectifier was the 816, a junior version of the popular 866. Designed to handle 125 milliamperes at a peak voltage of 5000 volts, it is less than 4-3/4 inches in over-all length.

O. H. SCHADE USING COLOR REEL
TO TEST KINESCOPES

Chemical Section

Chemical Engineering activities during the year specialized in the subject of alternate materials. A general program of changing over inner leads, grid side rods, grids, and plates to the use of iron was carried on. For some parts, the iron is plated with a thin layer of nickel or of silver to improve the surface characteristics. A process for carbonization of steel has been developed to eliminate the necessity of nickel-plating before the carbonizing process. From the changes made and planned, it is expected to save 6 tons of tin, 12 tons of aluminum, 29 tons of nickel and about 400 tons of brass in 1942.

Standardizing Activities

The Standardizing Section continued its regular work of assisting engineering groups with complete working specifications on all new tube

types. An engineer was assigned to the Power Tube Factory to facilitate better coordination of the work on the many new problems produced by the rapid expansion of power tube production.

Commercial Engineering

Sales of all Commercial Engineering publications ran about 40% higher than for 1940. These publications are being used in large quantities for the training of military technicians and in the designing of defense equipment. During the year, this section started the local printing and distribution of the Radiotron Designer's Handbook edited by F. Langford Smith of the Amalgamated Wireless Valve Company Pty. Ltd., in Australia. This book has proven very popular with designers of radio equipment. A single copy is available to each RCA employee at a special price of 60 cents a copy.

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PRODUCT ENGINEERING

BLOOMINGTON

Home Receivers

The 1942 receiver line developed in the earlier part of 1941 has been already described in the July issue of "The Scanner." In addition to the instruments described in that article several other receivers were designed.

MODEL 36X

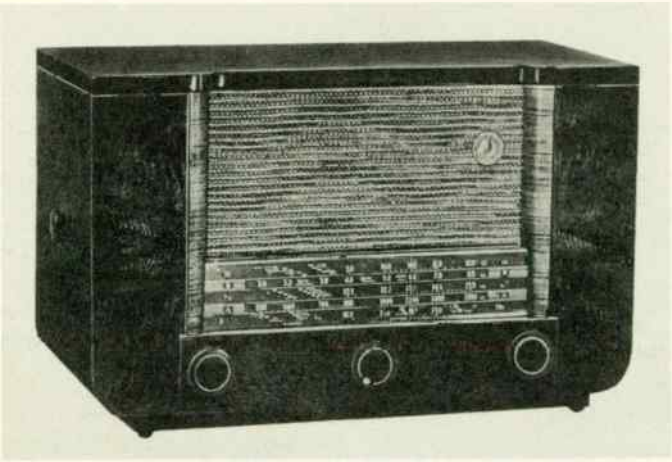
The popular 15X Concentration Model has been revised to give improved sensitivity and signal/noise ratio. This has been accomplished by enlarging the area of the loop antenna and the development of a separate oscillator high G_m converter system using a 12J5GT as oscillator and a 12SG7 as the converter in place of the 12SK7 untuned r-f amplifier and 12SA7 converter tubes. The overall sensitivity has been increased about 2 to 1 and the signal/noise ratio approximately 3 to 1. These receivers will be available under model numbers 15X and 36X - both of which are Underwriters' Laboratory approved.

A model 37X has also been developed which incorporates the same larger loop mentioned in connection with the new 15X and 36X models and is a six tube version of the popular 14X Overseas Model. The extra tube is a 12SG7 used as

MODEL 37X

an untuned r-f amplifier. The oscillator circuits of this receiver have been revised to eliminate certain undesirable degenerative effects which would ordinarily reduce the sensi-

MODEL 35X



EXPORT MODEL Q-33

tivity and the resultant receiver exhibits unusually good sensitivity and signal/noise ratio throughout its range. Underwriters' approval has been obtained for this receiver also.

Models 12X and 14X have been made available in newly styled wood cabinets of attractive appearance as models 35X and 34X respectively, which are illustrated herewith. Both models are Underwriters' approved.

During the latter part of 1941 and the first quarter of 1942 the Bloomington Works has also taken over the manufacture of several of the Export models. The popular Q11, Q14, Q16 and Q33 models being among those manufactured. In addition production of models 28T, 29K, 29K2, V135 and V140 was also undertaken. In the auto-radio field, models for Buick, Chevrolet and Pontiac were also produced.

MODEL V-140 PHONOGRAPH COMBINATION

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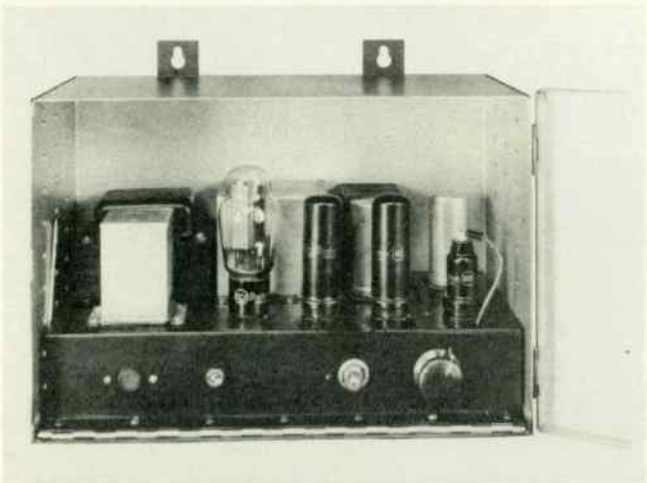
SOUND ENGINEERING

INDIANAPOLIS

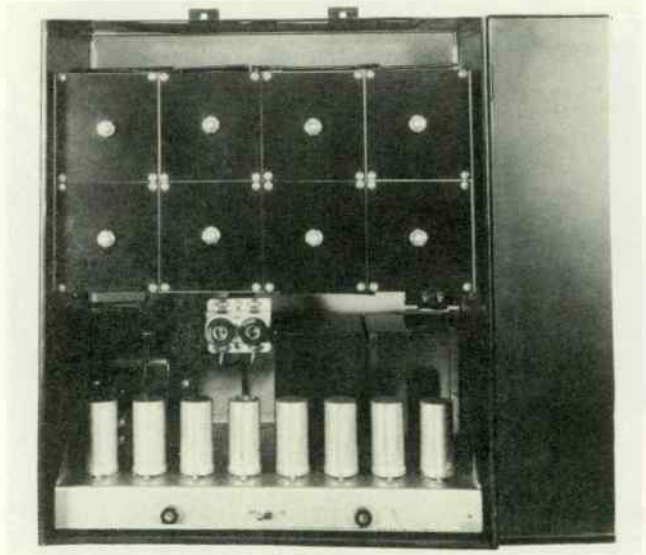
Sound Motion Picture Recording Equipment

The MI-10504 Regulated "B" Supply is designed to provide a low-priced unit capable of providing the plate current of a small film-recording channel or of supplementing the plate supply of existing recording channels when additional facilities are added. It has an output of 90 milliamperes at 250 volts and a hum level of -125 db below the rated output voltage. A hinged construction of the chassis is used to facilitate the maintenance of the unit.



REGULATED "B" SUPPLY

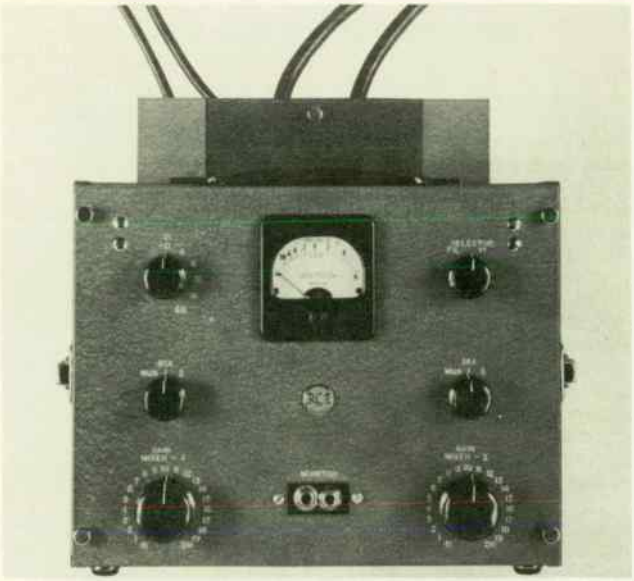
The MI-10505 "A" supply is designed to operate the exposure lamp of a sound-film recorder or as a filament supply for the amplifier in a film recording or rerecording channel. The



"A" SUPPLY

rectifiers used are of the copper-oxide type and were chosen to give a combination of maximum stability, long operating life, and trouble-free operation. This unit is rated at 11 amperes at 14 volts and has a hum level of -70 db below the rated output voltage.

The PM-45 Small Studio Recording Equipment is designed to meet the requirement of our industrial motion picture producers and of customers in the export field desiring to produce pictures at a minimum of cost. Its design permits it to be moved readily from the studio to



MIXER AMPLIFIER

a truck for recording on location. The amplifier circuits are arranged so that by the use of a "B" supply unit such as the MI-10501 or MI-10504, all of the amplifiers can be operated from a 115-volt d-c supply. For truck operation a storage battery can be used for the tube filaments and "B" batteries for the plate supply. An MI-10216 Mixer Amplifier having two input channels with high-level mixing is used remote from the main amplifiers in order to permit mixing at the point of action. The MI-10219 Amplifier Cabinet contains the remaining amplifiers necessary to complete the equipment. The amplifiers in the cabinet are of hinged construction and can be opened for easy service after removing the front cover of the cabinet.

AMPLIFIER CABINET FOR RECORDING EQUIPMENT

The MI-10304 Film Recorder used with the PM-45 Equipment is styled attractively and provides performance characteristics similar to that of the MI-10301 Recorder. One feature of this recorder is that it can be converted readily in the field to record on 16 mm film.

Sound Motion Picture Reproducing Equipment

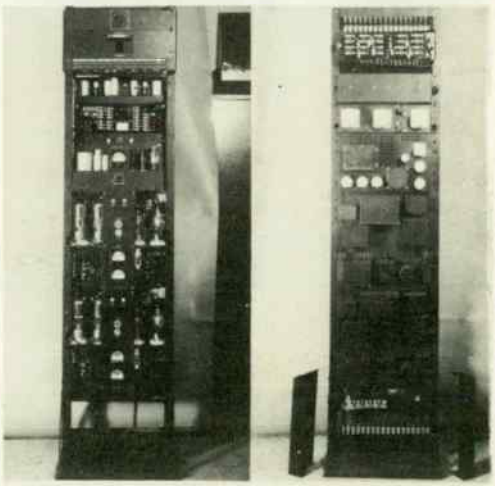
Control-Track Equipment

One of the outstanding developments of the year was the Control-Track Equipment which is a modified version of the "Fantasia" system. It consists of a 96-cycle control track which is obtained by scanning the sprocket hole area of the film, the amplitude from which modulates a separate photocell. This photocell in turn excites a logarithmic amplifier that controls the bias of two variable-gain amplifiers. One of these amplifiers is located in the normal channel and one in a separate channel which bridges the input of the normal one and feeds additional speakers mounted on the sides of and adjacent to the normal stage speakers. The amplitude of the control track is varied in the recording and the bias voltages of the respective variable-gain amplifiers so arranged that the additional speakers become operative and the volume of the complete system is controlled as desired.

While less elaborate than the "Fantasia" system, this equipment still makes it possible to exhibit war and mob picture scenes and present music with considerably more appeal than heretofore, at a price which is well within the reach of the average exhibitor.

New Sound Motion Picture Reproducing Equipment for Radio City Music Hall

A complete new sound motion picture reproducing system was designed for Radio City Music Hall. While standard components were mostly used, the system has many unique features. Paramount among these are: complete dual-channel amplifier equipment with all switching accomplished with mercury tubes; special fader and volume control system which permits the volume of any of four projectors to be controlled from any station with lever-operated mercury fader switches; amplifier bridging facilities for operating the movie system in conjunction with the PA system; control-track provisions; and a special pyramid horn to insure adequate high-frequency distribution.



RADIO CITY MUSIC HALL AMPLIFIER RACKS

Lens Coating

A coating material has been developed which is more durable than competitive coatings that are offered at the present time. This new coating can be readily cleaned, using the same care one would give any high-grade optical system. We recommend the use of Benzene as a

cleaning agent, and it can be applied with a laundered linen cloth, and polished dry. All surfaces of projection lenses, including the external surfaces can, therefore, be treated by our new process.

The reduction in reflection at the surface amounts to approximately 4% per surface which amounts to about 24% increase in light transmission in the average theater-projector lens after coating. The major advantage is in the elimination of internal reflections in the lens. This increases the contrast and definition of a projection picture very materially.

Commercial Sound

A new fifteen-watt amplifier, MI-12222, was designed and put into production. This amplifier replaces the MI-12202 and becomes a unit in our new line of coordinated amplifiers. It has performance characteristics which make it especially suitable for medium-power installations. It is equipped with individual inputs and volume controls for microphone and phonograph. The gain of this unit is sufficient to operate directly from any high-impedance microphone. Frequency response is from 30 to 10,000 cycles, and the amplifier is equipped with a high-frequency tone control. A special music switch provides attenuation of the low frequencies when required. A sloping panel provides easy access to all controls.

15-WATT AMPLIFIER

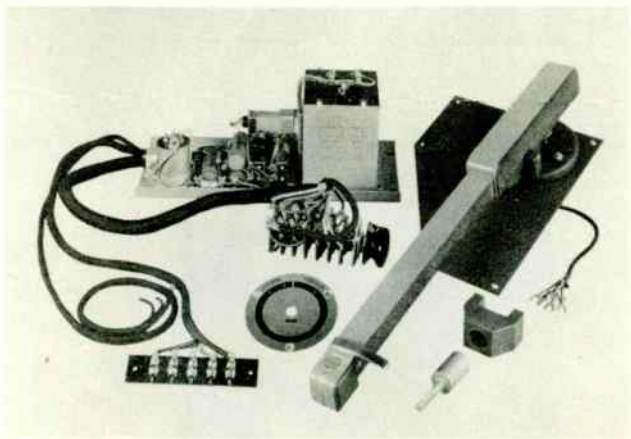
A deluxe 25-watt amplifier, MI-12225, was also introduced as another unit in the new coordinated line of amplifiers. This unit replaces the MI-12205 and has features which make it an outstanding piece of equipment. It is equipped with two low-impedance microphone inputs and two universal-impedance phonograph inputs. Individual high- and low-frequency tone controls provide great flexibility of frequency characteristics. Provisions for remote control are supplied as well as facilities for adding additional input stages. This unit is attractively finished in a two-tone-gray color and has a vertical control panel, characteristic of the deluxe line of equipment.

A high-pass filter, MI-12104, was designed for a 250-ohm balanced or unbalanced input circuit. This filter has a sharp cut-off of frequencies below 500 cycles and is used when it is necessary to reduce the low speech frequencies. By means of this unit in the microphone circuit, the frequency response of a paging system can be made to provide more intelligible speech under adverse noise conditions.

Speech Input Equipment

The design of new speech-input items during the year 1941 was greatly curtailed due to the press of Government work. Only those projects that were necessary to meet current demand and that had been nearly completed were carried to conclusion. Modifications to amplifiers and other speech-input items necessary to accommodate alternate materials were the only changes made to the line as carried over from 1940.

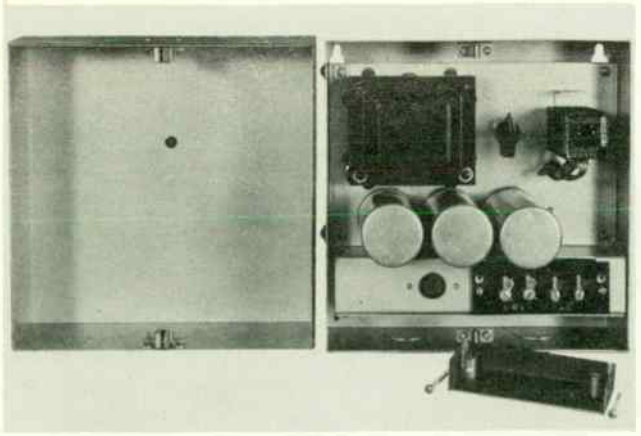
Of the new items to appear, the MI-4871 70C1 turntable equipped with the long looked for universal pickup was probably the most outstanding. The turntable itself carried a few improvements, one being the locating of the motor switch on the top of the cabinet, thereby making it accessible for either left- or right-hand operation without the necessity of moving the switch from one side to the other as in the older models. The star feature of the new turntable was the universal pickup. This pickup will play either the lateral or vertical recordings. Four points on the lateral side of the switch select four separate reproducing characteristics - one for the Orthacoustic records, one for Columbia recordings, one that has a flat response from 50 to 10,000 cycles, and a fourth that cuts off the high end. Two positions on the vertical side select vertical playing characteristics to accommodate World Records and Western Electric Records. This universal pickup was also made available in the form of a kit that contained, in addition to the pickup and arm, a filter, filter switch, and the necessary hardware to allow the new unit to be attached to older model turntables.



UNIVERSAL PICKUP KIT

Two new 12-volt relay power supplies were designed to replace the MI-4308 and MI-1500 tungar-type rectifiers. The MI-11303 is the new one-ampere unit using a copper-sulfide-magnesium disc rectifier. A switch is incorporated in the circuit that allows the voltage to be set at 12 volts for varying conditions of load from 0.2 ampere to the full load rating of 1 ampere. Maximum ripple at full load is 0.4 volt. Three 1000 μf plug-in electrolytic capacitors are employed for filter. The entire unit is contained in a neat wall-mounting type of cabinet that is fitted with a snap-on cover, the overall dimensions being 9-5/16" x 6" x 9".

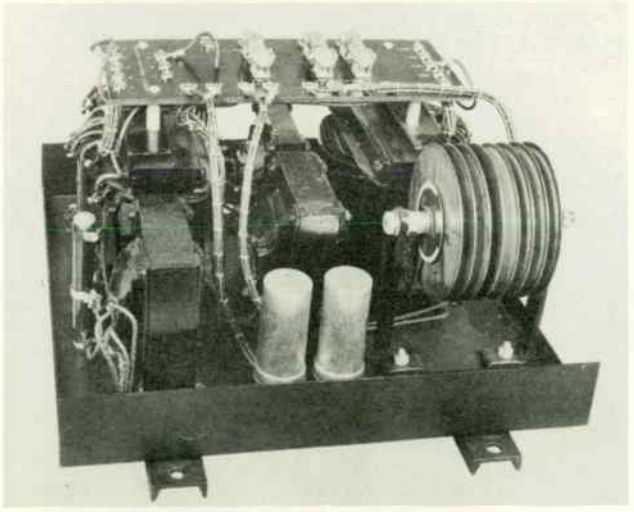
The MI-11304 is the new 5-ampere regulated unit using a selenium rectifier. Regulation of



ONE-AMPERE RELAY POWER SUPPLY

the d-c output voltage is accomplished by the use of a saturated reactor which maintains the output voltage substantially constant from no load to full load. Taps are provided on a terminal board for making adjustments to the output voltage as well as to take care of aging of the rectifier. The filter circuit consists of chokes and capacitors. Maximum ripple at full load is 0.6 volt. Overall dimensions of the streamlined wall-mounting cabinet are 15-1/4 x 8-1/2 x 16-3/8 inches.

The MI-4925 high-frequency compensator was designed to meet the FM requirements of telephone lines being equalized to 15,000 cycles. The MI-4925 compensator is to be used in conjunction with the 56B, 56C, 56D, or 56E equalizer, and acts as a 15,000-cycle booster to these units. The general procedure to equalize a line out to 15,000 cycles by use of the MI-4925 compensator is to first equalize the line to approximately 5000 cycles by using any of the current equalizers. The compensator is then put in the circuit and the equalizing continued out to 15 kc. Uniform cable circuits in the order of 10 to 15 miles can be easily equalized to a flat response within one db from 50 to 15,000 cycles by using the compensator in conjunction with another equalizer.



FIVE-AMPERE RELAY POWER SUPPLY

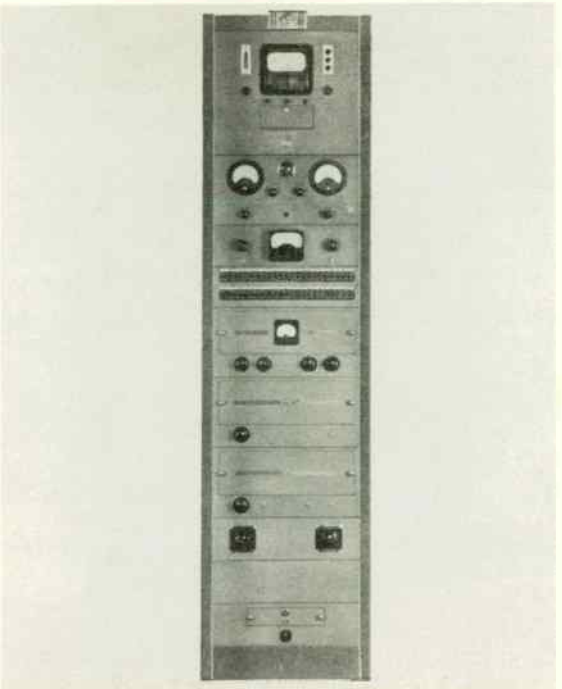
In order that the full advantage of the high signal-to-noise ratio of FM broadcasting may be realized, it is necessary to raise the level or add pre-emphasis to the frequencies from 1000 cycles up to 15,000 cycles. The characteristics of such a filter are to follow the 100 microseconds curve in accordance with FCC recommendations. (This pre-emphasis is removed in the FM radio receiver.) To provide a means of obtaining the pre-emphasis was the purpose of the design of the MI-4926 pre-emphasis filter. It consists of a simple bridged-T type of filter mounted in a shield can for convenient mounting. It is recommended that this pre-emphasis filter be connected in the program circuit at the transmitter. The minimum loss of the filter is 6.5 db at 15,000 cycles and the maximum loss is 26 db below 500 cycles.

Working in collaboration with the Transmitter Section in Camden, two new transmitter-control units were brought out in 1941. The first of these was the MI-11616 transmitter-control console. This transmitter-control desk has been designed for use with a broadcast transmitter to provide a complete and flexible system of control in one control desk. It contains all of the mixing and switching facilities required at the transmitter station. It is equipped with a standard VU meter, an extension-modulation-monitor meter, and an extension-antenna-current meter.

This control desk consists of a turret-type assembly mounted atop a metal desk. All controls, switches, and meters are mounted on three panels which are assembled in the turret top. Each of the three panels is hinged at the bottom so that it may be opened for easy servicing. The entire rear cover of the turret may be removed to facilitate installation.

The desk and turret are constructed of metal throughout. The left pedestal of the desk contains a typewriter shelf, and the right pedestal contains two drawers. A third drawer is located between the two pedestals. All wiring to the turret is carried up through one of the desk pedestals and is not visible externally.

All a-c power switches and associated indicator lamps are located on the left-hand panel. The three meters and six attenuator controls are mounted on the center panel. The monitor and VU meter selector switches, together with the audio-lever key switches and associated indicating lamps, are mounted on the right-hand panel. Chrome-plated guards prevent accidental operation of the important lever keys.



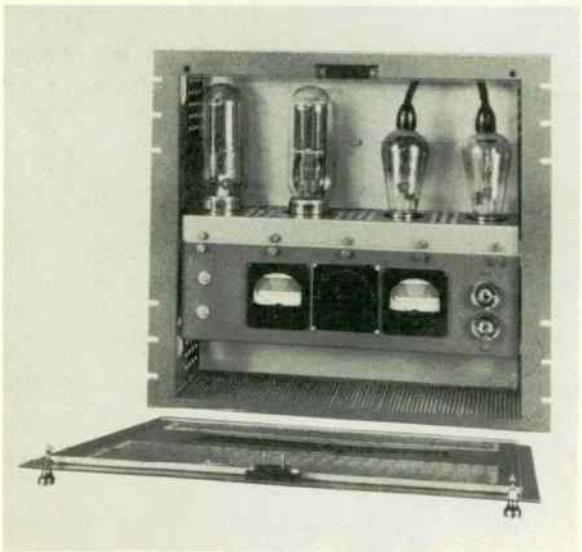
TRANSMITTER SPEECH INPUT AND CONTROL RACK

TRANSMITTER CONTROL DESK

The second of the two transmitter-control units is the MI-11620 transmitter speech input and control rack. This rack was designed for use with the broadcast transmitter in order to provide for complete monitoring facilities in one rack, together with the necessary audio facilities to raise the program level to that required by the transmitter. It was also designed to be used in conjunction with the MI-11616 transmitter-control desk. When so used, complete facilities for control, monitoring, and audio mixing and switching are provided.

Contained in a standard cabinet rack, the control rack consists of a frequency monitor, a modulation monitor, a VI meter panel, 2 strips of jacks for facilities patching, a limiting amplifier, a program-monitor amplifier, 2 line-isolation coils, 2 line equalizers, a power-change panel (for use at those stations that operate with reduced power at night), 3 pre-amplifiers for emergency microphones and turntables at the transmitter, and finally a switch and fuse panel. The rack is equipped with the J-type trim strips and is finished in the same umber gray to match the transmitter.

It has been gradually recognized during the past few years that the fidelity of recordings can be noticeably improved by using a record-



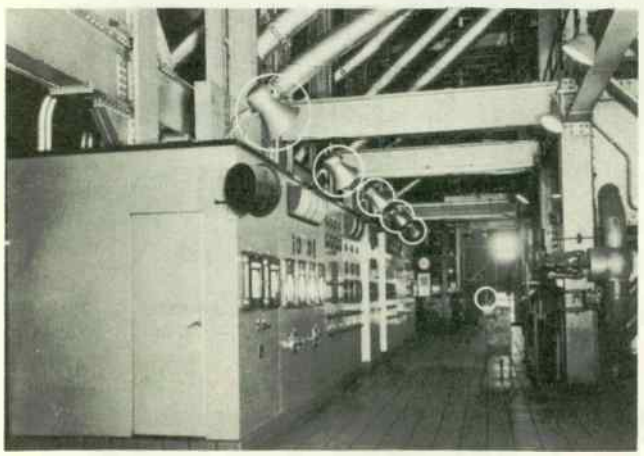
50-WATT RECORDING AMPLIFIER WITH COVER REMOVED

CONTROL ROOM - PHILADELPHIA ELECTRIC COMPANY - SHOWING MICROPHONES AND LOUD SPEAKERS

ing amplifier of considerably higher power than is necessary to cut fully modulated grooves. The reason for this improvement in quality has been traced to the fact that the usual run of recording amplifiers of some 5- or 10-watt output capacity would actually overload and distort on high instantaneous peaks of signal. By using an amplifier of sufficient power capacity the peak values of signal can be handled without distortion. The MI-11219, type 94E, 50-watt amplifier was designed to meet this new need of recordists. This amplifier has a gain of 18.9 db from a 500-ohm source to a 15-ohm load and uses two type 845 tubes in Class A push-pull. Two type 866A mercury-vapor rectifiers are used for the plate-supply voltage. The amplifier is designed to work from the output of an 86A limiting amplifier or from an 84B or 82C amplifier. A source signal of approximately +29 VU is required to properly drive the 94E amplifier. In addition to the 500-ohm input, the amplifier is supplied with a 2500-ohm bridging input tap that will allow bridging of a 500-ohm line or the using of from 1 to 5 amplifiers across one 500-ohm line. Frequency response of the amplifier is with ±1 db from 30 to 15,000 cycles and has a distortion less than 1.5% from 50 to 7500 cycles. Mechanical design of the unit is such that it can be mounted in the standard equipment rack.

Industrial Sound

A number of industrial-sound-broadcast installations were completed last year. Many of



BOILER CONTROL ROOM - PHILADELPHIA ELECTRIC COMPANY - SHOWING LOUD SPEAKERS AND MICROPHONE

A PRODUCTION FLOOR IN WESTON ELECTRICAL INSTRUMENT CORPORATION SHOWING LOUD SPEAKER INSTALLATIONS

these had to operate under adverse conditions, such as extremely high noise levels. Plant-wide music broadcasts were successfully provided in areas having noise levels of the order of 100 db. An adequate industrial record library was built up. A few of the installations are: Curtiss-Wright Corp. - four complete plants; Bethlehem Steel Company, Inc.; Lukens Steel Company; Grumman Aircraft Engineering Corp.; Scintilla Magneto Company; Philadelphia Electric Company - three power plants; American Viscose Corp. - two power plants; E. I. DuPont de Nemours - three plants; Associated Gas & Elec. Service Corp. - five power plants; Botany Worsted Mills; National Pneumatic Company; I-T-E Circuit Breaker Company; Carnegie-Illinois Steel Company; Arma Engineering Corp.; Wright Aeronautical Corp.; Behr-Manning Corp.; Weston Electrical Instrument Corp.; Ford Instrument Corp.; Bristol-Myers; and many others.

The industrial-sound broadcast has materially helped to improve morale and to increase production through such campaigns as "Beat the Promise." The time saved in locating personnel has materially increased production. One of the major aircraft companies put this in quite precise terms by stating that the system increased their production by the equivalent of 1/2 an airplane per day.

Industrial Products

Fill-Check and Recovery Machine

This machine was developed for the Continental Can Company, Syracuse, N. Y. It is designed to detect and remove any cans of Coca Cola or other syrup which are not filled to the required

FILL-CHECK AND RECOVERY MACHINE

level. Where the level of the syrup is too high, the excess syrup is automatically removed. The photograph shows a can ready to be pushed over the two metal electrodes and suction pipes. If the liquid is not sufficiently high, the resistance between electrodes remains high and a relay causes the conveyor to reject the short filled can. If the liquid is too high, it is lowered to the proper level by withdrawing the excess amount through the suction pipe. One of these machines has been operating since early last year in the Syracuse plant and has resulted in considerable saving of syrup and at the same time assuring full measure.

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SPECIAL APPARATUS

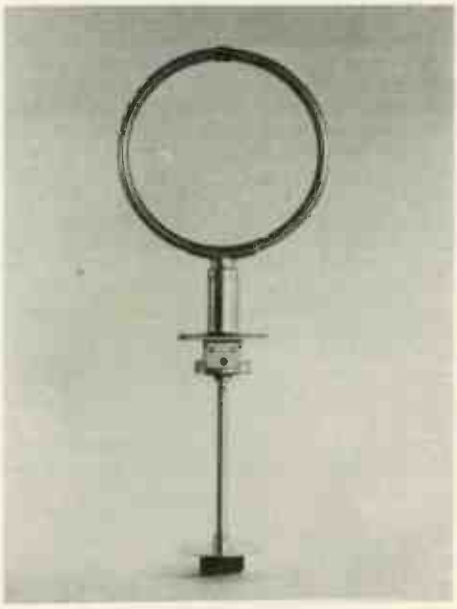
Special Receivers

AVA-122 Loop Antenna MI-19506

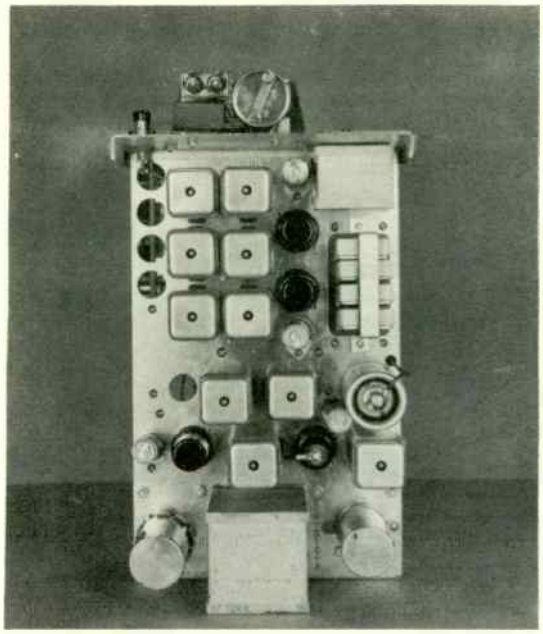
MI-19506 is a twelve-inch diameter low-impedance electrostatically shielded loop antenna arranged for direct rotation. This loop is not center tapped but otherwise has the same electrical characteristics as the AVA-56. The AVA-122 loop antenna is intended for operation with the AVR-100 and AVR-101 Receivers.

Loop Adaptor Kit MI-19509

MI-19509 is designed for use with Beacon Band (200-400 kc) Aircraft Receivers, having a high-impedance input circuit such as MI-19504 and MI-19504-A Receivers. This adaptor increases the utility of these receivers by making possible the use of an electrostatically



AVA-122 LOOP ANTENNA



AVR-24 RECEIVER CHASSIS

shielded loop for direction finding purposes, in addition to the conventional beacon antenna. The unit which mounts by a single hole in the instrument panel is designed for operation with the AVA-122 Loop Antenna.

AVR-24 Receiver MI-19508

The AVR-24 Aircraft Receiver is a four-frequency remotely controlled receiver designed for military and commercial aircraft installation. The frequency range of 3 to 12 megacycles is covered in two bands (3.0-6.6 Mc; 5.5-12 Mc). Provision is made for four crystal controlled pre-tuned channels, two in each band or four in any one band. A vibrator power supply for operation from 24 to 28 volts d.c. is an inherent part of this receiver.

Commercial Receivers

U-h-f Aviation-Ground-Station Receiver (AVR-18)

This receiver was developed primarily to meet the need of commercial airlines for communication with airplanes and for airport traffic control. The ultra-high frequencies give more reliable short-range communication through static interference. An effort was made in the design to anticipate future requirements for receivers of this type and a design was evolved which is flexible enough to serve other communication receiver applications.

The frequency range is 127 to 144 Mc. The design is such, however, that r-f units with different coils may be used to work on any frequency between 75 and 150 Mc. The receiver equipment consists of a basic unit which provides single-channel operation, and a second unit which may be used at the customer's option to provide operation on from one to three additional channels. Channel switching is accomplished by switching plate voltage from one r-f unit to another. All r-f units are permanently connected to a common antenna and a common i-f and audio unit.

The double-superheterodyne type of circuit is used with a crystal oscillator. Ordinary receiver metal tubes are used, such as the 6AC7 and 6SG7. A noise limiter and squelch circuits are used on this receiver, similar to those developed for police-communication service.

AVR-23 Airport Receiver

This receiver is a medium-high-frequency receiver with a 200 to 400 kc band for general airport and airline use. The receiver is a modification of the AR-77 amateur receiver design. Its outstanding feature is the provision made in the design for various kits and accessories, such as crystal control, radio-range filter, heterofil, and i-f crystal filter which may be purchased and added by the customer. In this way, the receiver meets the different requirements of many customers economically.

MI-7818-19 Medium-Frequency Police Receiver Modifications

The antenna coupling circuit on this receiver was redesigned to secure greater reduction of ignition interference.

The squelch circuit, which formerly was operated by a relay, was changed to an electronic type.

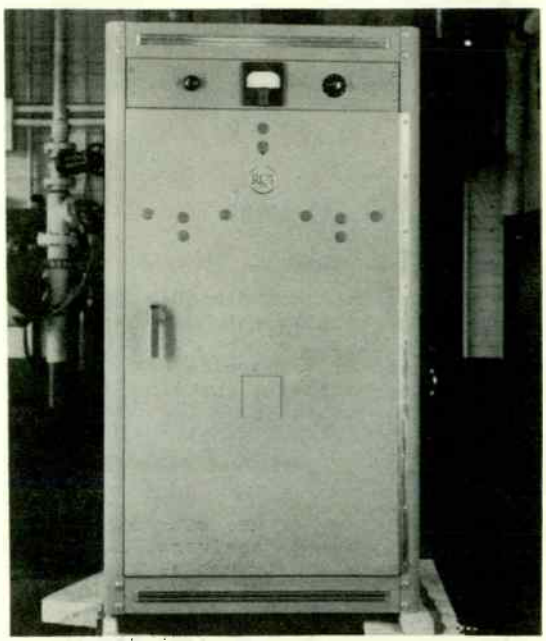
Low-Power Communication Transmitters

50-Watt Communications Transmitter

A newly developed general-purpose communications transmitter to be known as the type ET-4338 has been released for production. This equipment delivers an output of 50 watts over the r-f frequency range of 2 to 20 Mc and provides for phone as well as cw modulation. Other design features are M.O. or C.O. frequency control, low distortion, high-level modulation, and single-wire transmission line feeding circuits.

50-Watt U-h-f Airport/Airline Transmitter (AVT-20-A)

Frequency range 128-144 Mc single-frequency operation for airport use and four-frequency local or remote-control operation for airline use. The power supply and modulator are designed for simple conversion to higher power so that the AVT-20-A and the AVT-27, 30 watt, low-frequency airport transmitter may be operated simultaneously.



50-WATT U-H-F AIRPORT/AIRLINE TRANSMITTER

Aircraft and Mobile Transmitters
(Commercial Only)

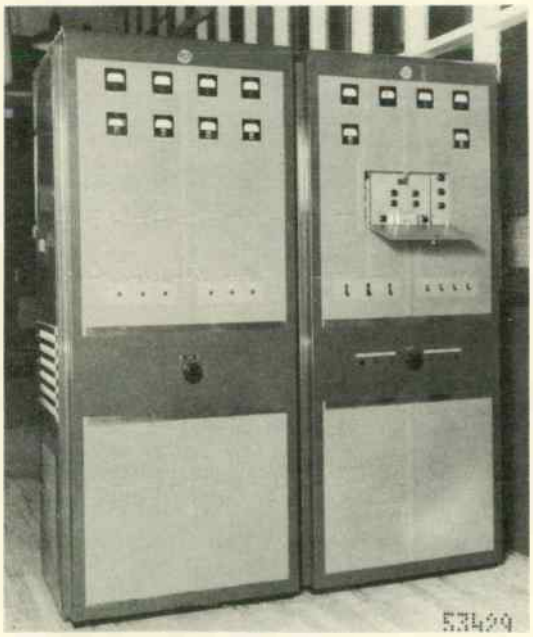
AVT-23 Aircraft Transmitter is a 4-channel equipment operating over the range 3.0-13.5 megacycles. Remote selection of channels and emission is possible from the pilot's control box. Phone-carrier power output capable of 100% modulation is approximately 20 watts. CW-telegraph power output is slightly higher. This power output is based upon operation into an optimum antenna. The antenna loading and coupling circuits are designed for operation into a wide range of aircraft antennas. This set is designed to meet C.A.A.T.C. requirements.

The design of the present line of frequency-modulated police, mobile and station-house transmitters was modified to extend the frequency range to 26 megacycles to accommodate newly assigned State Police frequencies.

The design of MI-7824 and MI-7825 22-watt amplitude-modulated police, mobile and station-house transmitters was modified to eliminate automatic-modulation-control circuits and to provide a separate crystal-oscillator tube.

A 24-volt version of the AVT-15 Aircraft Transmitter was completed. No changes in the basic oscillator and modulator circuits were made over the 6 and 12-volt versions. Cable designs for the 6-volt version were modified to reduce voltage drop.

One model of a 50-watt frequency-modulated police, mobile transmitter and one model of a 60-watt frequency-modulated police, station-house transmitter were completed.

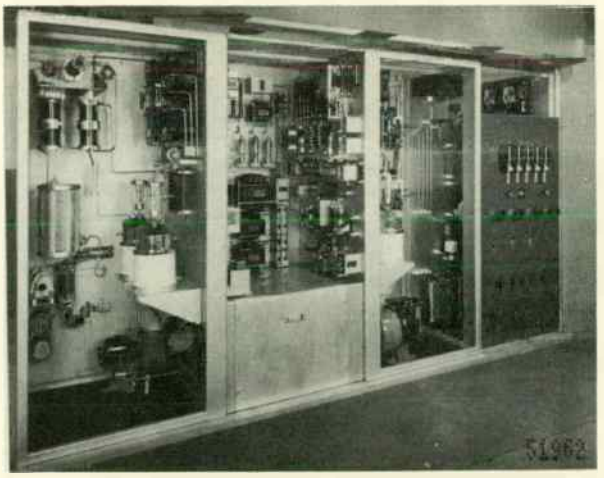


FM-3-A FREQUENCY MODULATED TRANSMITTER

Broadcast Transmitters

FM-3-A Frequency-Modulated Transmitter (MI-7270)

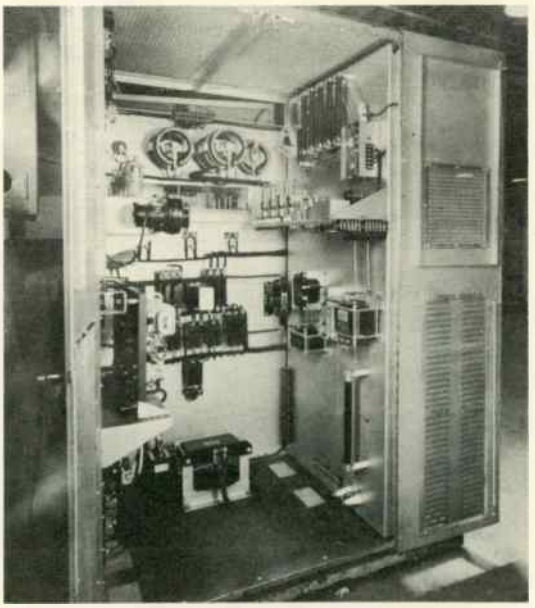
By means of a new power-supply unit, which provides higher plate voltage for the RCA-827R's, the FM-1-B transmitter was used as a basis for the FM-3-A. Frequency Range: 26-108 megacycles. Distortion: 1% from 30 to 15,000 cycles. FM Noise: -70 db. AM Noise: -50 db. The power output is 3 kw from 26-60 megacycles, and 2 kw from 60 to 108 megacycles. A motor drive is used on the load-coupling control. The control system provides automatic sequence operation. The complete transmitter is contained in the same cabinet space used for the FM-1-B.



VIEW OF 5-E BROADCAST TRANSMITTER SHOWING EQUIPMENT BEHIND PANELS

5-E Broadcast Transmitter (MI-7260)

The 5-E Broadcast Transmitter supersedes the 5-D- 5-DX. The power output can readily be increased from 5 kw to 10 kw by adding a tube in the power amplifier in the space provided and substituting a larger modulation and plate transformer. The outstanding features of the equipment are accessibility, ease of installation, and high efficiency. The audio system incorporates two RCA-828 tubes in a cathode-follower circuit as drivers for the RCA-892R modulator tubes. The overall distortion is less than 3% from 30 to 10,000 cycles and the audio-frequency response is flat within 1 db.



REAR VIEW OF FM10A FREQUENCY MODULATED TRANSMITTER

FM-10-A Frequency-Modulated Transmitter (MI-7310)

For frequency-modulated broadcast applica-

tions in the 42-50 megacycle band. Power output 10 kw. Performance: Distortion less than 1% from 30 to 15,000 cycles; frequency-modulated noise level better than 70 db below a predetermined swing; Amplitude noise level 50 db below 100% amplitude modulation. This transmitter utilizes the FM-1-B equipment as an exciter with two RCA-889R's as power amplifiers. To reduce the amplitude-modulated noise on the carrier, overall feed-back is used. A feature of the equipment is motor control of tuning in the power amplifier which resulted in an unusually clean design.

The first transmitter is installed and operating at WCAU.

Television Terminal Equipment

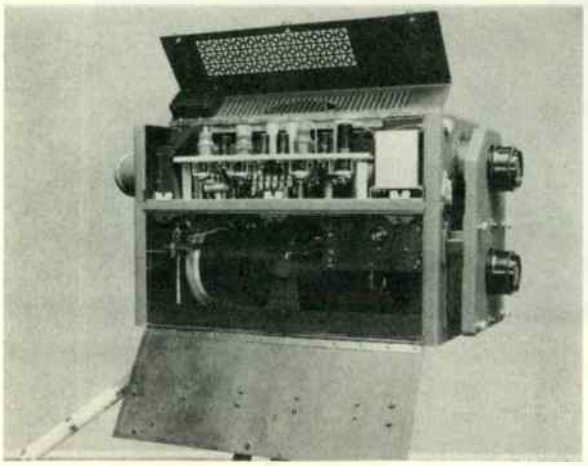
As in most activities of the Company, the work of this group changed over more or less completely during 1941 to the development of equipment for defense projects. However, some commercial equipment was designed and manufactured.

Early in the year, a complete portable Orthicon pickup system was delivered to Bell Laboratories for some special tests on the 400-mile coaxial link between Stevens Point, Wis. and Minneapolis, Minn. This equipment consisted of an Orthicon camera, camera control unit, and synchronizing generator, with associated power supplies. The equipment was divided physically into small compact units about the size of an ordinary suitcase, with weights kept down to what a single person could carry.

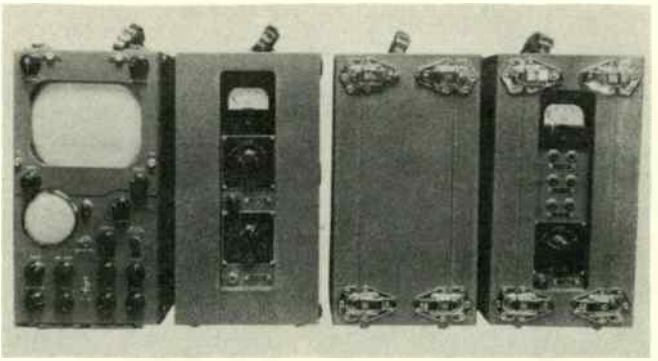
Some features of this equipment represent substantial advances over previous designs for portable equipment. Since this was the first Orthicon system designed for commercial sale, considerable thought was given to improving the ideas used in Iconoscope systems. The salient features are briefly reviewed in the following:

Camera

On account of the relatively large size of the Orthicon tube with its coil for magnetic focusing, the camera was necessarily considerably larger than the Iconoscope camera. The total weight could not be reduced below about 100 lb. Hence, it was divided into two parts - upper and lower sections - which can be separated in a few seconds for carrying to a new location. All inter-connections are made by plugs and jacks so that no tools are required for setting up the camera.



ORTHICON CAMERA FOR
PORTABLE PICKUP EQUIPMENT



CONTROL, POWER SUPPLY, AND SYNCHRONIZING
EQUIPMENT FOR PORTABLE TELEVISION PICKUP

The lower section contains the Orthicon and coil with plug connection for the camera cable and mechanism for optical focusing. The upper section contains a video pre-amplifier and complete deflection amplifier for the Orthicon. Circuits were re-arranged so that a small camera cable could be used with only two coaxial conductors included as compared with previous cables having four coaxials. The upper section contains also an optical view-finder which provides an erect image. Two identical lenses provide images for the Orthicon and view-finder. A mechanism for correcting the parallax effect of the double-lens system is included in the view-finder. Optical focusing is thus accomplished through observation of the image in the view finder. The total weight of the camera is 115 lb.

Camera Control Unit

This unit contains all electrical controls for the camera, and in addition, a picture-signal monitor consisting of a seven-inch picture tube (Kinescope) and a 3-inch oscilloscope tube, the latter for observing the wave shape of the picture signal. The 3-inch oscilloscope represents a distinct advance over previous camera control units which employed a 2-inch tube for the same purpose. The weight of this unit is 48 lb.

Power-Supply Unit

This unit supplies all plate power for the camera and camera control unit, and in addition, the current for the focusing field coil. The total requirements of these loads were considerably greater than anything encountered before. The total load on the power supply is about 0.9 amperes at 300 volts, all well regulated. The chief advance in this unit is in the transformer design. A transformer of ordinary design for this unit would weigh nearly 50 lb. alone, a prohibitive weight for portable equipment. Hence, a very light weight transformer with open construction to provide for forced ventilation was designed. The total weight of this transformer, including the blower, is about 19 lb. The total weight of the power supply, including the case, is 56 lb.

Synchronizing Generator

This generator provides synchronizing signal according to the requirements of the FCC. The performance of this generator is equal to, if not superior to, that of the MI-20250 rack-type synchronizing generator. Circuits have not only been simplified, but improved in such a way as to give superior performance in much smaller space and at a great reduction in the amount of

power required. The complete generator including its own plate power supply is contained in two suitcase units, each of which weighs 50 lb. or less.

Reports from the customer have indicated that, in most respects, the operation of this equipment has been highly satisfactory.

Since delivering the equipment to Bell Laboratories, considerable additional equipment of similar design has been manufactured and will be delivered early in 1942. This has been built simultaneously for three customers. Each has purchased more than one camera chain and hence requires a Master Control Unit for combining the outputs of the various camera chains. This unit compares to the mixer-panel in a sound system. It contains a 7-inch Kinescope like the camera control unit, and a 5-inch cathode-ray tube to observe the final wave shape of the picture signal. This unit provides switching facilities for a maximum of four camera chains. The total weight of the unit is 56 lb.

Numerous electrical and mechanical refinements have been incorporated in these later units.

The following indicates what equipments have been purchased by the individual customers:

Don Lee

Two camera equipments without synchronizing generator and without the master control unit. The cameras were also built without the optical view finders. Instead a selsyn control operated by the man at the camera control unit has been provided for optical focusing. The complete equipment for this customer, hence, includes two cameras, two camera control units and two power-supply units with the associated cables.

Columbia Broadcasting System

Three complete camera equipments including master control unit and synchronizing generator, but without optical view finders. Here again the selsyn focusing control was provided. The complete equipment for this customer includes three cameras, three camera control units, one master control unit, four power-supply units, and the synchronizing generator (2 units) with associated cables.

Station WTMJ (Milwaukee Journal)

Two complete camera equipments including master control unit, and synchronizing generator. Here optical view finders of improved design were provided. The complete equipment for this customer includes two cameras, two camera control units, one master control unit, three power supply units and the synchronizing generator (2 units) with associated cables.

PORTABLE STUDIO MONITOR

A portable television monitor unit has been developed. This unit is not portable in the same sense as the equipment described above. It is made up of a standard studio monitor unit (MI-21154), a picture oscillograph unit (MI-21153), and two regulated power-supply units (MI-21523) all mounted in a special rack supported on casters. It is felt that this unit will be very useful in development work in the laboratory, and also will be useful to operators of multi-channel studios for checking and servicing purposes. It can be rolled about as easily as the type 305 C.R.O. Circuits have been added and rearranged to improve the operation of the standard units.

SYNCHRONIZING GENERATOR FOR COLOR

A standard MI-20250 rack type synchronizing generator was revised for the Columbia Broadcasting system so that by changing a single switching control, either the standard synchronizing signal (441 lines, 30 frames, interlaced) or the color synchronizing signal (405 lines, 120 fields, interlaced), could be obtained.

ELECTRON MICROSCOPE

The year 1941 witnessed rapid advancement in the production, acceptance, and application of the RCA type B Electron Microscope. In all, sixteen instruments were completed and installed. The installations were about equally divided between college laboratories and the research departments of various industrial institutions.

To add to its list of achievements, the Microscope received first prize as "Best Design of the Year" from Electrical Manufacturing Magazine.

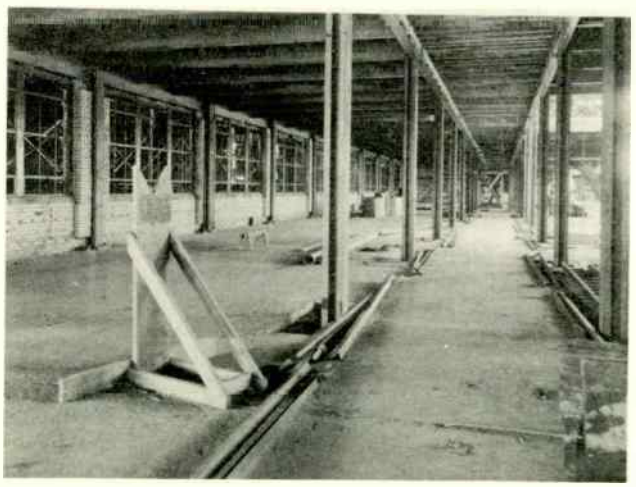
During the year many design improvements and attachments were made available for both field installations and new equipments. Among these were means for taking stereo-pictures.

Recent trends have indicated the need for larger fields at lower magnifications, particularly in the range where the useful upper limit of light microscopy ends and where the type B Electron Microscope normally commences; i.e. 1500 to 3500 diameters. To this end, a special specimen holder was developed which raises the specimen plane in the objective field and produces the desired results.

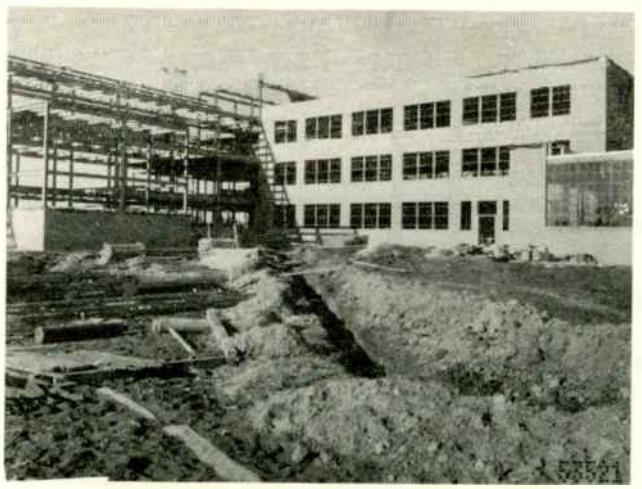
--ooOoo--

VIEWS SHOWING RECENT STATUS OF WORK ON RCA LABORATORIES' BUILDINGS

VIEW LOOKING NORTHWEST SHOWING PROGRESS ON BRICK WORK OF EAST WING AND COMPLETION OF GLAZING ON REAR BUILDING



VIEW ON FIRST FLOOR OF MAIN BUILDING LOOKING NORTHEAST DOWN CENTRAL HALL



VIEW LOOKING NORTH SHOWING PROGRESS WITH BRICK WORK ON CENTRAL CONNECTING STRUCTURE

THE POWERHOUSE

VIEW IN REAR BUILDING LOOKING SOUTHEAST DOWN CENTRAL HALL

INSTITUTE OF RADIO ENGINEERS

January 12, 13, and 14, 1942

WINTER CONVENTION

Hotel Commodore
New York, N. Y.

The Annual Convention this year was of special significance since 1942 marks the thirtieth anniversary of the Institute. This was celebrated with appropriate ceremonies at the banquet on Tuesday evening.

The registered attendance was 1753 which was within a small margin of the peak which occurred at the 1938 convention. Considering the pressure of work in radio engineering at this time, the attendance was surprisingly good. Inspection trips to the New York Daily News building and to the Alpine FM transmitter station had been scheduled but had to be called off.

At the banquet the citations for nine awards of Fellowship in the Institute were made. RCA was well represented in this group by G. H. Brown of RCAM, Camden, and H. O. Peterson of R.C.A.C., Riverhead.

The editors wish to acknowledge with thanks the assistance received from E. W. Winlund, J. E. Young and P. D. Gerber in the preparation and checking of the summaries of the technical papers which are given below.

Twenty-four technical papers were presented and of these 6, or 25%, were by RCA engineers, while 4, or 10%, were contributed by RCAM engineers.

Monday Morning

The first session was taken up with the message of the retiring President, F. E. Terman, the introduction of the new President, A. F. Van Dyck, and a talk on "The Mobilization of Science with Special Reference to Communication" by F. B. Jewett, President, National Academy of Sciences.

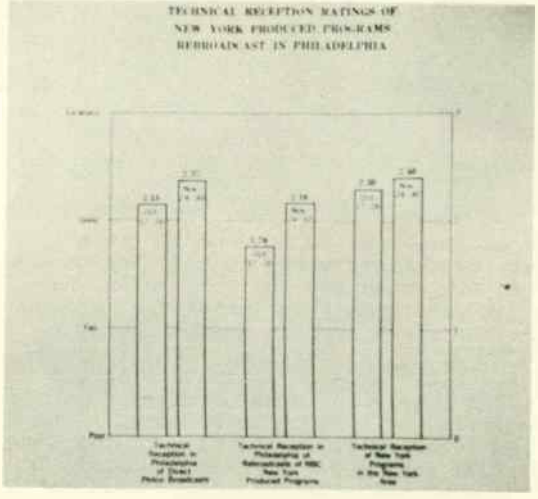
Monday Afternoon

The session was opened with a paper by Noran E. Kersta of NBC on "Half a Year in Commercial Television."

The author discussed the growth of television broadcasting and receiving facilities, the ratings of the programs, distribution of receivers, progress toward self-supporting status and the newest developments. Numerous slides were shown and the data from many of these (as of January 1, 1942) may be summarized as follows:

Television coverage of U.S. population	22.3%
This is divided among the following degrees of service	
Commercial, Experimental and Proposed	57%
Experimental or Proposed	26.9%
Proposed	16.1%
Television set ownership in New York market	
Dealers	9.2%
Public Places	12.5%
Homes	78.3%
Size of Screen used	
5 inch or under	31.9%
9 inch	18.8%
12 inch and over	49.3%
Ownership by make of set in New York Market	
RCA	62.1%
Andrea	8.0
DuMont	7.7
G.E. Co.	6.5
Home built	6.0
Meissner	3.4
All others	6.3
Divisions of WBNT Commercial Programs by Program Source	
Film	9.6%
Studio	27.4%
Mobile	63.0%

The author pointed out that the advertisers would require network television. The Philadelphia-New York-Schenectady network service was briefly outlined. A number of areas had been surveyed by sending out questionnaire cards and by actual personal interviews to get data on what the people liked in matters of



technical and program performance. The results of some of these surveys are shown in the accompanying figures. Roughly, the number of receivers in the principal areas having television service were estimated to be: Philadelphia - 400: New York - 2000; Chicago - 450; and San Francisco - 200. It was found that most people saw television on someone else's receiver before getting one themselves. In connection with the chart reproduced here showing commercial television time as a per cent of hours broadcast, it was pointed out that the figure of 10% approached in December was really rather good considering the age of this art since in sound broadcasting the usual similar

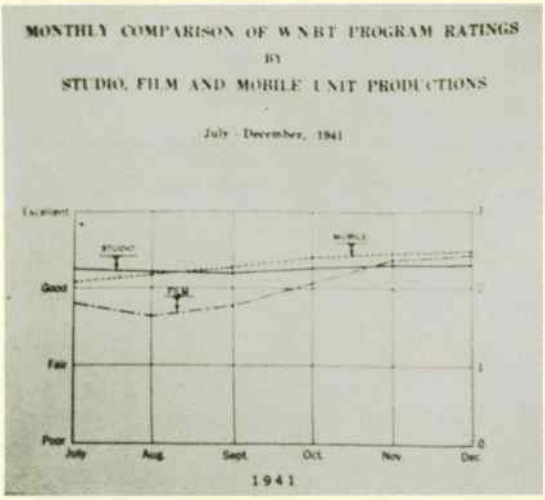
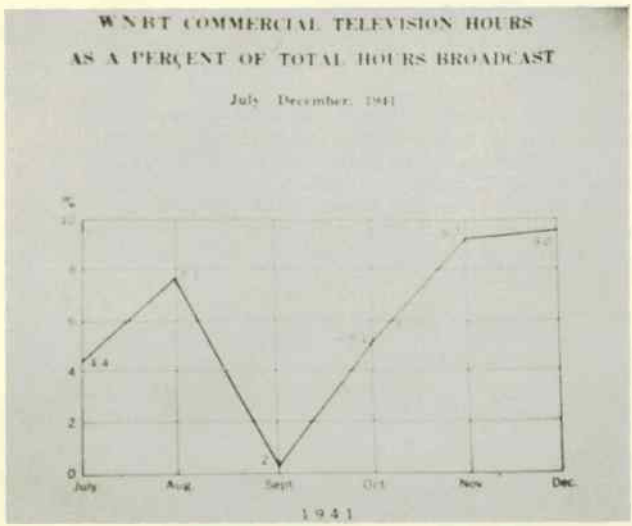
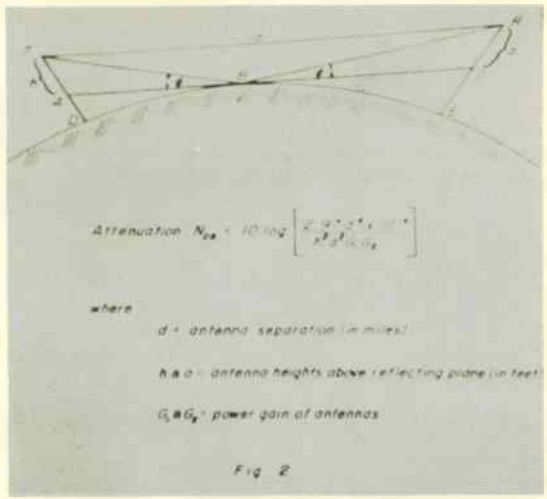


figure at present is only about 30%. With regard to possible audience size, it was estimated that, what with the neighbors coming in to homes having television receivers and the

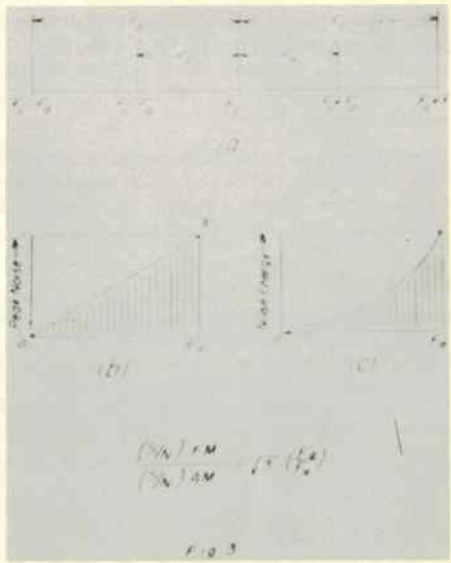


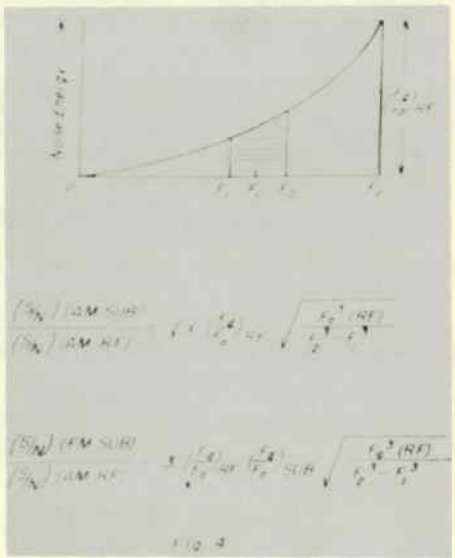
audiences of sometimes as many as 100 at a single set in public places, an audience of the order of 50,000 often saw the program in the evening. It was further estimated that about 80% of the receivers were in use in the evening and 60% during the daytime. Recent opportunities for television to contribute to the defense effort were mentioned as having been very successful. A television broadcast was given a few weeks prior to the time of the Convention. This consisted of a film program giving a demonstration of methods of dealing with incendiary bombs. It had been commented upon enthusiastically by those who saw it.

The next paper was on "Automatic Radio Relay Systems for Frequencies Above 500 Megacycles," by J. E. Smith of R.C.A. Communications. He first defined a radio-relay system as comprising a terminal transmitter, a series of relay stations and a terminal receiver. The problem of direct and reflected rays in relay work was next discussed and the relation of the phase of the reflected signals and the antenna height at the receiver was shown. The accompanying figure (Fig. 2) was shown to illustrate the relation of attenuation to the other factors involved. The author next discussed signal-to-noise ratios as related to relay work pointing



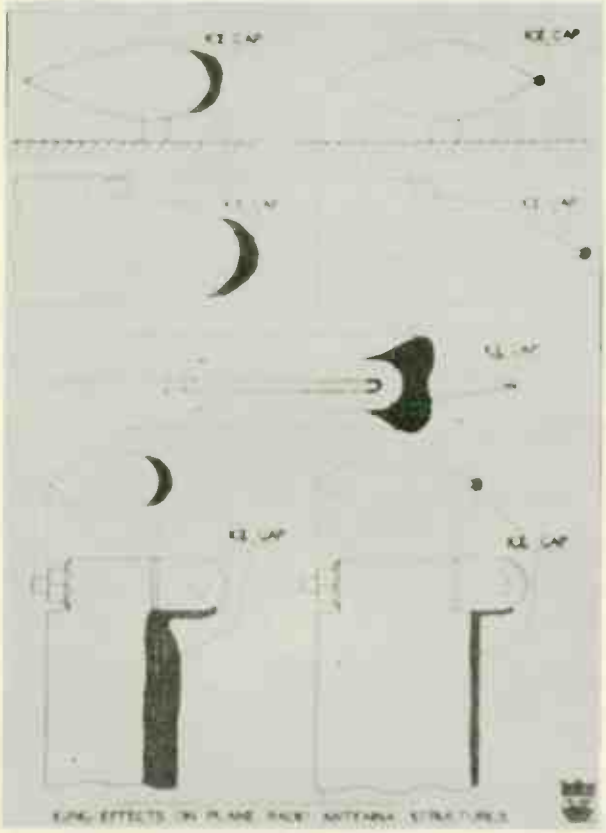
out the necessity of having a high limit on this characteristic for such services as television-program relaying. It was mentioned that about 0.3 microvolts across a 75-ohm receiver input transmission line was generally considered adequate to over ride the noise in the usual locations where relay stations might be situated. Next the question of what type of modulation to use (AM or FM) was discussed. Fig. 3 shows the



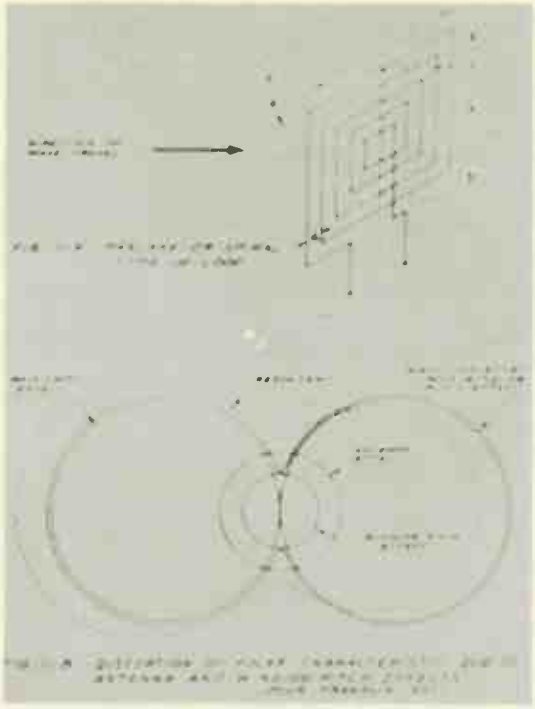


relative signal-noise ratios obtainable with the two types of modulation as related to the deviation ratio (Fd/Fa). The author next discussed the application of sub-carrier transmission for improving the signal-noise conditions. See Fig. 4. A generalized circuit was shown of the terminal transmitter which employed a phase modulator with multipliers. The characteristics of the transmitter were given as 5-watts output at 500 megacycles with a bandwidth of 50 kilocycles. The use of the relay system for transmitting a television program from Long Island to the Empire State transmitter was discussed. The use of alternate horizontal and vertical polarization was resorted to in order to avoid interference between incoming and outgoing signals at the relay points.

This was followed by a paper by G. F. Levy of United Air Lines on "Loop Antennas for Aircraft." After stating the well-known problems in the design of loops for aircraft use in the 200- to 400-kilocycle range the author proceeded to discuss these individually in more detail.



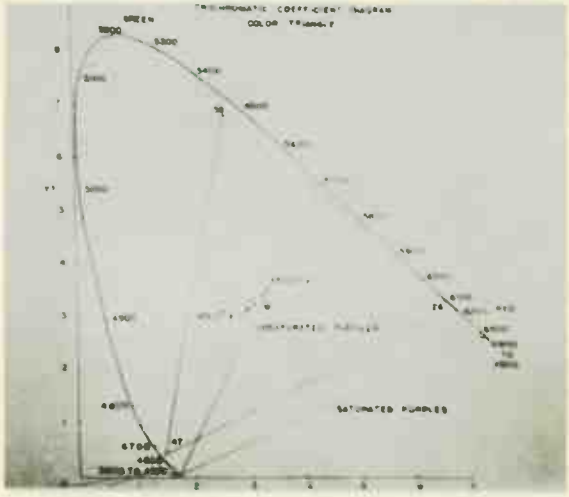
The matter of aerodynamic drag was discussed and the problem of icing as it affected the shape of loop housing and its placement was touched on. The relative advantages of low vs. high impedance-loop circuits were discussed as well as the relation of this problem to that of moisture absorption where the low-impedance loop has advantage. The use of an iron-core coupling coil was recommended for getting adequate coupling between a low-impedance loop circuit and the first tube grid circuit. The various distortions of the theoretical polar directivity characteristic were discussed at length and with relation to the solenoid and pancake types of winding. The solenoid-wound loop exhibits antenna effect and displacement-current effect. The pancake-wound loop shows antenna effect and winding-pitch effect. The author drew conclusions indicating as the most desirable type a shielded, high-impedance loop composed of a combination solenoid and pancake type of winding.



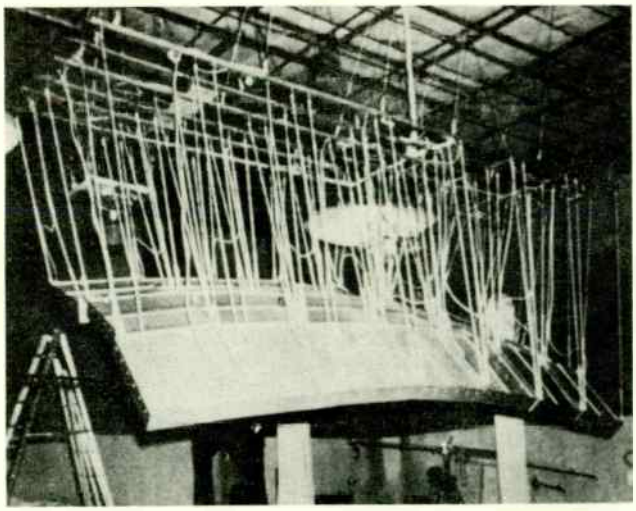
The next paper was by Marcel Wallace of Panoramic Radio Corporation on "Simultaneous Aural and Panoramic Reception." This paper was quite similar to the one the author gave on a similar subject before the I.R.E. Convention in Boston, June 1940. The chief differences were that this time the author had provided equipment to demonstrate his idea, and that he emphasized the possible defense uses of the device such as looking for illicit stations or watching for foreign broadcasts. Other uses might be for looking for unused channels in a given locality and for obtaining direction-finder signals from several stations on different frequencies simultaneously. A description of the author's system will be found in the December, 1941 issue of "Electronics."

Monday Evening

The only paper at this session was on "Color Television" by P. C. Goldmark, J. N. Dyer, E. R. Piore and J. M. Hollywood of CBS. The paper was presented by Goldmark. He began by saying, relative to the rotating color disc, that he does not claim that this will be the final



answer for color television but he does claim that it is quite reliable and is the only part of his equipment which has not gone up in smoke at one time or another. He discussed the tri-color sequential system, pointing out that if 12 Mc were available instead of the present 6-Mc channel, he could obtain better definition. Curves were shown of the spectral characteristics of the phosphors and of the filter which were used at both transmitter and receiver. This was followed by a considerable discussion on the method of determining the tristimulus values and corresponding trichromatic coefficients. The color triangle for his filters (Wratten Nos. 26, 47 and 58) on the well-known trichromatic coefficient diagram was shown and discussed. The limitations of the Wratten filters in the green section of the diagram was mentioned as a reason why his pictures were somewhat lacking in that color. The theoretical curves for the pick-up tube were shown, as well as the curves of the actual tube used. From the pick-up tube, the signal goes to the color-mixer control desk. The color mixer consists of an electronic switch which switches the signals in proper sequence to individual controls to balance the gain and brightness of the individual color components during the blanking intervals. The question of flicker was next discussed. It was stated that the flicker was contributed chiefly by the strongest color - that is green. By application of Talbot's law to color and reference to a graph from one of our published television papers the author arrived at a maximum tube brilliance which was permissible for minimum flicker at the field frequency and color frequency used.



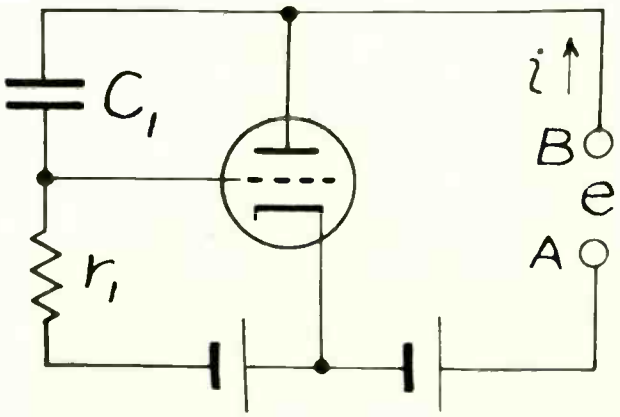
The author next discussed the synchronization problems of the color disc and showed the special magnetic break he had devised, together with its circuit for automatically holding the disc in proper phase and synchronism. At a specified time in the synchronizing part of every third field, impulses are transmitted to control the magnetic break on the color-disc shaft. This avoids the manually operated system used previously. A photograph of the fluorescent lamp bank mounted in the television studio was shown and is reproduced here.

The paper was followed by a demonstration which was about the same as that given a year before.

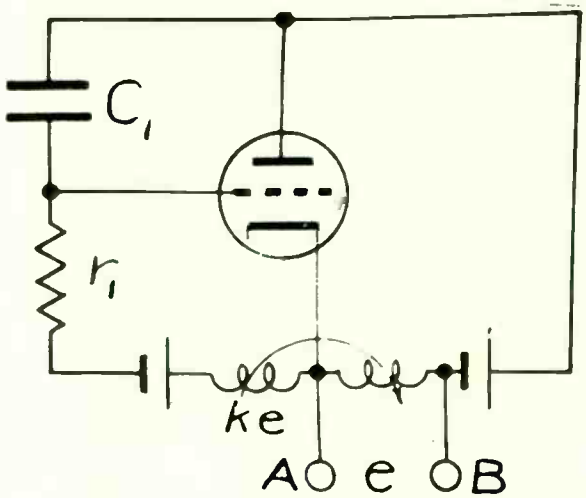
Tuesday Morning

This session was opened with a paper by B. Dudley of "Electronics" on the subject "How to Prepare Technical Papers for Publication." The author discussed first the method of preparation of material and presentation of subject and the method of preparing copies which depended somewhat on the publication to which the article was to be directed. Matters of use of symbols and inclusion of acknowledgments were discussed. The author felt that the summary should consist of a condensed version of the paper. If the author's statement on this point is strictly interpreted it would appear to be somewhat at variance with the idea of the summary outlined in the A.I.E.E. "Information for Authors," where it is suggested that the summary should give a definite idea of the scope, method of approach and important conclusions rather than to describe the paper or give excerpts from it. The method of preparing illustrations to be most useful was discussed. The author concluded with a discussion of the I.R.E. setup for considering and editing papers, mentioning, as did several others at the Convention, the "streamlining" which was said to have been put into effect several months previously to expedite the procedure between submission and publication. Several of our engineers have been wondering when this much heralded "streamlining" will start operating.

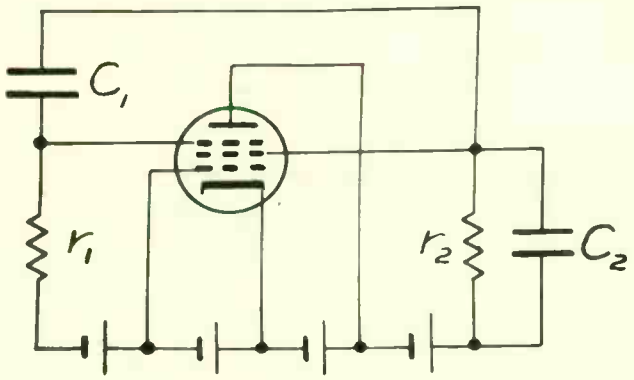
The next paper was by H. J. Reich of the University of Illinois on "The Use of Vacuum Tubes as Variable Impedance Elements." This paper will appear in the "Proceedings." The author discussed several circuits for obtaining effective high-capacitance values by the use of tubes associated with actual low capacitance. He also discussed several circuits for obtaining sustained sinewave oscillation.



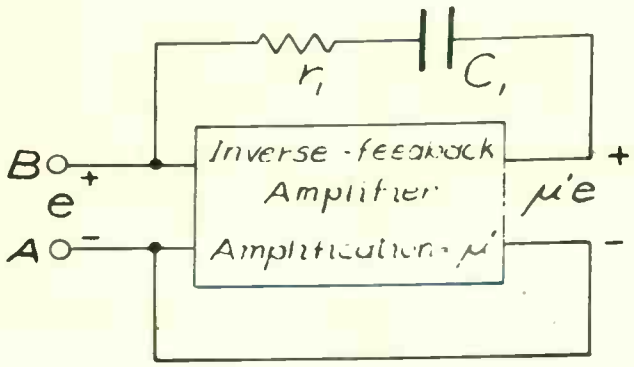
In the circuit above, the maximum effective capacitance at the terminals occurs when C_1 equals r_1. Tubes with the highest conductance are best but they also give the lowest effective resistance across the terminals.



The circuit above increases the available capacitance at the input terminals. The use of triodes is assumed in both the above circuits.



The above circuit is capable of producing sustained sinewave oscillations. Inductances may be substituted for the capacitances and the circuit will still oscillate but the author pointed out some question as to whether the oscillation would be entirely due to the inductances instead of partially due to distributed capacitance of the inductances.



The circuit above is essentially that used in a beat-frequency oscillator made by the Hewlett-Packard Company. Assuming that the output of the amplifier is 180° out of phase with the input, if R is 0 the effective capacitance at the input terminals is at a maximum. If the amplifier gain is 1000, then the effective capacitance at the input terminals is 1000 times the capacitance C_1. If an even number of stages is used in the amplifier, the circuit behaves at the input terminals as though it were an inductance shunted by a negative resistance. This will oscillate if shunted by an actual capacitor and this is what is done in the Hewlett-Packard circuit.

The next paper was by J. E. Shepherd formerly of Harvard University on "A Wide-Range, Linear, Unambiguous, Electronic Phasemeter." The author outlined briefly all the usual methods of measuring phase angle, including the one employed in our Type 300C phase meter, and then proceeded to describe his special circuit.

Referring to Fig. 1, the difference in phase of the two waves shown is represented by the distance ab. If we had a circuit such as shown in the lower part of the figure, and if the double-throw switch could be made to move back and forth so as to give d-c pulses as indicated by the shaded areas below the waves, the meters I_1 and I_2 would give readings - one proportional to the interval ab and the other to the interval ba. Obviously these would be proportional to the phase difference between the two waves and the meters could therefore be calibrated in phase angles.

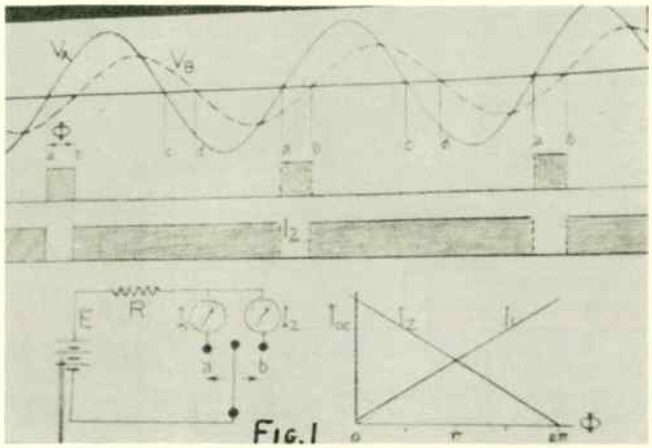


FIG. 1

Instead of the elementary switch shown in Fig. 1, elaborate amplifying, clipping and differentiating circuits were employed by the author to switch d-c impulses in the proper part of the cycle. Also, by using a zero-center-reading type of instrument instead of the two meters designated as I_1 or I_2, a single dial could be calibrated to read phase angles directly. These and other details were described by the author who demonstrated one of the fundamental principles involved by means of what might be termed a "motion picture slide" in which the periodic alternations of the switch were graphically portrayed by making this switch in the form of a pendulum and affixing it to the lantern slide so that the pendulum motion reproduced that of the switch on the stereoptican screen.

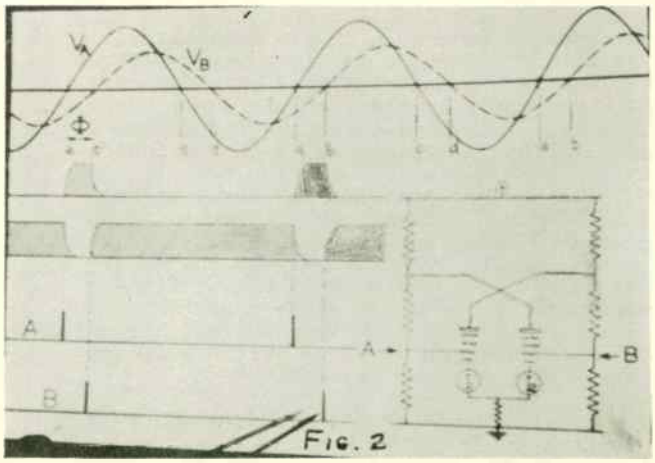


FIG. 2

The author employs the d-c multivibrator circuit shown in Fig. 2 in which the two triggering impulses are injected at A and B. This means that when one wave crosses the axis the multivibrator will swing in one direction and when the other wave crosses, the multivibrator will swing back again providing a pulse length actually equal to the time difference in phase between the two waves.

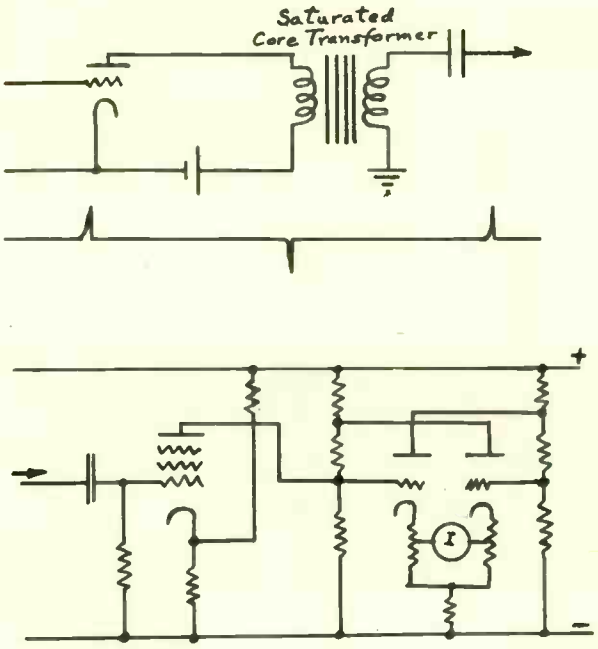


Fig. 3.

The two circuits of Fig. 3 show how limiting action is obtained and the method of actual feed to the multivibrator grids. By connecting the meter between the two cathodes as shown, it reads minus phase angles to the left and positive to the right.

A complete channel (of which there are two) may be shown by the block diagram of Fig. 4.

The author showed photographs of the completed equipment. It was mounted on a 7" x 19" panel including an electronically controlled "B" supply. Calibration of the plus and minus 180° angles was made by screw-driver adjustments on the front panel. The meter frequency range was from 30 to 15,000 cycles although the author stated that it had been used at 30 Mc by heterodyning down with a single oscillator. The input-voltage range was from 0.01 volts to 500 volts and the author stated that the next model would probably operate much lower than 10 millivolts. The phase-angle range was from 0 to 360°. Since the panel meter on the instrument read from minus 180° through zero to plus 180°, bringing the phase of the input voltage through 180° would cause the pointer to go up to plus 180°, snap back to minus 180°, and continue from there. The accuracy of the meter was stated to be approximately 0.5%. Even-harmonic distortion would cause phase shift but the author suggested filtering out all harmonics since the definition of phase shift is ambiguous when harmonics are present.

The closing paper of this session was by W. G. Shepherd and R. O. Wise of Bell Telephone Laboratories on "Variable-Frequency Bridge-Stabilized Oscillators."

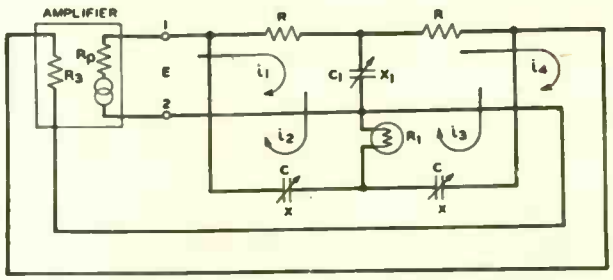


Fig. 1—Circuit of stabilized oscillator suitable for low frequencies

The authors first discussed general and well-known methods of stabilizing oscillators. The effect on the fundamental frequency of changing the amplitude of the harmonics was pointed out. The use of a circuit involving a resistor having a variable characteristic with temperature was discussed as a means of controlling this. Previous work on this subject had been confined to fixed-frequency oscillators but the authors had applied this theory to variable-frequency oscillators. By using the thermal element in a bridged-T or parallel-T network, it was stated to be possible to retain good stability over a frequency range of several megacycles. Fig. 1

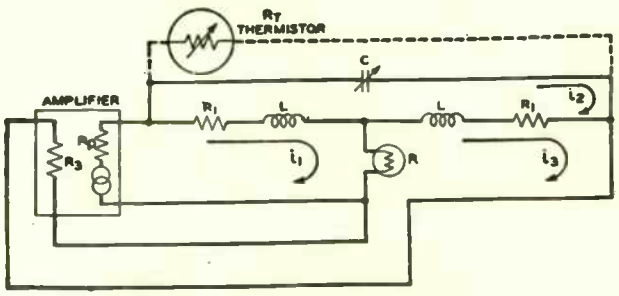


Fig. 2—Functional wiring diagram of oscillator for frequencies above the audio range

shows a circuit using a parallel-T frequency-determining network which was stated to be most effective at low frequencies. By varying the capacitances simultaneously, with a fixed ratio, the amplitude becomes independent of frequency. Such an oscillator is said to be capable of giving a very high degree of stability. The circuit of Fig. 2 was said to be applicable to frequencies above the audio range. Thermal control could be obtained in this circuit either by the use of the shunt-control element - requiring a positive thermal coefficient - or by a resistor in the position shown by the dashed line. In the latter case a negative temperature coefficient was required. The latter has some advantage from the standpoint of greater sensitivity of the thermal element.

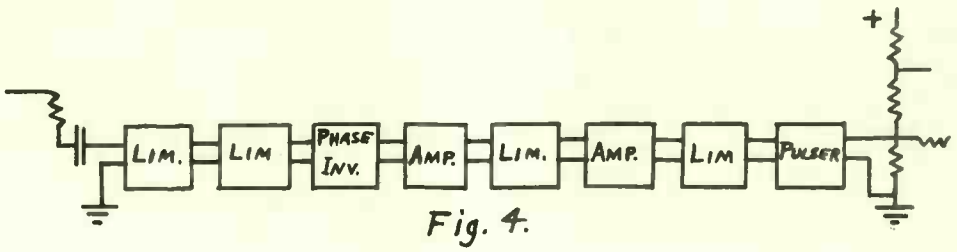


Fig. 4.

Tuesday Afternoon

The first paper at this session was by E. U. Condon of Westinghouse on "Space-Charge Relations in the Magnetron with Plane Electrodes." This was a highly mathematical paper on the somewhat academic subject of the travel of electrons between parallel planes in magnetrons. The author stated that the frequency varies from maximum to one-half maximum when the space charge is increased from zero to maximum; also that the space-charge current decreases from maximum to 71% of maximum between zero and cut-off field.

The next paper was by H. Goldberg, formerly of the University of Wisconsin and now of Stromberg Carlson, on "Bioelectric Research Apparatus." The author had spent some time on the subject of radio application to biological research and had built several amplifiers for this work of which photographs were shown. He stated that the magnitudes of voltage to be measured ranged from 20 microvolts to 70 millivolts, the latter being the voltage obtainable from tissue of a dog. The duration time of the phenomena to be measured ranged from one millisecond to one minute. The frequency range required for this particular type of research was from d.c. to 10 kc. Because of the high impedance of the parts under measurement, the input resistance of the equipment must be at least one megohm. The amplifier gain must be at least 120 decibels. One of the principal difficulties encountered in this type of work is that if an electrical stimulus is used to excite the tissue, this stimulus may have to be one-million times the amplitude of the pulse to be measured. In order to prevent this from interfering with the measurement, the common practice has been to use differential amplifiers. These are push-pull so as to provide an alegbraic sum at the output.

The author's circuit employed a 2½-megohm input, provided calibration from 2 to 500 microvolts, had two stages of d-c amplification and all stages except the last operated on batteries. The differential action was about one-hundred thousandth, meaning that the amplifier could be adjusted so that application of equal voltages at the input terminals in phase or out of phase would produce this ratio of voltage at the output terminals. This action was obtained by balancing input potentiometers. The amplifier had eight microvolts of noise, a gain of 130 decibels and the total voltage of the batteries was 180 on the three stages so supplied. The cathode-ray equipment had to be synchronized with the stimulus and the equipment provided elaborate means for this purpose. A single sweep was obtained by opening a switch across the normal time-constant capacitors. Pulses were used for stimuli. Also there were circuits for providing a burst of pulses required for different types of work. These circuits could be adjusted for any rate of repetition or pulse length and would continue for any specified duration. In the discussion it was pointed out that a German has quite successfully used a differential circuit in the first stage only, following this by normal single-ended amplifiers. A biologist rose to state that 7 kc would take care of a very large portion of the applications where a bundle of nerves is being investigated. For work on a single nerve, the frequency response might have to go out to 200 kc or more. Another person asked whether the RCA-931 electron multiplier had been used for this work and no one seemed to know of such an application.

The next paper was by H. P. Vore of Westinghouse on "The Dynetric Balancing Machine." Instead of the customary method of balancing machines which involves placing trial weights on the rotor and measuring the change in vibration amplitude, the author had developed apparatus which would indicate by means of meters the proper location of correction weights, from the initial vibration and phasing, without resorting to trial weights. The circuit shown

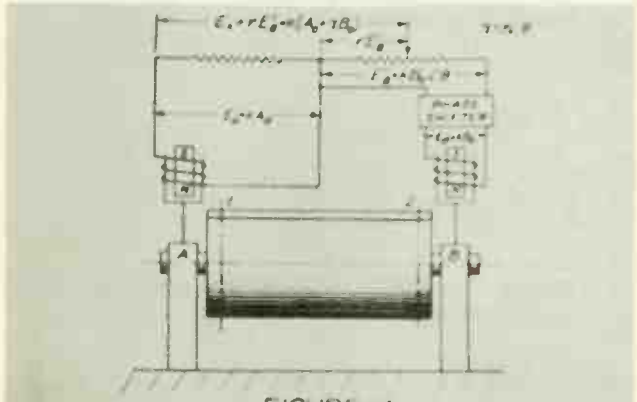


FIGURE 4
MEASUREMENT OF UNBALANCE BY MEANS OF AN ELECTRICAL NETWORK

basically in Fig. 4 was used in conjunction with a stroboscope.

The stroboscopic light was played upon the rotor which was mounted on a pedestal equipped with vibration pickups. The natural resonant frequency of the system was kept well below that of the vibration being measured. The remainder of the circuit consisted principally of elaborate switches for reversing phase. Another method described by the author employed an alternator attached to the shaft of the rotor which fed sinewaves to the coils of the wattmeter (See Fig. 7). It was pointed out that this method was not as satisfactory as the first but was the only one applicable to very large machinery where it was not convenient to put the rotor into a special vibration machine. In the discussion it was pointed out that sometimes photo-electric and oscillographic means were also used but the author stated that with these the accuracy was not nearly as good as with the one he described.

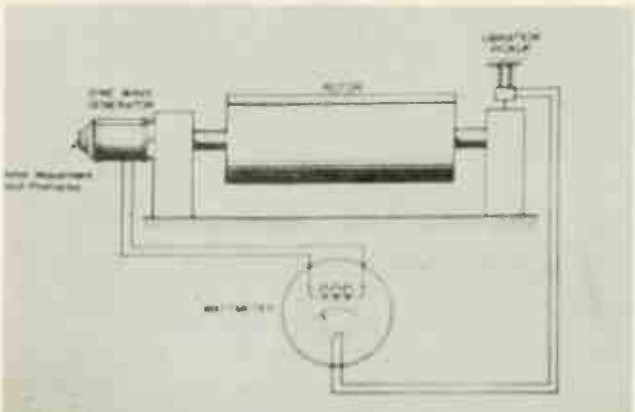


FIG. 7
WATTMETER METHOD OF VIBRATION MEASUREMENT

The session closed with a paper on "Inospheric Investigations at Huangayo Magnetic Observatory, Peru, with Applications to Wave-

Transmission Conditions" by H. W. Wells, of the Carnegie Institution of Washington. This was a description of some observations made in Peru on the heights of the various ionosphere layers. Particular reference was made to the behavior of the ionosphere on or around September 18, 1941, when we had the heavy aurora borealis. It was shown that the sun spots were pointed directly at the earth on September 16 and the two-day delay of effects on the earth is generally ascribable to the fact that two days are required for the "corpuscles" to reach the earth. This is assumed to mean that it took two days longer than it took the light to reach the earth. The apparatus employed was such that a chart was produced automatically by oscillographic means for showing virtual-layer height versus frequency. It was very significantly demonstrated that between 2:30 and 3:00 p.m. on September 18, this layer was entirely missing on the chart. The oscillographic traces simply disappeared. The earth's magnetic field was shown to have a sharp rise during this period.

Wednesday Morning

This was scheduled as a "college technical session." The nearby technical institutions - including our associate, R.C.A. Institutes - were well represented through their students at this meeting. The talks presented were directed particularly to the students and were given in a somewhat less formal fashion than those in the other technical sessions.

The first was presented by J. V. L. Hogan of Interstate Broadcasting Company on the subject "Modern Techniques in Broadcasting." He started by emphasizing that students would find plenty of opportunities in this constantly expanding field of radio. He then took up the subject closest to his heart - FM - and spent the remainder of the time discussing it. He gave the conventional material on the primary and secondary service areas with relation to AM and FM systems. He pointed out the advantage of a system which would cover all of New England with signals for purposes of air-raid warning and other defense and war purposes. He gave as an advantage of FM the fact that it would not carry far enough out to sea to act as a source of directional signals for enemy use.* The author pointed out that in his opinion the high-fidelity angle of FM transmission has been over emphasized and stated that FM had no inherent Characteristic which made it produce better fidelity than could be obtained with AM under proper conditions. His AM station with wide-band transmission had produced signals covering an audio range of 20 to 16,000 cycles without difficulty. He then discussed the signal-to-noise advantages at proper relative amplitudes of signal and noise which was characteristic of the FM system. He emphasized the need for good audio systems in FM reception and implied that this was present in FM receivers to a greater extent than in AM receivers. He specified a dynamic range of 50-60 db as desirable for FM receivers. In closing he touched briefly on facsimile, pointing out its relation to television as supplementary rather than parallel or in opposition.

The next talk was by B. J. Thompson of RCAM, Harrison on "Modern Developments in Electronics." He pointed out that he could only hope to cover a part of the field implied by the title and that he would confine his remarks to those developments with which he was best acquainted.

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*It appears that this advantage is attained because of the carrier frequency used rather than the type of modulation.--Ed.

He described the relation of television to electronic developments and discussed the large-screen and Orthicon developments. The field of u-h-f was discussed briefly. He concluded his remarks with a description of the electron microscope.

The concluding paper of the session was by J. H. Hackenberg of Western Union on "Demonstration of Facsimile Equipment." He stated that 2,000,000 telegrams had been handled by Facsimile during 1941. Rates were based on the number of square inches of copy transmitted. New York to Chicago was 37½ cents per linear inch with a maximum width of 7"; minimum charge was $1.00. The method of transmission and reception using the Western Union Company's Teledeltos paper was described and a setup of automatic transmitting and receiving machines was demonstrated.

Wednesday Afternoon

This session was started with a paper by Lieutenant Colonel R. V. D. Corput, Jr., United States Army, Fort Monmouth, N. J. on the subject "The Fort Monmouth Laboratory of the Signal Corps." The speaker commenced with a general discussion of the laboratory organization pointing out that whereas they had 200 people in the laboratory in 1940, recent appropriations have enabled them to increase their staff to a present total of 2437. The organization of the laboratory is primarily civilian with a few officers, primarily to take care of policy matters and to coordinate activities with the military forces. The civilian personnel is under Civil Service. The speaker then described briefly the various sections into which the personnel was divided. The function of the Product Engineering Section is to keep existing apparatus up-to-date by adding newly developed parts, gadgets, etc. They also get out specifications and drawings for these changes. The Specifications and Records group is a sub-section under this section. In general, the majority of the specifications, however, are written up by the sections developing or working on the equipment.

The Inspection Engineering Section inspects components to determine whether they meet specifications and drawings.

The Procurement Division purchases supplies and also takes care of the letting of contracts.

The Supply Section keeps track of property of the Laboratory.

A shop is provided which has as its primary function the working up of manufacturers' models to a point where they will be satisfactory for production.

There are a number of development sections, each under a project officer. Three field laboratories are provided in the organization. The field radio section is concerned primarily with the development of equipment to be carried by foot soldiers.

The radio direction-finding section develops equipment for use in air navigation and air interceptor work. The wire section takes care of telephone, telegraph, printers and similar equipment.

The Meteorological Service has been discontinued at Fort Monmouth and the group remaining there merely do development of equipment for obtaining meteorological information. The Thermionic Section was said by the author to have as one of its chief functions the develop-

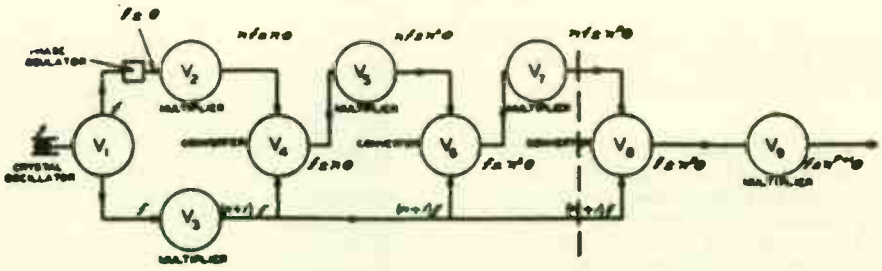


Fig. 1 —Stabilized frequency-modulation system using several converters.

ing of vacuum tubes which people in the industry believe will not work.

The Radio-Direction-Finding Section closely coordinates work with that of the Naval Research Laboratory, with industrial laboratories and with the National Defense Research Council.

The next paper was by A. J. Ebel of the University of Illinois Station WILL on the subject "Note on the Sources of Spurious Radiations in the Field of Two Strong Signals." This paper described tests made of an interference condition which existed as a result of a combination of signals from two stations in Urbana, Illinois - WILL and WDWS. The investigation came to the same conclusion as that arrived at in a similar case in Seattle, Washington, which was investigated several years ago by L. C. F. Horle for the RMA. The spurious signals resulted from nonlinearities in conductors which served as antennas, due to poor contact with ground and in other parts of the conductors. This article has been published in the February 1942 issue of the Proceedings of the I.R.E.

The next paper was by C. S. Perry and E. W. Winlund of RCAM, Camden, on "RCA 10-Kilowatt Frequency-Modulated Transmitter." A copy of this paper is available in E. T. Dickey's office for those interested.

The next paper was by R. J. Peracci of Collins Radio on the subject "A Stabilized Frequency-Modulation System." This described a system of phase-angle frequency modulation with pre-distortion which was substantially equivalent to Major Armstrong's new system as used by Radio Engineering Laboratories. The pre-distortion equipment was described in detail by the author. It was a simple device which relied on the fact that amplitude modulation of the carrier component before combination of the phase-modulation side bands effectively changed the degree of phase modulation in the proper phase to overcome the non-linearity resulting from wide-phase-angle swings in the phase modulator. The basic idea is shown in the block diagram of Fig. 1.

The author showed that if the carrier was amplitude modulated at approximately twice the modulating frequency, the resultant compensation was almost exactly that required to straighten out the phase-modulation characteristic for wide phase-angle excursions. The particular examples he quoted were two: in one case distortion at 50 cycles was reduced from 22% without compensation to 3% with compensation; in the second case with a somewhat smaller phase-angle excursion the distortion was reduced from approximately 8% without compensation to 1.5% with compensation. The means of obtaining a double-frequency signal, having substantially undistorted wave form was as follows: A simple full-wave rectifier, fed with the input signal, produced in its output circuit half-sine waves with a major double-frequency component. The sharp curvature obtained at the bottom of the wave, characteristic of such rectifiers, was then broadened out by putting the signal through a remote cut-off tube. Because of the well-known grid-plate characteristic of such a tube, the effect was to broaden out the bottom of the wave making it closely approach a sine wave in form. Slightly biasing the rectifier further broadened out the base of the wave so that

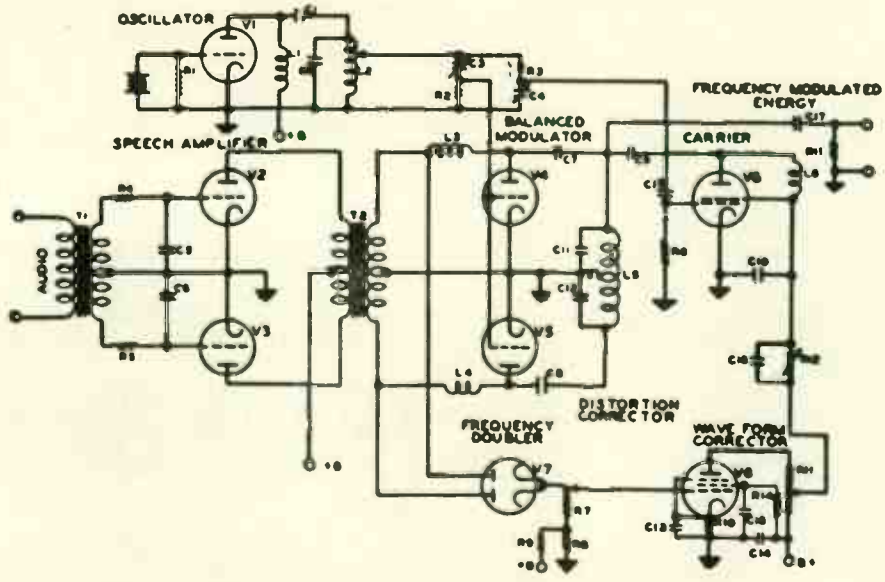


Fig. 2 —Circuit diagram frequency modulator and distortion-correction system.

the resultant was within 5% of a true sine wave of twice the modulating frequency. The circuit of the modulator and wave-form corrector is shown in Fig. 2.

There was considerable discussion at the conclusion of the paper which centered around the fact that all of the author's work was done with single-frequency tones, whereas the signal which the system would be called upon to handle in actual service would be a complex wave. The point was raised that the frequency-doubling circuit which the author described is not completely effective on complex waves. An example brought up to substantiate this statement was the fact that a square wave is unaffected by such a rectifier, i.e., its major frequencies are not doubled. It was stated that for the predistorter to operate properly it should double the frequency, not only of the major component but also of all the other components of the signal and the circuit characteristics should be such that inter-modulation, ordinarily associated with a frequency-doubler characteristic, was likewise provided to secure complete compensation in the case of a complex wave.

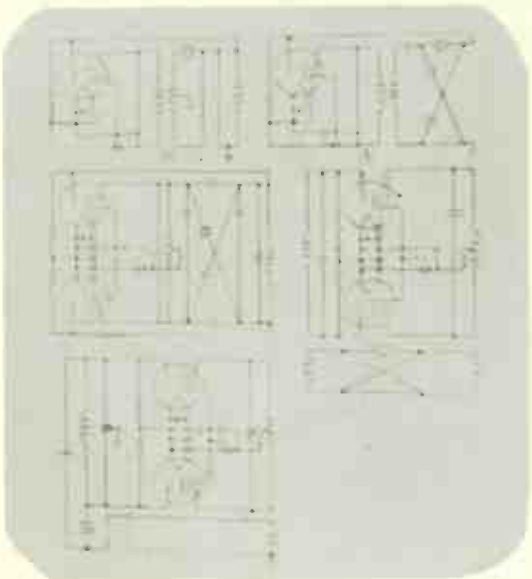
The speaker had obviously never considered the case of anything but single-frequency functions. He was partially rescued by Mr. White of the CBS Television Group who described some related mathematical work he had done which indicated that while such a pre-distorter was not completely effective on complex waves, it did provide considerable distortion correction.

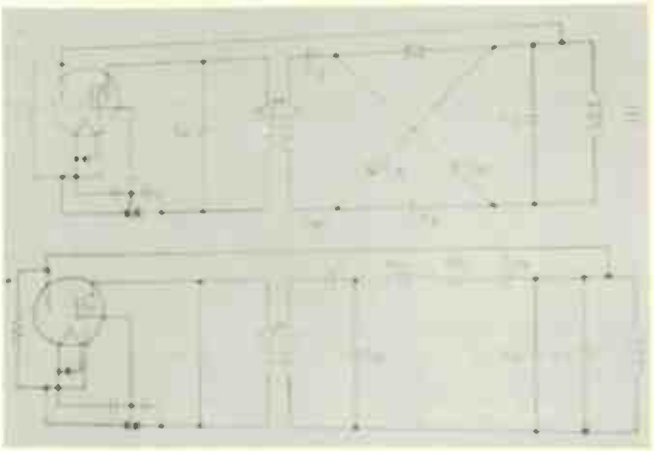
Wednesday Evening

The first paper at this session was by D. O. North of RCAM, Harrison, on "The Absolute Sensitivity of Radio Receivers." This paper appeared in the January, 1942 issue of the "RCA Review."

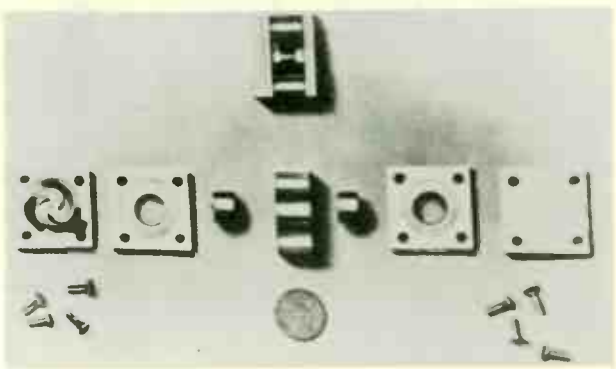
The next paper was by E. W. Herold of RCAM, Harrison on "An Analysis of the Signal-to-Noise Ratio of Ultra-High-Frequency Receivers." This paper also appeared in the January, 1942 issue of the "RCA Review."

The next paper was by W. P. Mason and I. E. Fair of Bell Telephone Labs. on "A New Direct Crystal-Controlled Oscillator for Ultra-Short-Wave Frequencies." The paper was presented by





I. E. Fair. The authors discussed the general problem of getting quartz crystals to operate at higher and higher frequencies and stated that they had found it unsatisfactory to grind crystals to less than 6 mils in thickness. The crystals operated at a multiple of their natural frequency, dividing into oscillation modes in the thickness direction. The equivalent circuit of the crystal and its reactance characteristic were shown and the factors governing its "Q" were discussed. It was pointed out that the crystal exhibits positive reactance only over a small frequency range near resonance. The elements of the crystal equivalent circuit used as a coupling between plate and grid circuits of a tube were shown and it was indicated that the condition for oscillation required that the sum of the shunt reactances be less than the series reactance and the values of both shunt reactances must be positive. The circuit for measuring the "Q" of the crystal by a comparison or substitution method was shown. An oscillator and tube-volt-meter method for making this same measurement was also shown. Characteristic graphs of "Q" for 3 crystals were then shown. At 15 Mc the lowest "Q" was 75,000 and the highest 400,000. Various symmetrical-lattice coupling networks were then shown and their characteristics were discussed. The use of a single crystal was indicated as desirable and two coupling circuits for oscillators were shown. A series of variations on these - some using one tube and some push pull



U-H-F CRYSTAL AND HOLDER

- were shown. See accompanying figures. The balanced circuits were said to be best for the very high frequencies. A photograph of the crystal holder and parts for the u-h-f crystals was shown and is reproduced herewith. The small circular crystal can be seen in this figure. It was stated to be about 1/2 inch in diameter. Curves of frequency stability and grid current with respect to grid-circuit capacitance for a 120-Mc crystal were shown. The frequency stability with respect to temperature variations was also shown. For a change from 30° to 80° C it was 2 kc for one crystal and 8 kc for the other. The authors gave as one advantage of the crystals described the fact that they could be used in circuits of oscillators of considerable power. Several had been used directly in 8-watt oscillator circuits. During the discussion it was brought out that 197 Mc was the highest frequency at which the authors had made and operated the crystals described. For this particular frequency the crystal oscillated in 27 thickness-section modes.

The concluding paper of the convention was by Andrew Alford and A. G. Kandoian of International Telephone and Radio Laboratories on the subject "An Ultra-High-Frequency Two-Course Radio Range with Sector Identification."

The author began with a discussion of the difficulty characteristic of the conventional "A-N" radio beacon whereby off-course ambiguity exists. This prevents the pilot from relocating himself with precision in case the course is accidentally lost for a time. The new system to be described was intended to eliminate this ambiguity.

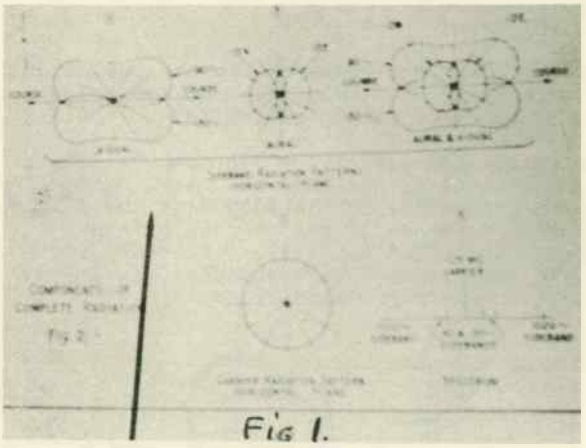


Fig 1.

Visual as well as aural indications were provided through the use of an indicating instrument. An audible station-identifying signal was also radiated by the transmitter. The signal radiated also indicated to the pilot which side of the station he was on. The range station radiated a carrier equally in all directions. Side bands were then radiated in directional patterns. The radiated patterns are illustrated in Fig. 1. For the visual indication signal, one pattern was modulated with 90 cycles and the other 150 cycles. The mechanical-modulation system used for producing these modulated signals is shown in Fig. 2. A bridge circuit was used to properly feed the side bands to the appropriate radiators. The

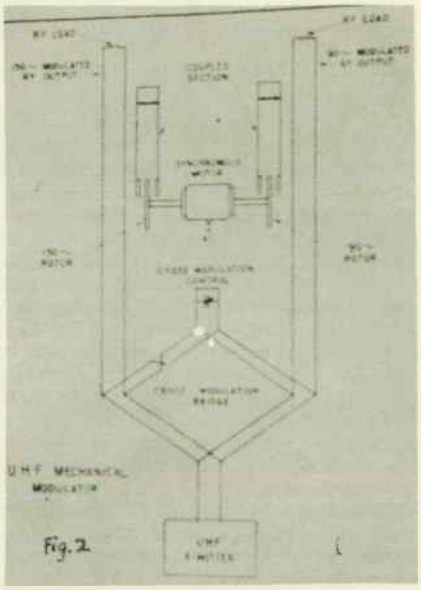


Fig. 2

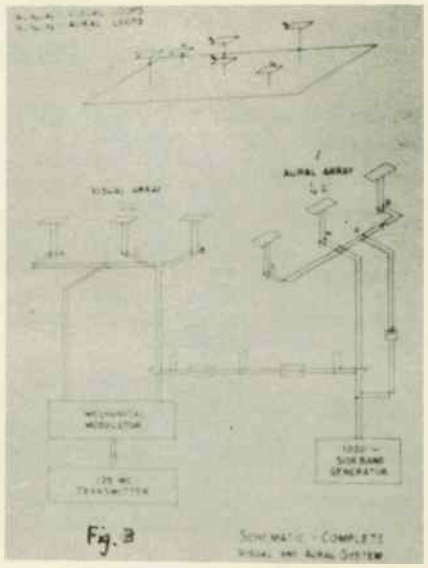


Fig. 3

authors spent considerable time discussing the various problems involved in producing the complicated radiation patterns. The complete set-up of radiators with tie lines to prevent interaction is shown in Fig. 3.

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PAPER FROM OHIO BROADCAST ENGINEERING CONFERENCE*

Paper by D. E. Noble of Galvin Manufacturing Company on "Mobile FM." The subject was introduced with a review of the various methods of obtaining frequency modulation. Equations showing the relation between amplitude, frequency and phase modulation were discussed. The balanced modulator as used in the Motorola transmitter was then described. It was mentioned that although some amplitude modulation did occur, its effect was minimized due to saturation in the multiplier stages. Furthermore, since a distortion figure of 1 or 2% is not sought for, this amplitude modulation is considered negligible. No corrective networks are utilized in the audio system of the transmitter to convert the phase modulation to frequency modulation. Advantage is taken of the energy distribution of the average male voice in obtaining approximately equal frequency deviations within the speech spectrum. A corrective network in the receiver associated with the transmitter further equalizes the frequency response. Mention was made of an RC network at the input to the modulator which served to reduce the effects of the microphone resonance peaks on the overall frequency response of the system. Reference was made to the Crosby modulator. A description of its principles was given and comment was made that this type of circuit is being successfully used in practice.

A photograph of the mobile transmitter chassis was shown. The transmitter is rated nominally at 30 watts but a conversion kit is available for changing it to a 50-watt transmitter. The mobile transmitter may be converted for a-c operation by substitution of suitable components which are available in kit form.

Multiplication of 32 times was used in 3 stages following the modulator. No specific figure was given on transmitter distortion. The author, however, stated that a 30° phase shift in the modulator was accompanied by approximately 7% distortion. (At 300 cycles this is only 5000 cycles frequency deviation).

The receiver used the double-superheterodyne principle with a crystal-controlled oscillator for each frequency converter. The first i.f. was 4.3 Mc and the second 455 kc. The receiver could be battery or a-c operated. A squelch circuit was provided for eliminating noise and this could be set to operate on a 0.4 microvolt input signal. Such a signal was not necessarily considered a usable one, however.

The author next described various installations of the equipment. In New Hampshire some outdoor unattended stations had been giving very satisfactory service. The network of the Michigan State Police was also described. In this case 10 250-watt fixed transmitters were employed and 355 mobile installations.

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BLOOMINGTON I.R.E. SECTION MEETING

By J. G. Badger
Bloomington Engineering Division

The Engineering Division at Bloomington acted as host to one of the most successful I.R.E. meetings ever held in the Indiana Section, when it arranged for and handled a group of slightly in excess of 150 persons last January 16. The technical session was conducted in cooperation with Indiana University, who placed the splendid lecture-room facilities in its new Physics Building at the disposal of the Institute. This was the biggest attraction of the program, judging by the number attending.

During the business meeting which preceded the presentation of papers, certificates indicating satisfactory completion of a Defense Training Class in Industrial Electronics were awarded to D. N. Kaltenbacher, Lewis W. Dixon, J. Walter Trumpy, Louis L. Lipps, and Joe G. Badger, all members of the Bloomington Plant.

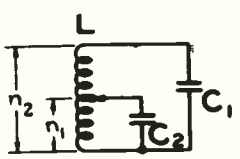

FIG. 1

Three papers were presented to the assembled group. They are of timely interest and therefore are worthy of consideration here.

The chief engineer of the Bloomington Plant, Mr. Sarkes Tarzian, outlined the novel band-spread-tuning arrangement employed in the 14X "Foreign Correspondent" receiver in a paper entitled "Simplified Band-Spread Circuits for Multiband Receivers." Three slides used in the presentation are reproduced below.

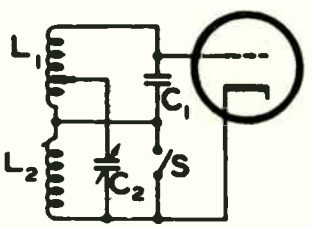

FIG. 2

Figure 1 illustrates the fundamental circuit and indicates the values used in equations (1) and (2).

$$C_T = C_1 + C_2 \left(\frac{n_1}{n_2}\right)^2 \quad \text{..... 1}$$

$$f_R = \frac{1}{2\pi\sqrt{L\left[C_1 + C_2\left(\frac{n_1}{n_2}\right)^2\right]}} \quad \text{..... 2}$$

Figure 2 demonstrates a developmental application of this principle of band spread by impedance transformation in a receiver circuit

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*Mr. Harry Sussman of the Special Apparatus Engineering Division attended some of the lectures and has provided us with a report on one of the papers which is summarized here.--Ed.

and forms the basis for further mathematical analysis, (see equations 3 to 8 inclusive).

$$f^2_{MAX} = \frac{1}{4\pi^2 L C_{MIN}} \quad \text{.....3}$$

$$f^2_{MIN} = \frac{1}{4\pi^2 L (C_{MIN} + C_{INC})} \quad \text{.....4}$$

$$\frac{1}{4\pi^2 f^2_{MAX} C_{MIN}} \quad \text{FOR L IN 4}$$

$$f^2_{MIN} = \frac{f^2_{MAX} C_{MIN}}{C_{MIN} + C_{INC}} \quad \text{.....5}$$

$$C_{MIN} = \frac{f^2_{MIN} C_{INC}}{f^2_{MAX} - f^2_{MIN}} \quad \text{.....6}$$

$$C_{INC} = \frac{C_{MIN}(f^2_{MAX} - f^2_{MIN})}{f^2_{MIN}} \quad \text{.....7}$$

$$C_1 = \frac{f^2_{MIN} C_2 \left(\frac{n_1}{n_2}\right)}{f^2_{MAX} - f^2_{MIN}} - C_{MIN}\left(\frac{n_1}{n_2}\right) \quad \text{...8}$$

Figure 3 is a schematic of the 14X "Foreign Correspondent" receiver and indicates the application of the principle to the r-f and oscillator circuits, thereby permitting simplified band spread in a low-cost receiver. The chief advantages of the system are its simplicity (elimination of series and shunt capacitors and consequent reduction of switch functions) and the ability to switch exclusively in low-potential circuits.

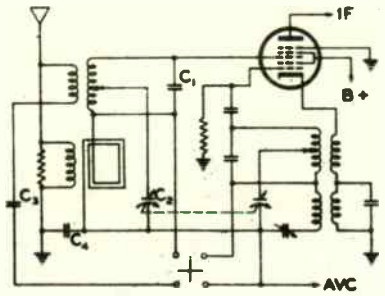

FIG. 3

The second paper entitled "Kinescope Contrast-Range Improvements by Circuit Means" was presented by George Sziklai of the Bloomington Engineering Division. This paper presented the subject of contrast range and its relation to focussing, particularly with regard to improvements in focussing which tend to reduce "blooming" effects.

For a mathematical approach to the problem reference was first made to Figure 4, which shows the trajectory of an electron from the time it enters the focussing field at a beam cross-section radius R_o and is acted upon by this electrostatic field, which tends to reduce R_o to some value r. The following relation was obtained for r:

$$r = R_o \epsilon^{\frac{-V_d \frac{m}{e}}{4Ie} (V_R^2 - V_r^2)}$$

where $\frac{m}{e} = \frac{\text{mass of electron}}{\text{charge of electron}}$

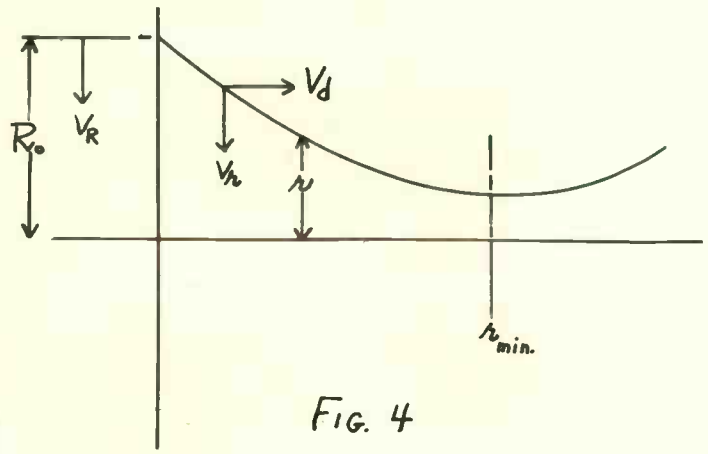

FIG. 4

Optimum focusing, represented by a minimum value of r, occurs when V_r, the radial velocity, is a minimum, and from the foregoing analysis it is apparent that point focusing is unattainable, inasmuch as r must always be a finite quantity. It is also apparent that the beam diameter at a given distance will vary in proportion to the axial velocity (voltage difference) and inversely with the beam current.

Mr. Sziklai illustrated various circuit means for obtaining constant $\frac{V_d}{I}$ exponents; i.e., changing the focusing anode potential inversely with the beam current and pointed out complications involved in time-constant requirements. Photographic reproductions of Kinescope images obtained by the improved circuits as contrasted with previous images were presented. A noticeable reduction in "blooming" effects was readily apparent from the photographs.

The third paper, which dealt with "Oscillator Coil Design for Permeability Tuners" was presented by Robert Trachtenberg, formerly of the Bloomington Engineering Division and at present engaged in Government work in Camden. His paper discussed the common problem in all permeability-tuning systems for superheterodyne receivers - the design of the oscillator for proper tracking.

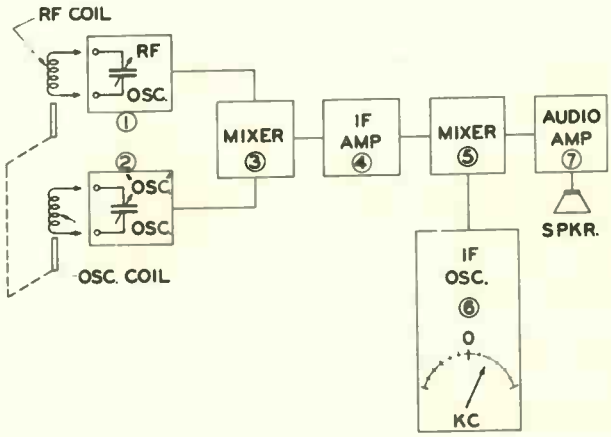

FIG. 5

TRACKING CHECK EQUIPMENT

In order to determine rapidly the tracking characteristics of various oscillator coils, a double mixer circuit, the block diagram of which is indicated in Fig. 5, was utilized. Such a device enables accurate checks to be made very quickly and is a distinct aid to the extensive number of experimental variations attempted.

Following the presentation of papers, the group was invited to inspect the new sixteen-million-volt cyclotron of Indiana University. Interest in this equipment was quite widespread.

February 6, 1942

TO THE OFFICERS AND EMPLOYEES OF RCA MANUFACTURING COMPANY:

The election of George K. Throckmorton as Chairman of the newly created Executive Committee of the Board of Directors, and Robert Shannon as President of RCAM is announced in the accompanying news release to the press. A public announcement cannot fully convey my sense of confidence and satisfaction in our new organizational set-up which was proposed by Mr. Throckmorton himself. My feeling is largely based on the fact that "Throck" remains with our organization in a position where we shall continue to receive the best he has to give us, and to benefit from his wisdom, inspiration and comradeship.

Bob Shannon is an example of the democracy of American industry. He proves that the door of opportunity is still open for those who demonstrate through their intelligence, hard work, loyalty and study that they have the qualities of leadership. He is a friend of all workers. He is sympathetic with their problems for he, himself, has been a worker in every step of his rise to his present position. I have full confidence in his ability to lead the organization in its onward march toward victory, both in war and in peace.

I know you will continue to give Throck and Bob your wholehearted support and that you join me in wishing them Godspeed and happiness in their new tasks.

Sincerely,

DAVID SARNOFF

...'''...

EXCERPTS FROM THE PRESS RELEASE

February 6, 1942

George K. Throckmorton, for the past five years President of the RCA Manufacturing Company, Inc. of Camden, N. J., was today elected Chairman of the Executive Committee of that company. Robert Shannon, former Executive Vice-President, was elected President.

The promotion of RCA's two senior manufacturing executives was announced by David Sarnoff, President of Radio Corporation of America and Chairman of the Board of RCA Manufacturing Company, Inc.

In announcing these organization changes Mr. Sarnoff said:

"The new President of the RCA Manufacturing Company is a man from the ranks. 'Bob' Shannon, as he is affectionately known by thousands of employees, started as a factory worker thirty years ago. He has occupied various executive positions in the R.C.A. organization during the past twelve years.

"The conversion of a substantial part of the facilities and personnel of RCA Manufacturing Company to specialized manufacture of radio and electronic products for the Army and Navy has greatly increased the load on the management in two important respects," Mr. Sarnoff stated. "First, the volume and variety of these products require increased study and effort which must be given to plans and their execution. Second, speed is of the essence. Nothing can be put off until tomorrow which it is humanly possible to do today.

"The Directors of RCA Manufacturing Company have therefore created an Executive Committee of the Board. This committee will act during the intervals between meetings of the full Board, so that decisions on all plans can immediately follow their formulation, thus effecting the greatest possible flexibility and speed of action.

"Now that the size and complexity of the job to be done require Mr. Throckmorton to act in a role similar to that of chief of staff, his logical successor as the company's front-line commander is Robert Shannon. Mr. Shannon's many years of production and management experience insure the maintenance of the high standards of quality and efficient production for which the company has won universal recognition."

Membership of the Executive Committee of RCA Manufacturing Company, as announced today by Mr. Sarnoff, is composed of the following members of the company's Board of Directors:

G. K. Throckmorton, Chairman
Gano Dunn
J. G. Harbord
DeWitt Millhauser
David Sarnoff
O. S. Schairer
Robert Shannon

...'''...

RCA NEWS INFORMATION

January 14, 1942

Dr. Charles B. Jolliffe has been appointed Assistant to the President of the Radio Corporation of America. In making the announcement, David Sarnoff, President of RCA, who made the selection from the personnel of the RCA organization, said that Dr. Jolliffe, in addition to his new duties, will continue the position he has held for some time as Chief Engineer of the RCA Laboratories.

After serving as instructor of physics at West Virginia University, and from 1920 to 1922 at Cornell University, Dr. Jolliffe became associated as physicist with the Radio Section of the Bureau of Standards. His research was in radio-wave propagation and the development and maintenance of standards of frequency.

Dr. Jolliffe was appointed Chief Engineer of the Federal Radio Commission in 1930 and continued in that capacity when that organization was changed to the Federal Communications Commission in 1934. He resigned from the FCC in 1935 to become engineer in charge of the RCA Frequency Bureau. He has attended many international radio conferences as delegate of the United States Government. Dr. Jolliffe is a member of several committees of the Defense Communications Board and for more than a year has been working on communication problems with the National Defense Research Committee of the Government office of Scientific Research and Development.

...'''...

ANNOUNCEMENT

December 16, 1941

It gives me great pleasure to announce that the Board of Directors has elected Mr. E. E. Lewis to the office of Vice President.

In this executive position, Mr. Lewis will direct the activities of Finance and Accounts, and will continue to direct the Priorities Division.

The assignment to Mr. Lewis will relieve Mr. Corregan for general executive activities.

G. K. THROCKMORTON
President

...'''...

N O T I C E

December 31, 1941

Effective January 1, 1942 Mr. C. D. Tuska is appointed Division Patent Attorney in charge of the work of the Camden Division of the Patent Department replacing Mr. Jesse Huff whose resignation becomes effective on that date. The Assistant Patent Attorneys at Hollywood, California and Indianapolis, Indiana will continue to report to the Camden Division as heretofore.

An arrangement has been made with Mr. Jesse Huff to render service to the Patent Department on a part-time basis thereby enabling continued availability of his valuable experience and advice. Such services to the Camden Division will be rendered upon authorization of the Camden Division Patent Attorney and will be rendered to others upon authorization of the Vice President in charge of RCA Laboratories or the General Patent Attorney.

sgd. H. G. Grover
General Patent Attorney

...'''...

Mr. Tuska received his B.S. from Trinity College, Hartford, Conn. He was founder and first editor of "QST." Secretary and co-founder of the A.R.R.L. From 1918 to 1926 he was President of C. D. Tuska Company, Hartford, Conn. In 1926 he went with the Atwater Kent Company as Engineer - Patents. In 1935 he came with the RCA as Assistant Patent Attorney.

--ooOoo--

RCA TO BUILD NEW TUBE PLANT AT LANCASTER, PA.

Plans for the erection of a large new radio tube manufacturing plant at Manheim Township, Lancaster, by RCAM, were disclosed on January 27 with the announcement that a large tract of land from the Frank McGrann properties adjacent to the Pennsylvania Railroad main line had been purchased by the company.

It is estimated that the new manufacturing activity on special-purpose-radio tubes, which is being undertaken in cooperation with the U. S. Navy, will ultimately provide employment for upward of 1800, of whom an estimated 80% will be female workers.

Ground for the main building, which will occupy 326,000 square feet of space, will be broken around March 1, and it is expected to be completed about September 1.

The vital role which radio plays in modern warfare has increased the need for special types of radio tubes far beyond the present capacity of the radio industry. In addition, increasing applications of special-purpose tubes hold out great promise for the future after the war is over.

Tremendous demands for power and special-purpose tubes, on which until recently industry has had relatively little experience, are being imposed by the defense program. RCA has already responded by greatly increasing production during the past year at its principal tube manufacturing plant at Harrison, N. J.

The Company in 1941 built over 400% more power tubes than in 1940, over 200% more cathode-ray tubes, and over 300% more special purpose tubes. In these three categories shipments are running substantially above 70% for defense purposes. Based on present available estimates, demand in 1942 will be five to six times the value of RCA's 1941 shipments, which were 2-1/2 times the 1940 total.

The new factory building will be constructed of brick and, because of the character of the operations require the utmost cleanliness, it will be completely air conditioned.

...'''...

STOKOWSKI AND DISNEY STREAMLINE "FANTASIA" FOR GENERAL RELEASE

"Fantasia," the Walt Disney-Leopold Stokowski-Philadelphia Orchestra music and movies experiment, has been streamlined for general release to key and neighborhood houses.

The new "Fantasia" has been pared down to 81 minutes and musically includes, with minor cuts here and there: Dukas' "The Sorcerer's Apprentice," Beethoven's "Pastoral Symphony," Ponchiello's "Dance of the Hours," Moussorgsky's "Night on Bald Mountain," Schubert's "Ave Maria," Tschaikowsky's "Nutcracker Suite," and Stravinsky's "Rites of Spring." The music is provided by Stokowski and the Philadelphia Orchestra, exclusive RCA Victor recording artists.

The return of "Fantasia," object of national discussion during its coast-to-coast road tour last year, is expected to bring to public attention RCA Victor's wealth of "Fantasia" recordings, also by Stokowski and the Philadelphians. All the musical selections contained in the original "Fantasia" are on Victor records.

--ooOoo--

Mr. Herman Eugene Reeber (Special Apparatus Engineering) was married on February 25, at Lititz, Penna. to Miss Evelyn Mabel Farrand.

...'''...

Patricia Ann Selby was born on November 21, 1941 and is the daughter of Mr. and Mrs. E. O. Selby (Special Apparatus Engineering). Patricia weighed 8 lb. on arrival.

Mr. and Mrs. F. E. Talmage (Special Apparatus Engineering) have a daughter, Sara Ann Talmage, born on January 16 and weighing 5 lb. 15 oz.

Eric Leonard Haeseler is the son of Mr. and Mrs. L. W. Haeseler (Special Apparatus Engineering). February 6 is Eric's birthday and 7 lb. 4½ oz. his weight on arrival.

Born to Mr. and Mrs. J. Firth Marquis, 664 Maple Ave., Haddonfield (Home & Auto. Rec. Engr.), a son - David Stanley - on August 26, 1941 at Jefferson Hospital.

There is a new son at the D. H. Cunningham's (Home & Auto Rec. Engr.) - David Charles was born on December 14, 1941 at the Jefferson Hospital and weighed 8 lb. 12 oz. at birth.

Edward Martin Hershberger, son of Dr. and Mrs. W. Hershberger (Research Laboratories), weighed 7 lb. 12 oz. on arrival January 21 at the Cooper Hospital.

--ooOoo--

TRANSFERS AND ADDITIONS

Harrison

Additions

J. Towers	Life Test & Data Section
N. Shrinkarick	Life Test & Data Section
M. P. Feyerherm	Power Tube Section
J. DeRemer	Development Shop
H. Tipton	Development Shop
G. P. Molloy	General Engineering

Transfers

H. W. Leverenz	Chemical Engr. Section to Research Laboratories
E. J. Wood	Chemical Engr. Section to Research Laboratories
R. E. Shrader	Chemical Engr. Section to Research Laboratories
E. R. Wagenhals	Chemical Engr. Section to Factory #1
D. H. Wamsley	Chemical Engr. Section to Lancaster Organization
Rohn Truell	Power Tube Section to Research Laboratories
H. R. Seelen	Development Shop to Lancaster Organization
R. B. Janes	Special Tube Engr. Section to Chemical Engr. Section

...'''...

Camden

Additions

P. Herbst	Research
A. Wiggins	Research
D. K. Eppler	Blueprint
J. J. Eustace	"
J. W. Neal, Jr.	"
G. Sukol	"
N. Foote	Chemical Research

Transfers

H. Sadenwater	Television Projects to Research
K. Seiler	Quality Control to Research
C. Sevick	Home-Auto Receiver Drafting to Research Drafting
E. Watson, Jr.	Blueprint to Research Drafting
R. Coates	Spec. Appr. Prod. to Standardizing
Miss R. Anderson	Office Service to Standardizing
R. McBride	Drafting to Standardizing
W. J. Borton	Model Shop to Equipment Development
F. L. Maatje	Mfg. Methods to Equipment Development

--ooOoo--

CAPSULE OF DOPE ON THE MICROSCOPE

By Miss Frances Rice
Electronic Research

Quite reckless of the paper waste, we have to write an article
Descriptive of a gadget based on nature's smallest particle;
To keep the public up to date upon the latest topic,
It's up to us to demonstrate in matters microscopic.

A filament emits the stream, and, with slight hocus-pocus,
Electron guns will form a beam and bring it into focus.
Below is a condenser lens. Like optical refraction
It concentrates on specimens electrons in full action.

The specimens have hills and dales, in common with all matter.
Electrons slip through easy trails, or else hit bumps and scatter.
From that the beam new form will take - an outcome of the scrimmage -
And carry henceforth in its wake a neat electron image.

Now if you've followed us to here (and are easily convincible)
The rest of it should be quite clear: "Electron Optic Principle."
The image we can contemplate on fluorescent mixture,
Or with a photographic plate we take a lovely pixture.

Thus is the hunt for truth pursued as objects of small sizes
Attain amazing magnitude when resolving power rises.
So we report in glowing terms on this superb appliance
Which seeks out atoms, shows up germs, and knocks the spots off science.

--ooOoo--

ADDITIONS TO THE ENGINEERING LIBRARY

Camden

Technical Reports

TR-703 - Indianapolis - Transformer Shielding - A. Badmaieff - 1/5/42.

TR-845 - New Acoustic Stethoscope - H. F. Olson - 12/31/41.

TR-846 - A Stable Frequency Modulated Oscillator for Broadcast Service - N. Korman - 12/31/41.

TR-847 - Simplified Alert Receiver - G. L. Grundmann and W. F. Koch - 12/26/41.

TR-848 - General Investigation of Tuning Systems, with Suitable Antenna Devices, for Broadcast Band Receiver - W. F. Sands - 1/29/42.

TR-849 - Analysis, Synthesis and Evaluation of the Transient Response of Television Apparatus - A. V. Bedford and G. L. Fredendall - 2/6/42.

TR-850 - U-h-f Heterodyne Frequency Meter and Crystal Calibrator - H. Kihn - 2/16/42.

TR-490 - A Portable High Frequency Square Wave Oscillograph for Television - R. D. Kell, A. V. Bedford and H. N. Kozanowski - 2/4/42.

Engineering Memorandums

EM-2230 - Amperite Regulating Tube - H. C. Lawrence - 12/11/41.

EM-2231 - A Two Dipole Uni-directional U-h-f Antenna for Police Work - G. H. Brown - 1/3/42.

EM-2232 - Gluing Wood by R-f - C. N. Hoyler and R. A. Bierwirth - 1/7/42.

EM-2233 - Detonation of Explosive Rivets with R.F. - R. A. Bierwirth - 1/10/42.

EM-2235 - Performance Tests on Meissner Signal Shifter - J. G. Beard - 2/16/42.

EM-2236 - The CA-26A Tuning Indicator Tube for FM Receivers - F. B. Stone - 2/23/42.

EM-2409 - Indianapolis - Groove Dimensions of Commercial Phonograph Records - H. I. Reiskind - 2/10/42.

EM-2410 - Indianapolis - Tube Circuits to Replace Transformers Between Balanced and Unbalanced Lines - H. I. Reiskind and A. Badmaieff - 2/14/42.

Pamphlets

Bowles, Edward L. - Manipulating the microwaves; u-h-f radiation offers tremendous value for varied tasks from guiding airplanes to drying vegetables. 1940.

Carpenter, C. B. - Powder metallurgy. (Colorado school of mines quarterly. Oct. 1941)

Radiotron Publications

Reports

LR-152 - Analysis and Design of Magnetic Scanning Circuits for Cathode-Ray Tubes - O. H. Schade - 1/13/42

LR-153 - The Absolute Sensitivity of Radio Receivers - D. O. North.

LM-132 - Coatings on Kinescope Screens to Reduce Ion Spot - A. D. Power - 11/21/41.

LM-135 - An Efficient R-f Oscillator Circuit for Operation of the Type 931 Multiplier Phototube - O. H. Schade - 1/28/42.

Reprints

624 - Folkerts, H. F. and P. A. Richards - Photography of Cathode-Ray-Tube Traces.

625 - Waller, L. C. and P. A. Richards - A Simplified Television System for the Radio Amateur and Experimenter.

626 - Janes, R. B. and A. M. Glover - Recent Developments in Phototubes.

630 - Malter, L. - The Behavior of Electrostatic Electron Multipliers as a Function of Frequency.

631 - Thompson, B. J. - Voltage-controlled Electron Multipliers.

632 - Wagner, H. M. and W. Ferris - The Orbital-beam Secondary-electron Multiplier for U-h-f Amplification.

636 - Haller, Cecil E. - The Design and Development of Three New U-h-f Transmitting Tubes.

640 - Herold, E. W. - An Analysis of the Signal-to-Noise Ratio of U-h-f Receivers.

641 - North, D. O. - The Absolute Sensitivity of Radio Receivers.

Translation

R-17 - Loseff, I. P., Kotreleff, V. I. and Kamensky, M. V. - Shellac-less Phonograph Record with Polymerized Vinyl Chloride Base. Translated from Industry of Organic Chemistry (USSR) by I. Maloff.

Magazine

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Books

The American Annual of Photography... edited by Frank R. Fraprie and Franklin I. Jordan - Bost. Amer. Photography Pub. Co. 1941.

Bartlett, F. W. - Engineering Descriptive Geometry and Drawing. N. Y. Wiley, 1941.

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Lowe, E. W. - What you want to know about developers, fine grain and otherwise. San Francisco. Camera Craft Pub. Co. c1939.

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Rosin, Joseph - Reagent Chemicals and Standards... N. Y. Van Nostrand, 1937.

Sisco, Frank T. - Modern Metallurgy for Engineers. N. Y. Pitman, c 1941.

Southwell, R. V. - Relaxation Methods in Engineering Science; a treatise on approximate computation. Oxford. Clarendon Press, 1940.

Wall, E. J. - Photographic Facts and Formulas. Revised and largely rewritten by Franklin I. Jordan. Boston, Amer. Photog. Pub. Co. 1940.

Welcher, Frank - Chemical Solutions; Reagents Useful to the Chemist, Biologist and Bacteriologist. N. Y. Van Nostrand, 1942.

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R. E. Lonberger, Librarian

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LIST OF PERIODICALS - 1942

ACOUSTICAL SOCIETY OF AMERICA, J.
AERO DIGEST
AIR FORCES NEWS LETTER
AWA TECHNICAL REVIEW
AMERICAN CHEMICAL SOCIETY, J.
AMERICAN PHOTOGRAPHY
ASME TRANSACTIONS
ASTM BULLETIN
AVIATION

BELL LABORATORIES RECORD
BELL SYSTEM TECHNICAL JOURNAL
BERNE LISTS OF FREQUENCIES
BROADCAST ENGINEERS JOURNAL
BROADCASTING
BROADCAST NEWS

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INDUSTRIAL & ENGINEERING CHEMISTRY
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INSTITUTION OF ELECTRICAL ENGINEERS, J.
INSTRUMENTS
IRON AGE

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JOURNAL OF PHYSICS (U.S.S.R.)
JOURNAL OF SCIENTIFIC INSTRUMENTS
JOURNAL OF TECHNICAL PHYSICS (U.S.S.R.)

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MONTHLY METEOROLOGICAL SUMMARY
MOTOR

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NATIONAL BUREAU OF STANDARDS, TECH. NEWS BUL.
NATION'S BUSINESS
NATURE

OIL, PAINT AND DRUG REPORTER
OPTICAL SOCIETY OF AMERICA, J.

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PHOTOGRAPHIC JOURNAL
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PHYSICAL SOCIETY PROC.
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PRODUCT ENGINEERING

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RADIO CLUB OF AMERICA, PROC.
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RADIO CRAFT
RMA ENGINEER
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Papers Approved for Presentation or Publication

Camden

Title	Author	
New Process Greatly Reduces Glass Reflection	F. H. Nicoll	Electrical World
The Electron Microscope Comes of Age	V. K. Zworykin	Radio Age
Polydirectional Microphone	H. F. Olson	RCA Review
The Characteristic Impedance of a Pseudo-Concentric Transmission Line	G. H. Brown	Electronics
Oscillator Coil Design for Permeability Tuning	R. Trachtenberg	Bloomington I.R.E. Section Meeting
RCA 10-Kw FM Transmitter	C. S. Perry & E. S. Winlund	I.R.E. Convention
Electron Optics and the Electron Microscope in 1941	G. A. Morton	Progress of Science Yearbook
An Omnidirectional Radio Range System (Part III)	D. G. C. Luck	RCA Review
Analysis, Synthesis, and Evaluation of the Transient Response of Television Apparatus	A. V. Bedford & G. L. Fredendall	Proceedings of the I.R.E.
A Portable High-Frequency Square-Wave Oscillograph for Television	R. D. Kell, A. V. Bedford & H. N. Kozanowski	Proceedings of the I.R.E.
Turntable Requirements for Record Slipping	H. E. Roys	NAB Standards Committee
Measuring Turntable Speed Variations	H. E. Roys	NAB Standards Committee
Note on Electromagnetic Fields in Tubes Smaller Than the Critical Size	E. G. Linder	Proceedings of the I.R.E.
Why Not Provide Overload Protection for Your Equipment?	H. C. Lawrence	Radio News

Harrison

The Design and Development of Three New Ultra- High-Frequency Transmitting Tubes	C. E. Haller	Proceedings of the I.R.E.
An Analysis of the Signal-to-Noise Ratio of Ultra-High-Frequency Receivers	E. W. Herold	RCA Review
The Absolute Sensitivity of Radio Receivers	D. O. North	RCA Review & IRE Convention
The Operation of Frequency Converters and Mixers for Superheterodyne Reception	E. W. Herold	Proceedings of the I.R.E.
Factors Governing Performance of Electron Guns in Television Cathode-Ray Tubes	R. R. Law	Proceedings of the I.R.E.
Radio Tubes and National Defense	G. R. Shaw	Radio, Trade and Technical Magazine Representatives
Electronic Television	J. L. Quinn	Montclair State Teachers' College
An Analysis of the Signal-to-Noise Ratio of Ultra-High-Frequency Receivers	E. W. Herold	January I.R.E. Convention
Modern Developments in Electronics	B. J. Thompson	January I.R.E. Convention
Trends in Receiving Tube Design	R. L. Kelly	Hartford I.R.E. Section
RCA's Alternate Material Program	R. S. Burnap	A.I.E.E. Technical Conference

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New Tube Data

Technical information has been issued on the following new tubes and is available in the Library.

Type	Description
12AH7-GT	A small twin-triode receiving tube with octal base with a mu of 16 in each unit.
8012	A u-h-f transmitting triode having higher perveance and lower transit time than the RCA-1628 which it supersedes. Will operate up to 500 Mc.
8013	Half-wave high-vacuum rectifier for use in high-voltage applications.
8016	A small, high-voltage, high-vacuum rectifier for supplying small currents (about 2 ma) up to 4500 volts.
6ST7	Single ended metal type duplex-diode triode similar to the 6SR7 but with a 6.3-volt, 0.15-ampere heater.

RCA-9011 has been withdrawn until further notice.

Application Note No. 117 on Design Precautions for Oscillators Employing Filament-Type Tubes has been issued since our last publication date. A copy is available in the Library.

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