PRICE—TWENTY-FIVE CENTS

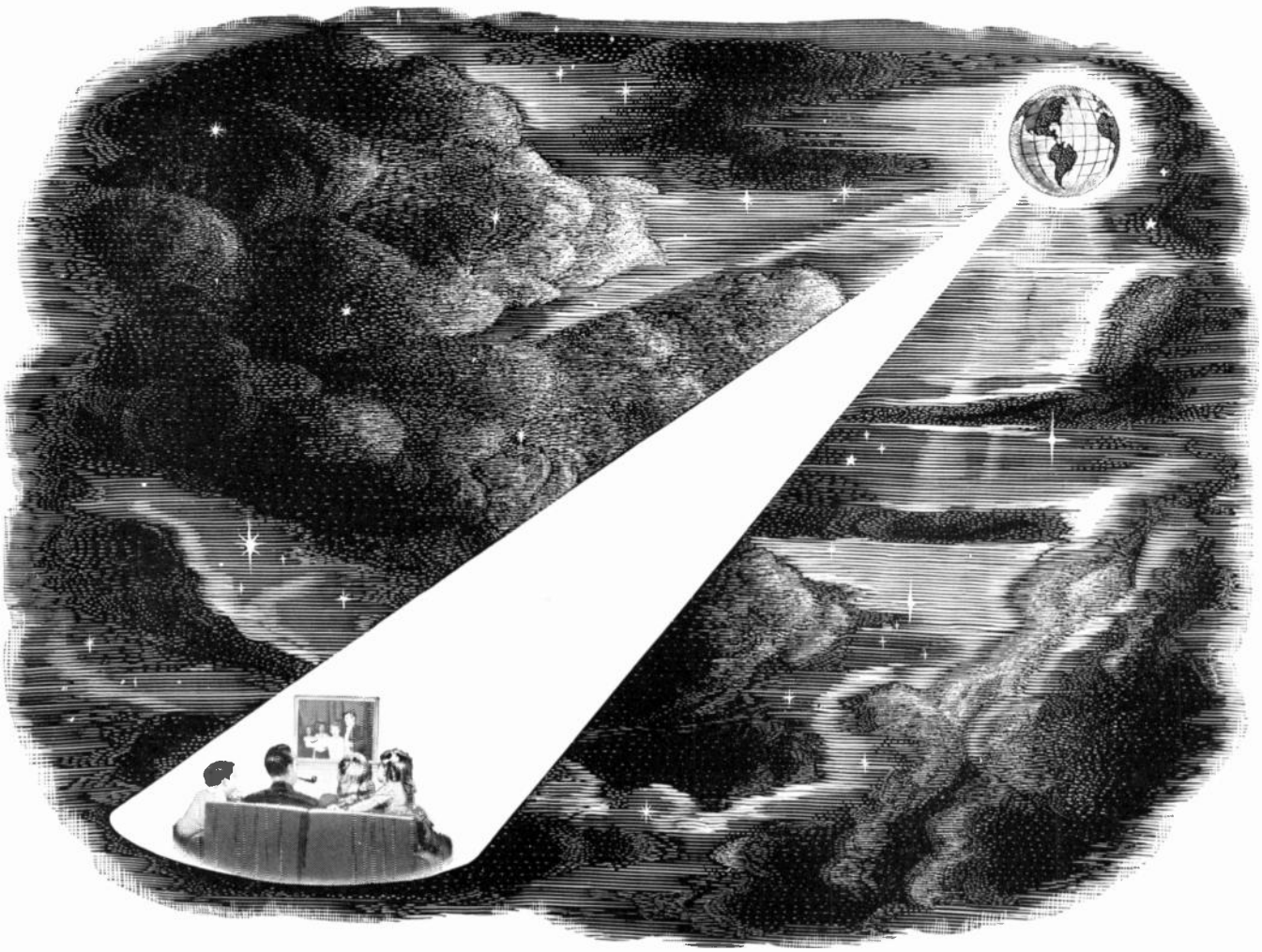
FM AND TELEVISION

NOV. 1944

TELEVISION AT SCHENECTADY

Directory of Manufacturers

★ ★ Edited by Milton B. Sleeper ★ ★



ARE YOU READY FOR TELEVISION?

The time is here for America to revise its concepts of its living-rooms, its classrooms, its town halls. The time is here to become familiar with new measurements of human progress... economic, political, scientific.

For full-scale Television is near... a force of unparalleled power. Television will carry new thoughts, new hopes, new products into millions of homes. It will stir men's minds and hearts in a matter of moments. We will watch the truly wonderful tomorrow take shape before our eyes.

DuMont will provide you with the finest in Television reception... sight and sound. DuMont quality will be assured by impressive prewar pioneering in Television, by vigorous wartime development, by highly specialized production "know how," by advantageous patents.

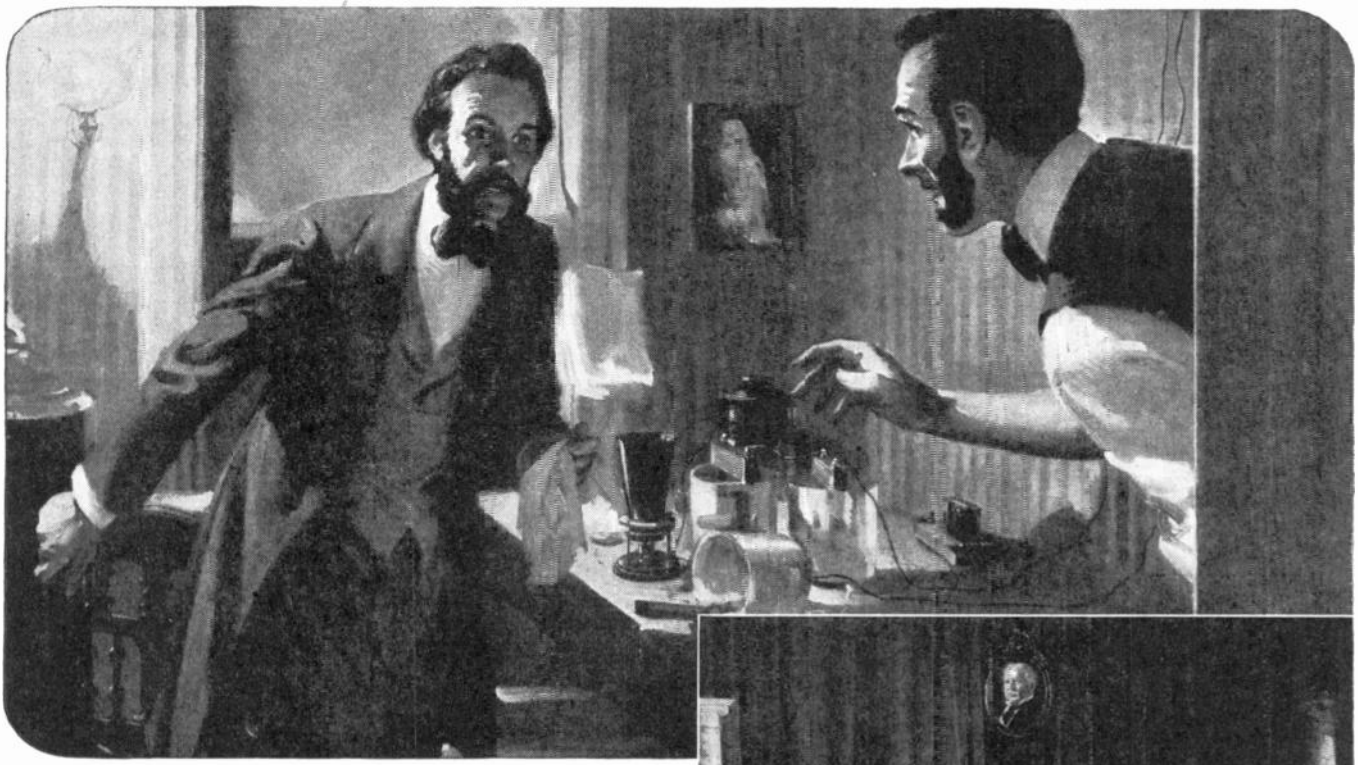
Indeed, the world stands on the threshold of an astonishing age... DuMont Television is ready... Are *You?*

DUMONT *Precision Electronics and Television*

ALLEN B. DuMONT LABORATORIES, INC., GENERAL OFFICES AND PLANT, 2 MAIN AVENUE, PASSAIC, N. J.
TELEVISION STUDIOS AND STATION WABD, 515 MADISON AVENUE, NEW YORK 22, NEW YORK

Great Events in the History of...

COMMUNICATIONS!



The Telephone Talks! "Mr. Watson, come here, I want you!"—this sentence uttered by Alexander Graham Bell on the evening of March 10, 1876, was the first ever transmitted by telephone. This great event soon led to the beginnings of the Bell Telephone System—for which Western Electric has been the manufacturer ever since 1882.

EVEN BEFORE the first of these events Western Electric—founded on November 18, 1869—was making electrical communications equipment. Bell Telephone maker since '82—pioneer in radio since its beginning—the Company today is the nation's largest producer of electronic and communications apparatus for war. In the peace that's coming, count on Western Electric—with its unique 75-year experience—for continuing leadership.

During the 6th War Loan Drive, buy more Bonds than ever!

75TH ANNIVERSARY

Western Electric

ARSENAL OF COMMUNICATIONS EQUIPMENT

The Telephone Spans the Continent! On January 25, 1915, Alexander Graham Bell talked once more to Thomas A. Watson on a momentous occasion—the first time a telephone message crossed America. This great advance was made possible by the use of Western Electric vacuum tube repeaters—the first of many millions we have produced for the Bell System.

Radio Telephone Spans the Atlantic! Just before dawn on October 21, 1915, the first spoken words spanned the Atlantic—transmitted from Arlington, Va., and received in Paris by radio telephone apparatus designed and made by Western Electric. Out of this pioneering came world-wide telephony—broadcasting—aviation, marine and mobile radio.

FM AND TELEVISION

FORMERLY: FM RADIO-ELECTRONICS

VOL. 4 NOVEMBER, 1944 NO. 11

CONTENTS

★ ★ ★ ★ ★ ★

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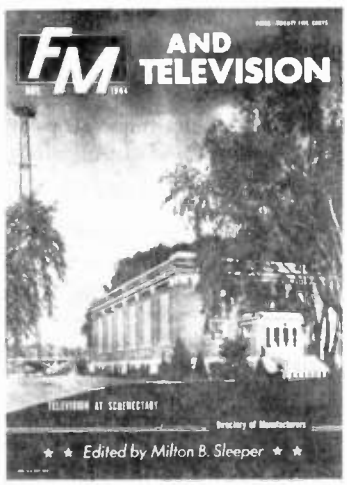
The publishers will be pleased to receive articles, particularly those well illustrated with photos and drawings, concerning radio-electronic developments. Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit. Payments are made upon acceptance of final manuscripts.



THIS MONTH'S COVER

THE significant thing about the current discussion of television is not that opinions differ widely but that so many people are talking so much about it. To those of us who are outside trying to look in, that is at least proof that a lot is going on, even though we shan't see it until a time we might call VE plus X. Then, we shall begin to know how much time will be required to build enough stations to provide a national market. Definite statements, which may serve as clues to X will be made soon after the FCC announces the frequency allocations. One of the stations where there has been long-continued television activity is General Electric's WRBG, at Schenectady, N. Y., illustrated on this month's front cover.

WHAT'S NEW THIS MONTH

1. Au Revoir, Mr. Fly
2. Those Radio Surveys
3. Misuse of "Electronics"

1. FCC Chairman James Lawrence Fly is returning to private law practice, after concluding the ground work of frequency allocations on which postwar radio will be built. His has been an active and constructive administration. Much of it has been stormy, yet he seems to have held the respect of even those he antagonized most.

Perhaps that was because it is natural to admire a man who wins consistently. Many times, though, he won because those who opposed him wilted without giving battle. To an outsider, it sometimes appeared that the broadcasters may have felt in their own hearts that they were wrong, for it seemed that, if they had had the courage born of sincere convictions, they could not have quit so easily. Or perhaps they knew that Mr. Fly had been instructed to win by the White House, and so he could not lose.

It is too bad that the industry was not permitted to enjoy a head-on clash between Mr. Fly and Baby Face Petrillo. But there, again, he may have had his orders. Some day we may read of "My Five Years as FCC Chairman."

At any rate, it must be said that no one ever fooled James Lawrence Fly, and while he was not a technician, his keen analysis of technical problems frequently gave the correct answers to matters that were badly fumbled by engineers. Now Mr. Fly has established offices at 30 Rockefeller Plaza, New York City. Peter Shuebruk, for several years his legal assistant, and Miss Charlotte Gallop, his confidential secretary, will join him there. To fill his place as Chairman of FCC, his successor will have to be a man of great administrative ability and tremendous energy.

2. Home radio sets are not being given a high rating among items that people want to buy first when civilian production is resumed. If the surveys are right, something is wrong with the radio industry. And if there is something wrong with the industry, it is because, for nearly three years, manufacturers' advertising has been so largely a fare of vague promises mys-

(CONTINUED ON PAGE 71)

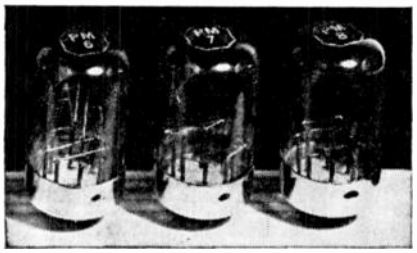
SYLVANIA NEWS

ELECTRONIC EQUIPMENT EDITION

NOVEMBER — *Published in the Interests of Better Sight and Sound* — 1944

PM Lamps Offer Easy Way of Measuring RF Power Output

The group of Power Measurement Lamps introduced by Sylvania a little over a year ago have fully demonstrated their merits as a simple, accurate means of measuring the high-frequency power output of radio equipment.



3 of the 6 Sylvania PM Lamps

The present series consist of 6 lamps, with which power outputs ranging from 0.05 to 25 watts can be measured directly, with the aid of ordinary meters. Accuracy of the measurements is within 5%, without any special calibration of the lamps.

Full information on the principle of operation of these lamps, and on their ratings and characteristics, is available from Sylvania.

DID YOU KNOW...

That fluorescent lights are now helping with the job of guiding Pan American Clippers to port? They illuminate seadrome landing strips which were developed by Sylvania in cooperation with Pan American.

* * *

That 7½-watt ruby lamps have been developed by Sylvania for use in Army photographic printing equipment? Smaller than most lamps of its type, the 7½-watt size is easily installed in portable printers.

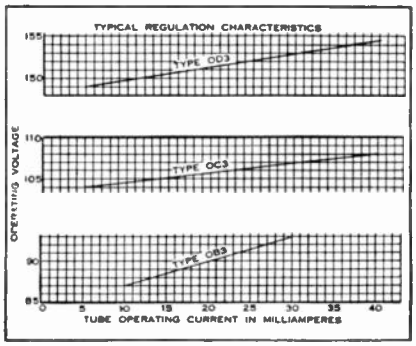
* * *

That the Army Medical Corps' new ten-car hospital train is fluorescent lighted throughout? Patients in the tropics will be more comfortable under these lights, which radiate little heat.

Regulator Tube Maintains Voltage within Narrow Limits

Maximum Regulation of Type OC3/VR105 Is 4 Volts over Operating Current Range

A voltage regulator tube, for applications where practically constant voltages must be delivered to a load, was recently placed on the market by Sylvania. Like previous tubes in the Sylvania line of voltage regulators, the new tube, designated as Type OC3/VR105, is of the gas filled, cold cathode type. It's outstanding difference from earlier types lies in its lower voltage regulation. With a design center operating voltage of 105, the OC3/VR105 has a maximum regulation of 4 volts over the operating current range from 5 milliamperes minimum to 40 milliamperes maximum. Characteristics of the new tube are compared with those of the OB3/VR90 and OD3/VR150 in the accompanying curves.



Comparative regulation characteristics of Sylvania voltage regulator tubes.

It should be noted that individual tubes may not deliver identical voltages to the load. However, the voltage will be within the specified operating limits of 105-112 volts, and the regulation 4 volts or less for any tube.

The tube is mounted in an ST-12 bulb with a standard small 6-pin octal base.

Base diagram of OC3/VR105

A current-limiting resistor should always be used in series with the OC3/VR105, to keep the operating current through the tube down to 40 milliamperes if the load should be disconnected.

28D7 USEFUL AS VOLTAGE BOOSTER

With 28-volt operation of radio equipment attracting increasing interest in its current aircraft applications, and in its commercial potentialities, the Sylvania Type 28D7 is finding new fields of usefulness.

The 28D7 is a Lock-In output tube specifically developed for operation direct from a 28-volt source. The 28D7 can be used as a convenient voltage booster. This feature is particularly important where the 28-volt supply may drop too low to operate tubes having a critical minimum voltage.

For voltage boosting, the 28D7 is coupled as an oscillator to a load coil of the required characteristics, and the output rectified by a diode. Output voltages up to 500 to 600 volts can be obtained in this way.

"Car 54 go to 8th and Main — Signal 17 and doesn't the transmitter sound swell since I put in those Sylvania tubes? That is all."

ADVERTISERS INDEX

25 Years that Created a New World of Radio 1919-1944

From 1919 to 1944 . . . RCA has pioneered in the science of radio and electronics . . . from world-wide wireless to national network and international short-wave broadcasting . . . from electron tubes to electron microscopes and radiothermics . . . from the hand-wound Victrola to the automatic radio-phonograph . . . from television to radar.

Twenty-five years of service to the nation and the public have made RCA a symbol of achievement and progress . . . RCA is a monogram of quality in radio-electronic instruments and dependability in communications throughout the world.

From the First World War to the Second, RCA developed and expanded its "know-how" in skilled engineering and production so vitally needed to meet the demands of war . . . these qualities will be reflected in the peacetime products of RCA.

RADIO CORPORATION OF AMERICA

30 ROCKEFELLER PLAZA, NEW YORK CITY

RCA LEADS THE WAY . . In Radio . . Television . . Phonographs . . Records . . Tubes . . Electronics

RCA 1919 1944
25 YEARS OF PROGRESS IN RADIO AND ELECTRONICS

ENGINEERING SALES

International Resistance: Robert N. Baggs, formerly advertising and sales promotion manager of the RCA tube division, will handle jobber distribution of I.R.C. products as manager of the merchandising division.

Philco: Newark, N. J., Division of Philco Distributors, Inc., has been set up with Louis R. Schneider as general manager, and Albert K. Spears as general sales manager. Address is 1060 Broad Street, Newark.

Du Mont: Canadian distribution, field engineering, maintenance, and repair of DuMont cathode ray tubes and associated equipment will be handled by Cyclograph Services, Ltd., 12 Jordon Street, Toronto.

Admiral: South Texas Appliance Corporation, San Antonio, will handle all Admiral products in the San Antonio trading area. President of the company is A. W. Kilgore; Jack B. Pollock is vice president.

Carter: Frazar & Hanson of San Francisco has been appointed export agents to handle Carter generators and dynamotors in China, the Philippines, Australia, New Zealand, and India. Williams & Associates, Chicago, will handle this line in Mexico, Central and South America, and Africa.

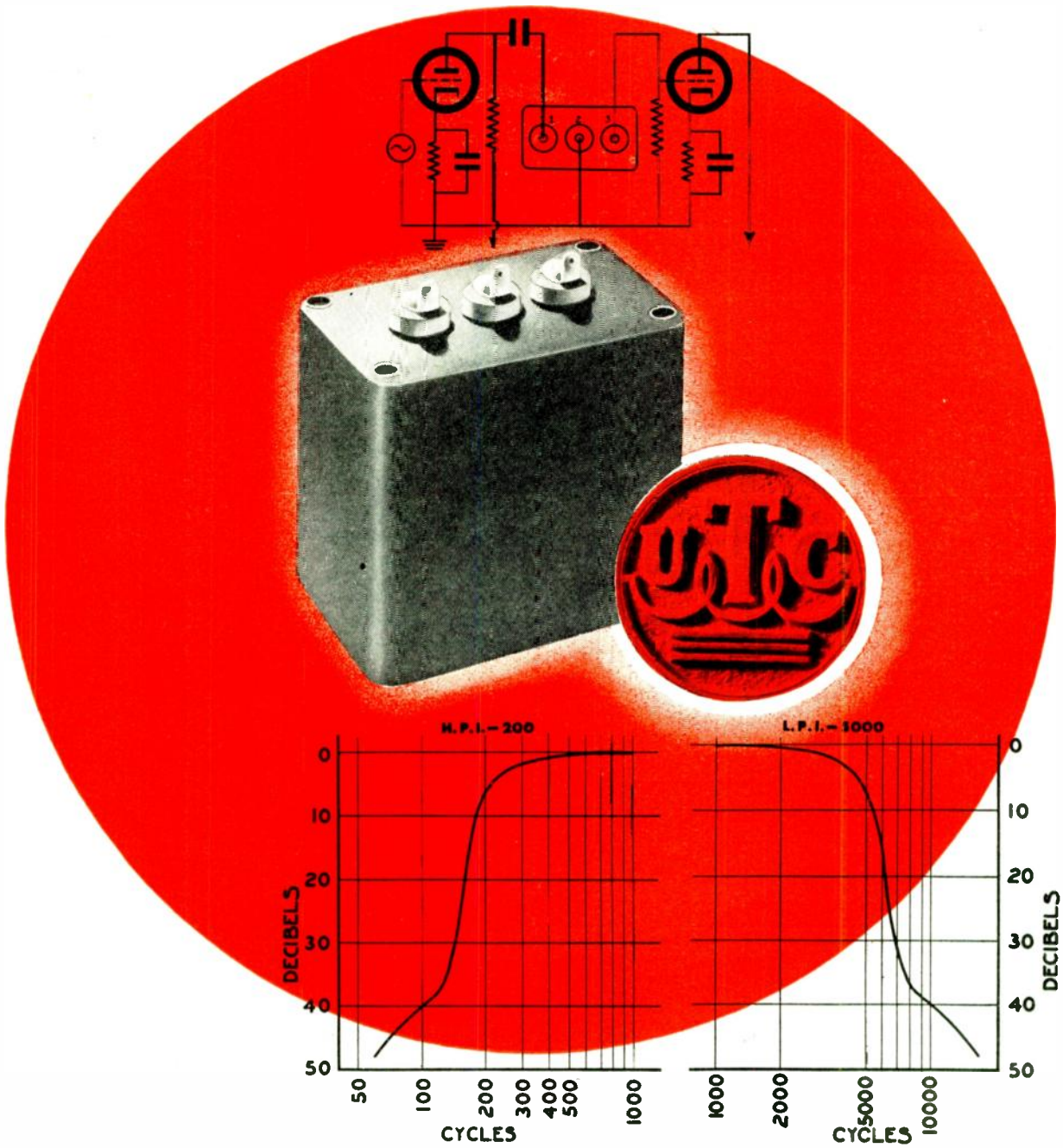
Walsco: A new catalog from Walter L. Schott Company, Beverly Hills, Calif., lists some 500 items for radio manufacturers, laboratories, repair shops. They include cements, varnishes, lacquers, refinishing kits, and a wide range of radio hardware.

Hallicrafters: Discussing postwar policies, President William J. Halligan has announced that his Company will continue to manufacture high-frequency communications equipment exclusively, will continue to use the same type of distributors that handled Hallicrafter products in the past, and will put particular sales emphasis on the amateur radio market.

The Reps: Newly elected officers are Irvin I. Aaron, president, Royal A. Stemm, vice president; David Sondkin, secretary-treasurer. Board of governors comprises Chairman Sam MacDonald, Philadelphia; Dan Bittan, New York; Perry Saftler, New York; Leslie M. Devoe, Indianapo-

(CONTINUED ON PAGE 69)

LOW PASS (TYPE L. P. I.)
HIGH PASS (TYPE H. P. I.) FILTERS



New additions to the UTC Interstage Filter family are now available in the type HPI and LPI units, respectively high pass interstage and low pass interstage filters.

The units are designed with a nominal impedance of 10,000 ohms to be used in a circuit as illustrated. Typical curves obtainable are shown above. Loss at cutoff frequency is less than 6 DB. At .75 times cutoff or 1.5 cutoff frequency respectively, the attenuation is 35 DB, and at one-half or twice cutoff frequency respectively, the attenuation is 40 DB.

These units employ a dual alloy magnetic shield which reduces inductive pickup to 150 Mv. per gauss. The dimensions in hermetically sealed cases are 1½" x 2½" x 2½". Filters of the HPI and LPI type can be supplied for any cutoff frequency from 200 to 10,000 cycles. Specify by type followed by frequency, as: LPI-2500.

May we cooperate with you on design savings for your application . . . war or postwar?

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y.. CABLES: "ARLAB"

ALDEN FACSIMILE

FOR any kind of graphic recording, look to ALDEN, whose years of skill in designing and producing components now covers the entire facsimile field.

ALDEN equipment has been proven in the exacting service of communications and military use. For illustration:

1. ALDEN tape recorders, printing in ink, are working on all kinds of circuits and are in use all over the world.

2. Using photograph film and Teledeltos paper, ALDEN portable transreceivers are working in combat positions without benefit of synchronous power supply.

3. On national and international press circuits, ALDEN continuous page printers are proving highly successful.

4. In important laboratories and Government departments, ALDEN signal analyzers are used for high-speed applications, and are recording at rates of 80 linear inches, or 168 square inches per minute with Alfax paper.

5. ALDEN instruments are also used for clear black-and-white recording of electrical impulses as they occur.

OTHER ALDEN EQUIPMENT AVAILABLE WHEN NEEDED:

1. Home facsimile recorders affording extreme simplicity of operation.

2. Dispatch recorders, occupying minimum space, suited to varied purposes, for confirmation of transmitted information.

3. Large-area, continuous recorders for maps, drawings, etc.

We shall welcome the opportunity to discuss with you whatever interest you may have in facsimile or impulse recording. Write us or, better still, visit us by appointment.

ALDEN PRODUCTS COMPANY

BROCKTON, MASSACHUSETTS

X-Ray O.K.-your final assurance of a perfect tube from Federal.

Every Federal water cooled tube must pass this pre-shipment test.

It is only one of the "Multiple Tests" Federal makes to bring you the ultimate in vacuum tubes. Every known test of mechanical and electronic perfection is a Federal "must" . . . tubes are tested for high-voltage overload . . . shelf life is given to prevent shipment of tubes with glass strains or slow leaks . . . and a final, all-inclusive, operation test leaves nothing to conjecture.

Federal's "Multiple Testing" adds up to longer tube life . . . uniform electrical characteristics . . . and lower cost of operation. Radio men acknowledge that "Federal always has made BETTER Tubes."

Radio Ranges and Instrument Landing Systems manufactured by Federal mark the principal air routes of the nation and control the landing at many leading airports. Pioneers in the development of Aerial Navigation Equipment, Federal has made spectacular contributions to aviation progress.

Federal Telephone and Radio Corporation

An IT&T Associate

Newark 1, N. J.

AMPHENOL offers you a COMPLETE INSERT REFERENCE CHART

You may have this helpful chart. You can in an instant find the correct insert that fits your particular combination of conductors, voltage and current requirements.

First advantage—this chart organizes for the eye the most complete line of AN inserts made by any one company—arranged and divided according to number of contacts—readable from top to bottom and left to right. Each insert is illustrated full size on this 38" x 50" chart. A table gives the mechanical spacing of contacts and other valuable information.

All it takes to get this chart is a request on your company's letterhead.

Also included are two ringbook charts. One shows all connector shell types and styles including the special purpose shells—pressure-tight, moisture-seal, explosion-proof, light-proof. The other clearly explains the numbering system for connectors.

AMERICAN PHENOLIC CORPORATION
Chicago 50, Illinois
IN CANADA • AMPHENOL LIMITED • TORONTO
Connectors (AN, British, U.H.F.) • Fittings • Conduits • Cable Assemblies • U.H.F. Cable • Radio Parts • Plastics for Industry

Specify C. T. C.

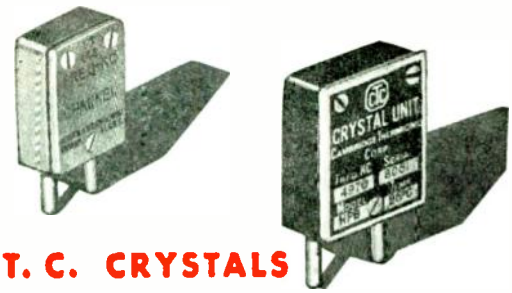
CRYSTALS

I-F TRANSFORMERS

TURRET TERMINAL LUGS

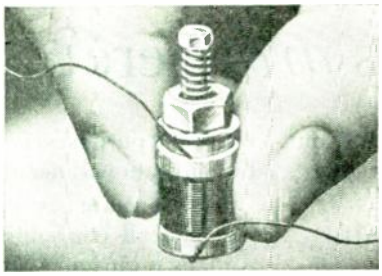
SPLIT LUGS

DOUBLE END TERMINAL LUGS



C. T. C. CRYSTALS

Accurate cutting of each slice — thanks to X-RAY ORIENTATION — insures constant frequency over a wide temperature range. Multiple mechanical lapping operations; dimensioning by edge lapping and finishing to final frequency by etching, are other important steps in the manufacture of C.T.C. Crystals that guarantee high activity and constant frequency throughout their entire life.



I-F TRANSFORMERS

These tiny, *ultra-high frequency*, slug tuned I-F Transformers are doing an efficient, thoroughly dependable job in many important radio and electronic applications.

Ask us about LS-1 (pictured above actual size) and LS-2 transformers.

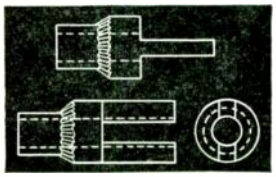
C. T. C. TURRET TERMINAL LUGS

Just swage these heavily silver plated Turret Terminal Lugs to the board and in a jiffy you have a good, firm turret terminal. Quick soldering, too. Sufficient metal is used in the Lugs to give them strength but not enough to draw heat thus increasing soldering time.

C. T. C. Turret Terminal Lugs are stocked to meet 1/32", 2/32", 3/32", 4/32", 6/32", and 8/32" board thicknesses.

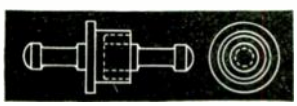
C. T. C. SPLIT LUGS

A .050 hole through the shaft permits wiring to these Split Lugs from either top or bottom without drilling or cutting. Just swage them to the board, then wire. Made of brass, heavily silver plated, C. T. C. Split Lugs are available in two sizes to fit 3/32" and 5/32" boards.



DOUBLE END TERMINAL LUGS

Use these Double End Terminal Lugs when you need terminal posts on both sides of the board. Like C.T.C. Turret Terminal and Split Lugs, C.T.C. Double End Lugs simply swage to the terminal board — provide twin terminal posts which may be wired from top and bottom. Heavily silver plated brass. Stocked to fit 3/32" terminal boards.

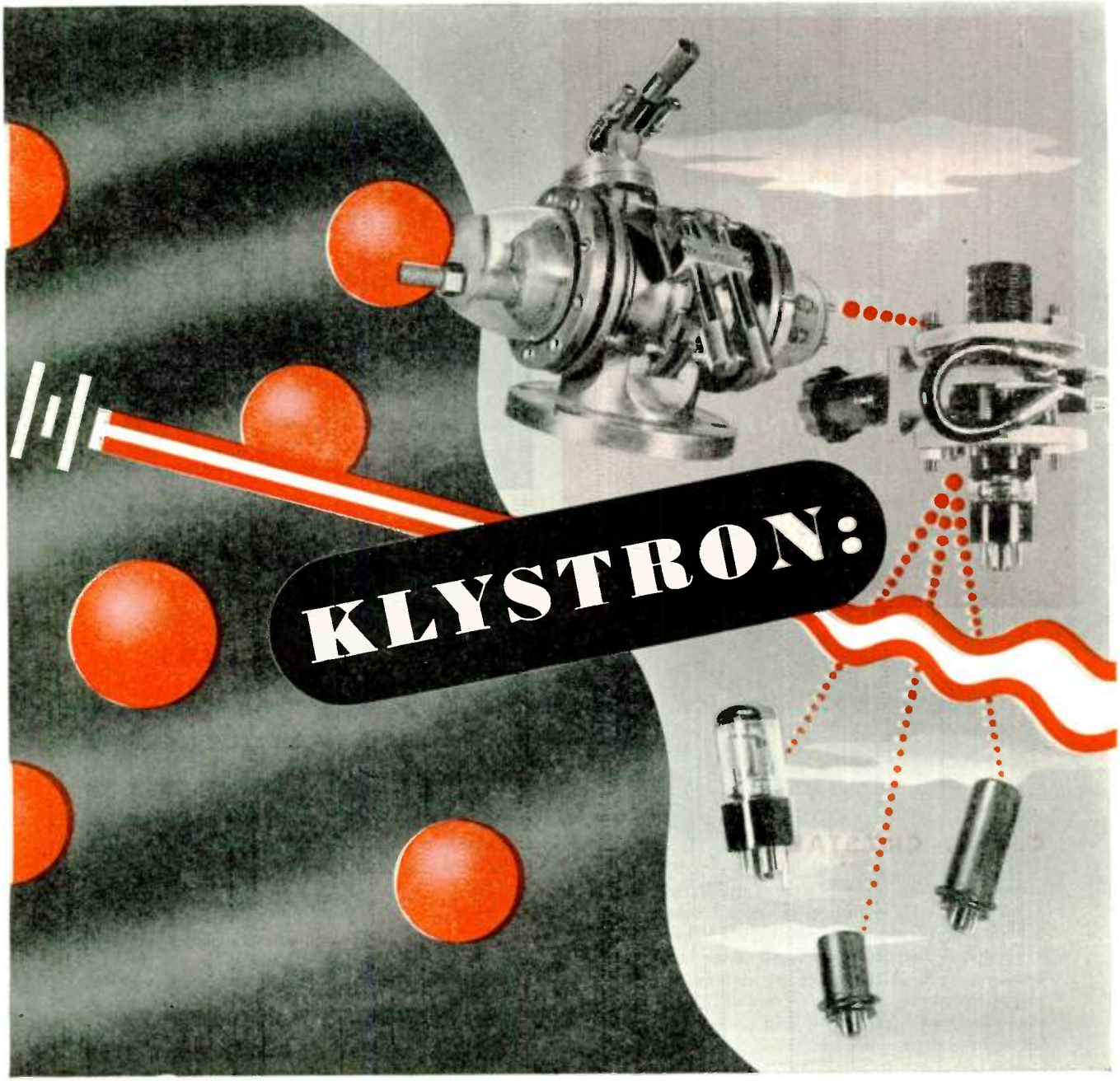


For complete information get in touch with

CAMBRIDGE *Thermionic* CORP.

443 CONCORD AVENUE

CAMBRIDGE 38, MASSACHUSETTS



How many Klystrons *are* there?

COMPARED with the early Klystrons which Sperry first developed some years ago, the more recent forms represent dramatic improvements in both size and performance.

And this is only the beginning!

Information on the newer types is presently restricted to those qualified under Military regulations.

But Sperry Klystrons are in use on many battle fronts, and in many applications . . .

There are small Klystrons, and large ones . . . low-powered ones and high-powered ones. There are Klystrons which generate, amplify, and multiply. Where required, frequency stability (better than that required for broadcast purposes) is readily applied by conventional means.

Klystrons are easily modulated for new and all conventional purposes. And, by means of a single knob, they can be tuned continuously over a wide band, or the operator can snap-tune them to previously selected bands.

Write us for further information.

Sperry Gyroscope Company INC.

GREAT NECK, N.Y. • DIVISION OF THE SPERRY CORPORATION

GYROSCOPICS • ELECTRONICS • RADAR • AUTOMATIC COMPUTATION • SERVO-MECHANISMS

A Statement by Allen B. DuMont

Television is unique in the annals of inventive genius. It stems not from the mind of one man but represents a union of related elements pieced together slowly over a period of many decades.

Only in recent years have we fitted together all the elements that make electronic television a commercially feasible instrument. Exhaustive research, field experimentation under trying conditions, long and wearisome hours of laboratory tests finally brought forth the superior television which is at our disposal today and which soon will provide entertainment, culture and happiness for millions of people throughout the world.

Teamwork created commercially practical television. The next stage is close at hand—the establishment of television as a large-scale public service and important postwar industry. This stage calls for a far, far greater measure of teamwork. For this reason, therefore, the First Annual Conference of the Television Broadcasters Association, Inc., has been called in New York. Its purpose is to provide everyone interested in any of the many aspects of television with the most complete and accurate understanding of present-day achievements and applications of this great new art.

The green light for unlimited civilian production may be authorized before total victory. Television can and must be ready!

Our great new television industry is moving up to the postwar starting line—ready to make a lasting contribution to the economic welfare of the nation. You can make this goal more certain of achievement by participating in the coming discussion forum of all interested in television. Attend the TBA Conference at the Hotel Commodore, New York, on December 11 and 12. Give me the pleasure of meeting you there.

Allen B DuMont

Published in behalf of the First Annual Conference of the Television Broadcasters Association, Inc., by the Allen B. DuMont Laboratories, Inc., Passaic, N. J.

AGAIN!

ARMY E NAVY

For the 5th time Hallicrafters employees win Army-Navy "E" Award!

First exclusive manufacturer of short wave radio equipment to receive the coveted Army-Navy "E" Award for the fifth time . . . the result of the continued and untiring devotion to duty of the company's 1,500 employees.

hallicrafters

THE HALLICRAFTERS COMPANY · MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT · CHICAGO 16, U. S. A.

Builders of the famous SCR-299

THE AMAZING PICTURE OF TELEVISION

Getting Down to the Significant Facts about Present and Proposed Television Standards

BY MILTON B. SLEEPER

RARELY has any scientific development been the subject of as many positive, and contradictory, statements by so many people who have so little first-hand knowledge as the subject of television. Back in the days when Fulton was planning to build the first steamship, the same sort of condition would have prevailed if sailing vessels were licensed to travel in specific sea lanes, so that Fulton would not only have been confronted with the problems of pioneering steamship construction and operation, but of prevailing upon the licensing agency to give him a lane in which to navigate his craft.

Going Back 150 Years ★ Then Fulton would have had to sell the performance, convenience, necessity and commercial possibilities of the steamship before he, or anyone else, had built anything more than a small-scale, experimental model. Certainly capital could not be attracted to finance the project before the use of a sea lane had been authorized. And that would have forced him into the position of presuming to be an expert on steamships still not in existence, and an oracle capable of foretelling what later, greater, and improved ships could do. Meanwhile, perhaps demonstrating with a model on inland waters, he would have had to prove that he could carry passengers and cargo successfully for, obviously, there would be no profit in sailing with an empty hold, nor any justification for occupying a sea-traffic lane.

His use of a sea lane would, of course, have been opposed by the owners of sailing vessels, to whom the advent of the steamship would represent competition and, perhaps, ultimate scrapping of ships which, whatever their short-comings, certainly represented a known quantity in world commerce.

It is easy to imagine the testimony of those who would have been called to a hearing to consider the assignment of sea lanes for steamships. Owners would have appeared, accompanied by the commodores of their fleets prepared to testify as experts, concerning such ships as they had neither seen nor operated.

Would those men have favored the readjustment of their traffic to accommodate potential competition? Hardly! They would have fought against it by every method, from every angle.

Can't you hear the owners, after exhausting every means of direct opposition, saying: "We are now convinced that the steamship will be an important means of transportation in the future, and we are in favor of assigning not the few lanes that Robert Fulton has requested, but at least twice that many, for we believe that his plan will soon prove totally inadequate.

"However, it is our conviction, supported by the commodore of our fleet, who has been sailing the seven seas for nigh on fifty years, that the design of Robert Fulton's ship is commercially impractical. We feel that vessels of the small size he proposes will not meet the demands of ocean travel or shipping. It is our considered opinion that no steamship should be built of less than 750 ft. length and 45,000 gross tons. Furthermore, we believe that the reciprocating type of engine is entirely inadequate, and that the inauguration of steamship service should be delayed until our engineers have completed the construction of a steam turbine on which they are now at work. Finally, the experience of our masters indicates that before exporters and importers would consider shipping in any steam-propelled vessel, they would want the added protection of automatic fog-dispellers, and a magnetic steering device that would bring the ship into port in case the navigator was washed overboard.

"When these developments are completed, and our engineers and naval architects are working night and day to perfect them, the steamship will be ready to take its place on the high seas. Even then, it is not certain that it will prove financially successful, but we are prepared to underwrite the venture because we have a market for smoked fish, and we plan to equip our ships with nets rigged at the stern, and to put a smoke-house on the poop deck, so that the fish can be processed as they are caught while our improved steamships sail from port to port."

Then there would have been a series of experts, to show curves on the ton-mile fuel load of ships of various sizes, to explain the effects of vibration from a reciprocating engine which the turbine would eliminate, the dangers of fog, and the percentage of ships lost at sea after the navigator was washed overboard, and the estimated time yet required for the completion of these red-herring marvels.

With all this testimony on the record, what would the members of the sea lane licensing board do? Quite likely, they would look at the calendar and say: "Well, there's an election coming up before long. Let's just let this matter ride, and let the next administration take the responsibility for making a decision."

That, of course, would mean victory for the opposition, because it is often possible to mire down a proposition completely in a bog of delay. On the other hand, if the opposition fails, it always has the alternative of adopting the plan as its own.

Now, in 1944 ★ Does this speculative excursion sound absurd? Not to those who have followed the statements on television which have been issued and testimony given at the various FCC hearings, for it is an exact parallel, no matter how absurd it seems.

It is not possible to judge even the sincerity of some who have had the most to say about television. No doubt, some are deliberately attempting to becloud the issue. Others may be sincere in their beliefs, but necessarily limited in their knowledge. In either case, television progress suffers. We shall never have good television reception in color until after there is commercially acceptable reception in black and white. Nor shall we have successful relay networks until after direct transmission and reception are in satisfactory operation. Nothing as complex as television can reach such maturity without an extended adolescence, fraught with severe growing pains.

Yet the urgent need of erecting the frequency allocation framework for all postwar services, so that manufacturers can turn quickly from military to civilian production, makes it necessary to plan the long-range development at a time when those concerned are forced to state their needs now, without the complete confirmation of research and experimentation.

Thus, at the television session of the current FCC allocations hearing, Chairman Fly gave the impression of being inclined to start television with higher definition, despite the fact that images of perhaps 585,000 elements will not give as

(CONTINUED ON PAGE 75)

THE POSSIBILITY OF A FIFTH NETWORK

Why the American Network Was Dissolved, and Why the Newspapers May Form a New FM Net

BY WILLIAM B. LEWIS*

LATE in August of this year the pioneer effort to establish a network composed entirely of radio stations employing the Frequency Modulation system of broadcasting came to an untimely end. In a solemn and heartbreaking session at Chicago, the stockholders of The American Network, Incorporated voted to dissolve the corporation.

Since then I have been called upon time and again to answer two questions:

The first question invariably runs something like this: "Does the dissolution of The American Network mean that the erstwhile members have lost faith in Frequency Modulation, and that their early enthusiasm for its possibilities has cooled substantially?"

The answer to that one is: "No. Emphatically, no!" The original members of The American Network all believe as I believe that nothing can now stop the progress of Frequency Modulation. No combination of forces has ever been able to stop any important technological advance in this country. Why should Frequency Modulation be an exception?

Perhaps many of you will question whether or not Frequency Modulation *is* an important technological advance, and on that score perhaps I can clear up a couple of misconceptions. If I were to ask you if you had ever heard Frequency Modulation, I suspect the majority of you would answer "Yes." Yet I doubt that more than a handful of you have ever *really* heard Frequency Modulation reception of the kind that will be commonplace after the war.

Perhaps you have tuned in the Cleveland Symphony on an FM set in the summertime and marveled at the absence of static and extraneous noise. You were conscious of one big advantage of the Frequency Modulation system, but you did not hear full FM reception. That program was carried from Cleveland to your station in New York over a telephone wire capable of carrying not more than 5,000 cycles; ideally, Frequency Modulation requires 15,000 cycles. The FM transmitter could send to your set, and your FM set could receive, no more quality than the telephone line delivered. Or you have tuned in on your FM set an evening's broadcast of fine symphony records and wondered, except for clarity and reception, how the quality differed materially from a WQXR broadcast of symphony records on your standard AM set. Again, the records themselves were delivering to the transmitter 4,000 cycle quality or less, and the transmitter could broadcast no more than it received.

In short you will never know how magnificent Frequency Modulation reception can be until studios, records, wires, and all other technical facilities are geared up to match the fidelity of which FM transmitters and sets are capable. Then you will be able to invite a great orchestra almost literally into your home and be able to enjoy full concert-hall values from the comfort of your armchair.

These technical facilities are ready for production, come peace. Recordings have been developed which will carry 16,000 cycles. Telephone wires can now be leased which will carry 16,000 cycles, but at such great cost that experiments are being carried forward to find a more economical method of tying together an FM network, either through the use of coaxial cable or the use of ultra-high frequency relay systems. Orders are being taken on all sides for FM transmitters and equipment, and the set manufacturers — almost without exception — are ready to build and heavily promote complete lines of combination FM-AM sets. One manufacturer predicts that 20,000,000 sets capable of receiving frequency modulation will be in use within 4 or 5 years after the war's end.

From the standpoint of public acceptance, it is hardly necessary to labor the point here that the public has been led to expect fabulous new things in the immediate postwar period, and it is inconceivable to me — and to most of the set manufacturers — that many people who can afford to spend $50 or up for a new radio set will pass up a combination FM-AM set in favor of a set that will give them AM reception only.

Yet even here skeptics will arise and tell you that many people will not like true fidelity in their reception, that they have been tuning out the highs in their present AM sets for years and will certainly not relish the additional highs FM will automatically bring them. I think there may be a great deal of truth in this assertion — at first. Listeners have been given considerably less than perfect reproduction for so many years that they will probably not recognize — or appreciate — perfect reproduction when they hear it. After all, Hitler made a whole nation like Fascism by giving them nothing else for years. But whether or not the buyers who flock to radio stores for sets appreciate FM reception at the start, I suspect they will buy the combination sets if only to keep up with the Joneses, and that before very long quality — as they say — will tell, and owners of combination sets will come eventually to listen to FM exclusively.

No, it was not lack of faith in the future of FM that put an end to The American Network experiment. Paradoxically the tremendous upsweep of enthusiasm for the new system, in evidence everywhere during the past twelve months, did not insure the success of The American Network, as might logically have been expected. On the contrary, the very success of the FM method was one of the basic reasons for the failure of the first network designed to further its progress.

When The American Network was organized in 1941 only a handful of farsighted operators were paying any attention to FM; the majority of radio men considered it a minor threat, at best, to the established system. Consequently, The American Network management was able to operate quietly and efficiently, without spotlight or hindrance, signing up affiliates as they became interested in FM, selling a program here and a spot schedule there to the few advertisers who had a possible business stake in the success of the method.

But Pearl Harbor called an abrupt halt to that first phase of American Network operation: no more FM sets, or transmitters, or construction permits, or licenses for the duration. The American Network went quietly into hibernation.

Two years later came whispers that the Armed Forces were equipped with all the signal equipment they would need and that some of the radio equipment plants would soon be reconverted to manufacture of civilian products. Hard on the heels of these rumors came an FM revival that would have turned a Baptist preacher green with envy. The FM trade association — FMBI — came out of hiding and announced an annual meeting for January of 1944. To insure getting an attendance of at least 100, the directors voted to throw open the meeting to anyone sufficiently

* Vice President and Radio Director of Kenyon & Eckhardt Inc., a talk before The American Marketing Association, November 2, 1944, New York City.

interested in FM to put up a $10 registration fee. *More than 700 attended.* Color pages began to appear in national magazines telling the public to be prepared for great reception from postwar FM sets. Applications for construction permits began to pour into Washington from cities, towns, and hamlets, from established radio operators and from potential ones anxious to cut a piece of this new radio pie providentially placed before them. The stampede was on, and once more The American Network hung out its shingle and confidently faced a happy future.

But as of 1944, FM was no longer a minor threat to the established system: it was a major danger. The established networks, in particular, faced a dilemma. If the FM system was fated in time to make the AM system obsolete, were they to sit back and calmly watch a $100,000,000 business disintegrate? Would you? The only practical solution open to the networks was to provide themselves two outlets in each market, one AM and one FM, both broadcasting the same network schedules. Then, as the AM audience decreased and the FM audience increased, they would be in no danger of losing the coverage which is the backbone of their business.

Now it was inevitable that the key members of The American Network would be among the most successful and farsighted of radio operators, precisely the kind of operators who would have established their stations as vital links in the present network chains. Certainly it was imperative that the networks with which they were affiliated in AM broadcasting guarantee themselves FM outlets with duplicate program schedules in the same markets. If the present affiliates refused to provide the necessary FM outlets, the networks would have to go elsewhere not only for FM outlets but for AM outlets, since the program service was to be duplicated.

The dilemma, therefore, was handed on to The American Network members: "Shall we risk losing an AM network franchise that pays us handsome yearly profits now, to gamble on a new and unproven venture that may pay us handsome profits starting five years from now?" Even to a backward mathematician, that is only a one-dollar question.

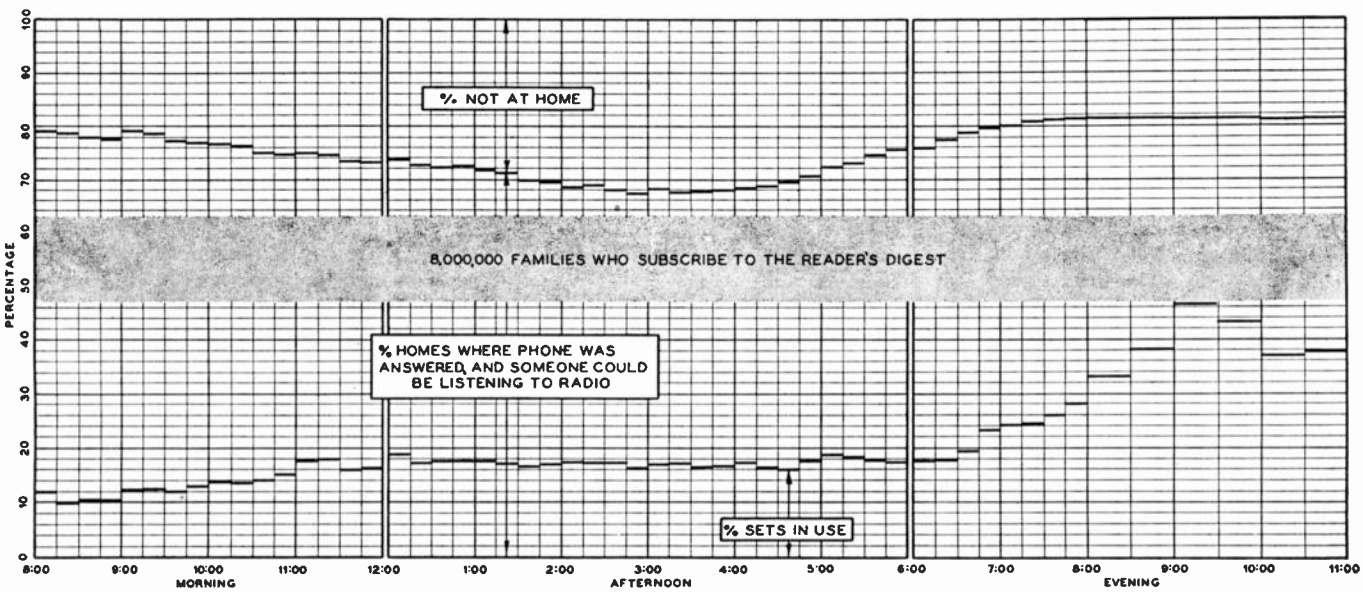
There might still have been hope for The American Network but for one further ironical stroke of fate. Since its invention, Frequency Modulation has been looked upon by the Federal Communications Commission as a means of providing new and additional radio service for the American people rather than as a means of bringing them improved reception of the present service alone. Consequently the Commission has consistently urged new and non-duplicated programming on FM stations. Yet again, if AM stations are to become obsolete, the FCC cannot very well forbid the present networks to make provisions to continue to do business through FM stations.

Nevertheless, The American Network might still have gratified the Commission's wish for a separate FM program service except for a rule the FCC itself promulgated two years ago — the widely publicized duopoly order which forbade single ownership of two or more radio stations in the same community. Save for that order, I am confident that most, if not all, of The American Network members would have solved their dilemma by electing to build *two* FM stations, one to duplicate the program service of their AM stations, and one to carry the new program service of The American Network. Hence the duopoly order, justifiable as it may have been in its original intent, boomeranged to the extent of delaying the Commission's own avowed hope of new and additional radio program service.

But, though the pioneer FM network effort has ended, I would like to reiterate the belief of all my former American Network colleagues that neither the dissolution of the network nor any other misadventure can stay the eventual progress of Frequency Modulation as an improved method of broadcast transmission and reception. If the FCC gives the green light to Frequency Modulation as a result of the allocations hearing, it is my personal hunch that within ten years all domestic radio broadcasting will utilize the Frequency Modulation method, with the exception, let's say, of eight ultra-high-powered AM stations operated for the benefit of rural and other remote areas.

The second question I am asked with clocklike regularity goes something like this: "Does the failure of The American Network mean that there will never be an FM network? Or that a fifth network cannot exist economically?"

My answer again is "No, it means no such thing!" In the first place, it is my opinion, as I have indicated before, that the four presently established networks will eventually become FM networks. This change alone will bring about an improvement in the radio structure that will be a boon to advertisers and to the public. In FM broadcasting there will be



USING THE NUMBER OF CALLS MADE IN EACH PERIOD AS 100%, THIS CHART SHOWS THE PERCENTAGE OF THOSE WHO ANSWERED, AND OF THOSE WHO SAID THEY WERE USING THEIR RADIO SETS

no such differentials in coverage as exist between the 250-watt station and the 50,000-watt station in AM broadcasting today. All FM stations in one community will have approximately the same coverage. With coverage more or less equalized, the weaker networks will have a much better chance to compete with the stronger networks on the basis of good management, to the profit of advertisers; and good programming, to the profit of the public.

But over and beyond the four established networks, I am certain there will be a fifth network which will be organized exclusively as an FM network and will, if it is properly managed and directed, have excellent chances for success.

Let's take a look first at the potential market which may exist for a fifth network. Like all radio men, I have a chart. This chart is based on figures reported by C. E. Hooper, Inc. for the period from December, 1943, through April, 1944. The heavy black line running across the top of the chart indicates the average percentage of the available radio audience by 15-minute periods throughout the broadcasting day. The heavy black line way down below, running across the bottom of the chart, indicates the average percentage of the actual radio audience for the same 15-minute periods — in other words, the percentage of families who had their radios turned on. The vast area between the two lines represents a whole lot of people who were at home, whose radios were in good repair, and who might well have been listening to the radio — but weren't. Keep in mind that even a modest slice of this no-listeners-land would represent a healthy and profitable audience for a fifth network.

Another pertinent fact which Mr. Hooper's figures reveal is that the SETS-IN-USE percentages, as represented by the bottom line, have not varied much in the past three years yet, as you all know, the number of commercially sponsored broadcast hours has increased materially. You would think that an increased variety of good programs would entice more people to listen to the radio, would raise that bottom line by increasing the sets in use. But instead of drawing new listeners from that huge reservoir of AVAILABLE AUDIENCE, the new programs have stolen what audience they have from the audiences of the established programs and have thereby lowered the average ratings of all programs.

Why is this so? To me the answer is obvious. It is because the new programs have the same common denominator as the old: their basic appeal is to the mass audience, as is the basic appeal of all network radio today. Granted that the networks are aiming more and more individual programs at targets a good deal higher than the popular mass level, still no one in his right mind will argue that any one of the present network schedules is planned for the general convenience and edification of anything but a mass audience.

A fifth network, to succeed, must break away from that mass tradition and try something new; and that "something new" is available, and crying to reward richly those men of vision who will exploit the idea.

The market a fifth network should be painstakingly tailored to satisfy is precisely the kind of market a magazine like *The Reader's Digest* so profitably satisfies: 8,000,000 families of better-than-average intelligence, and better-than-average income and spending power. I daresay there is not an advertiser who would refuse advertising space in *The Reader's Digest* if it were available, or would object to paying for it a considerably higher rate per thousand than he pays for mass media. I further predict that he would pay a relatively higher time rate to the network which could demonstrably deliver the same market.

How big is this market, in relation to the present radio market? Let's look at the chart again for a moment. The shaded area across the middle has been drawn arbitrarily to represent the 8,000,000 families who subscribe to *The Reader's Digest*. The fact that it is placed in no-listeners-land is based on no facts whatsoever, but purely on my own suspicion that that is where a survey would place a great proportion of it. In the peak evening listening hours there would obviously be a good deal of duplication between this area and the SETS-IN-USE area, but in many, many hours of the day I believe there would be little or no duplication.

When I speak of a network program service designed specifically for this type of audience, I am not thinking of the kind of fine music schedule offered by WQXR or the various plans contemplated by Muzak for service to the home after the war. I am thinking of a program schedule combining the best of everything — music, drama, comedy, variety, service material, news — not in hodgepodge confusion, but in a well-ordered presentation designed to provide a whole evening or a whole afternoon of balance listening, and edited, as a great magazine is edited, for one particular class of audience.

A fifth network, starting from scratch, could establish such an editorial policy and could control its program balance (at least by type of programs to be broadcast in any given time segment) much more easily than one of the established networks could revise its present policies and schedules.

I have a strong feeling that the American public is ripe for something new and better in radio and that such a program policy might start a bandwagon rush. In addition to winning the particular segment of the audience for which it was designed, I have a hunch it might win a goodly percentage of the mass audience, many of whom are tired of the present radio service, some of whom will emulate others, and a few of whom will accept better program service along with improved reception.

We come now to the most important question of all. With the nation's most skillful and experienced radio operators committed to the present networks in their FM planning, who is going to put up the money necessary to organize and establish a fifth network on this or any other basis? Being a gambler at heart, I shall try for the $64 question, and let you decide if the answer makes sense.

There is in this country a group of powerful and wealthy newspaper publishers who passed up radio in the early days, and have lived to regret it. Their newspapers are not going to miss the boat again. Already, the FCC pending file is crammed with their applications for FM construction permits. To give you a better idea of what I mean, here is a partial list: The *New York Times*, *The New York Daily News*, *The Chicago Sun*, *The Los Angeles Times*, *The Baltimore Sun*, *The Philadelphia Bulletin*, *The Boston Traveller*, *The Washington Post*, *The Atlanta Constitution*, *The New Orleans Times-Picayune*, *The Detroit Free Press*, *The San Francisco Examiner*, *The Cleveland Press*, *The Miami Herald*. It is an imposing list. All of these papers have bought FM stations or have applied for FM construction permits, or are about to apply. All of them have the wherewithal and the determination to back a network if they see the need for one.

Since many of them once recognized a similar need for a pooled wire service, and established the Associated Press with neatness and dispatch, I do not think it will take many months of FM operation to convince them of the need for an FM network program service. Whether they will logically follow their own AP precedent and establish their own network on a mutual and, therefore, more economical basis, or wait instead for another privately-owned network to sell them program service, I am not prophet enough to foresee.

But I do predict that these newspapers will enter the FM field and will eventually form the nucleus for a fifth network; that there will be enough independent FM operators in the remaining markets to complete a national chain; and that if the network is directed shrewdly and with purpose toward the market I have indicated, it will succeed.

ARMY-NAVY PREFERRED LIST OF RADIO ELECTRON TUBES

This List Supersedes the Army-Navy Preferred List of Radio Electron Tubes, Dated 15 February 1944*

15 September 1944

TO THOSE CONCERNED WITH THE DESIGN AND MANUFACTURE OF ARMY OR NAVY EQUIPMENT UTILIZING RADIO ELECTRON TUBES:

1. The following Army-Navy Preferred List of Radio Electron Tubes sets up a group of unclassified general purpose tubes selected jointly by the Signal Corps and the Bureau of Ships. The purpose of this list is to effect an eventual reduction in variety of tubes in Service Equipment.

2. IT IS MANDATORY THAT ALL UNCLASSIFIED TUBES TO BE USED IN ALL FUTURE DESIGNS OF NEW EQUIPMENTS UNDER THE JURISDICTION OF THE SIGNAL CORPS LABORATORIES OR THE NAVY DEPARTMENT BE CHOSEN FROM THIS LIST. EXCEPTIONS TO THIS RULE ARE HEREINAFTER NOTED.

3. The term "new equipments", as mentioned in Paragraph 2 above, is taken to include:

a. Equipments basically new in electrical design, with no prototypes.
b. Equipments having a similar prototype but completely redesigned as to electrical characteristics.
c. New test equipment for operational field use.

4. The term "new equipments", as mentioned in Paragraph 2 above, *does not* include:

a. Equipments either basically new or redesigned, that are likely to be manufactured in very small quantity, such as laboratory measuring instruments.
b. Equipments that are solely mechanical redesigns of existing prototypes.

(CONTINUED ON PAGE 25)

* See *FM* RADIO-ELECTRONICS, March, 1944.

ARMY-NAVY PREFERRED LIST OF RADIO ELECTRON TUBES

RECEIVING

Filament Voltage	Diodes	Diode Triodes	Triodes	Twin Triodes	Pentodes: Remote	Pentodes: Sharp	Converters	Power Output	Indicators	Rectifiers	Miscellaneous: Cathode Ray	Miscellaneous: Crystals
1.4	1A3	1S5**	1LE3	3A5	1T4	1L4 1LN5 1S5**	1LC6 1R5	1LB4 3A4 3S4		1006	2AP1 3BP1 3DP1 3FP7 5CP1 5CP7 5FP7 5JP1 7JP7 12DP7 12GP7 913	1N21B 1N23B 1N25 1N26 1N27 1N28 **Phototubes** 927 929 930 931A **Voltage Regulators** OA3/VR75 OC3/VR105 OD3/VR150
5.0										5U4G 5Y3GT		
6.3	6AL5 6H6* 559	6AQ6 6SQ7* 6SR7*	2C22 2C40 6C4 6F4 6J4 6J5* 7E5/1201 9002	6J6 6SL7GT 6SN7GT 7F8	6AB7 6AG7 6SK7* 9003	6AC7 6AG7 6AJ5† 6AK5 6AS6 6SJ7* 7W7 9001	6SA7	6B4G 6G6G 6L6GA 6N7GT/G 6V6GT/G 6Y6G	6AF6 6E5	6X5GT/G 1005		
12.6	12H6*	12SQ7* 12SR7* 14E6†	12J5GT	12SL7GT 12SN7GT 14N7†	12SG7* 12SK7* 14R7†	12SJ7* 14H7† 14W7	12SA7* 14J7†	12A6*	1629			
25 and above								25L6GT/G 28D7†	991	25Z6GT/G		

TRANSMITTING

Triodes		Tetrodes	Twin Tetrodes	Pentodes	Pulse Modulators	Rectifiers: Vacuum	Rectifiers: Gas	Rectifiers: Grid Control	Clipper Tubes	Gas Switching
2C26A	826	807	815	2E22	3D21	2X2A	4B25	2D21	3B26	1B32/532A
2C39	833A	813	829B	4E27	3E29	3B24	83	3C23	719A	
2C43	862A	814	832A	803	6C21	5R4GY	857B	3C31/C1B		
3C24	880	827R		837	715C	371B	866A	C5B		
CV92(Br)	889R	1625				705A	869B	6D4		
100TH	893A					836	872A	394A		
250TH	1626					1616		884		
304TH	8025					8016		2050		
527						8020				
811										

* Where direct interchangeability is assured "GT" and "L" counterparts of the preferred metal tube may be used.
** Diode Pentode.
† These tubes are the only types with characteristics specified for 28-volt plate supply, and may be used in this type of application. Any of the types listed under "Receiving Diodes" may be used for 28-volt plate supply applications.

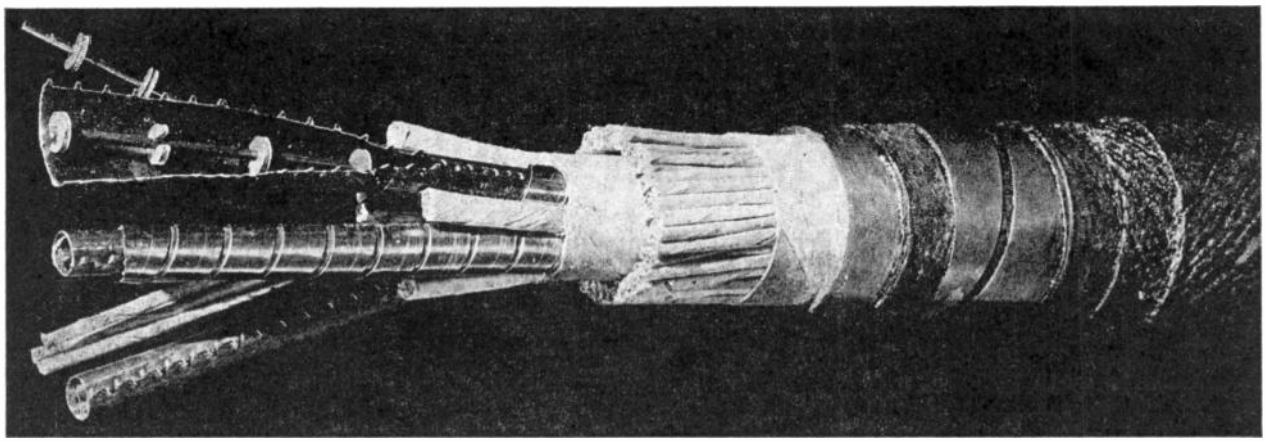


FIG. 1. FANNED-OUT VIEW OF A CABLE HAVING FOUR TUBES. ONE OF THE TUBES HAS BEEN OPENED TO SHOW THE DISCS

COAXIAL CABLES AND ASSOCIATED FACILITIES

Some Details of the Coaxial Telephone Cable System Which May Be Used to Carry Television Programs

BY J. J. PILLIOD*

COAXIAL cables provide means of transmitting frequency bands several million cycles in width over a metal tube a little larger than a lead pencil, with a copper wire extending along its axis. Several of these tubes can be placed inside a lead sheath, as is shown in Fig. 1.

The frequency band transmitted over coaxial cables may be split up so as to provide several hundred telephone circuits or, without such division, coaxial cables will provide for broad-band transmission service such as is required for television.

The older forms of cable employ many times the number of conducting wires, but each circuit transmits a more limited frequency range than a coaxial tube. This is illustrated in Fig. 2, which shows three types of telephone cable systems, each of

* Assistant Chief Engineer, American Telephone & Telegraph Co., 195 Broadway, New York City.

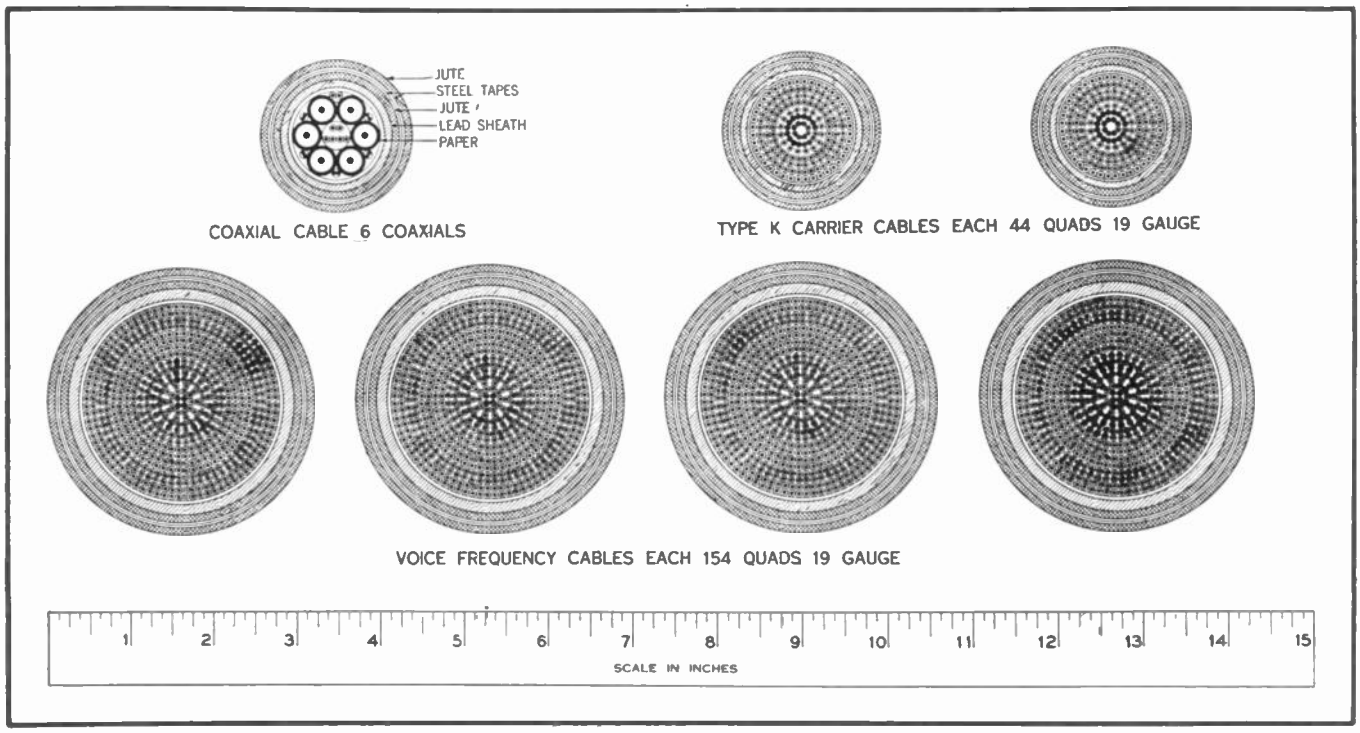
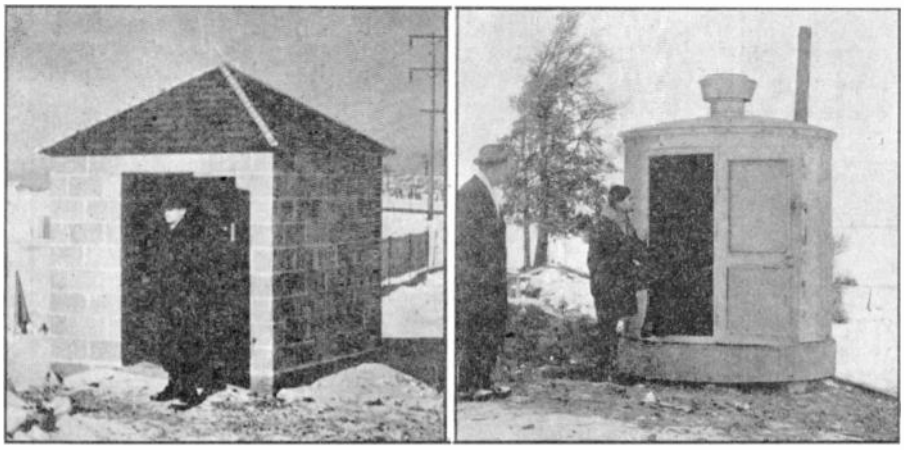


FIG. 2. THE COAXIAL CABLE SHOWN ABOVE PROVIDES ABOUT THE SAME NUMBER OF TELEPHONE CIRCUITS AS THE OTHER GROUPS



FIGS. 4 AND 5. REPEATER HUTS SUCH AS THESE HOUSE THE RELATIVELY SIMPLE REPEATER UNITS SHOWN IN FIG. 6. A 6-COAXIAL CABLE REQUIRES 3 SUCH UNITS

which provides about the same number of telephone circuits in the present state of the art. A cable is now being installed between Terre Haute and St. Louis which contains six coaxial tubes to provide telephone circuits, and which may, in the future, find use in connection with the provision of intercity television networks.

Coming now to the structure of the tubes used with coaxial cables, it may be seen from Fig. 1 that these consist of a central copper conductor within a copper tube about ¼ in. in diameter, made from flat copper strip which is formed around the insulating discs. Around each copper tube are two steel tapes which supplement the shielding of the copper tube in preventing interference between tubes in close proximity. The central conductor is separated from the outer conductor by slotted insulating disks which are forced onto the wire. The cables are formed with an appropriate number of these tubes along with some small gauge pairs used for control and operating purposes.

The cables may be carried on poles or run underground, but the latter type of construction is likely to be used for most new routes since this reduces the magnitude of transmission variations due to temperature changes for which compensation must be made. In the case of underground cables buried directly in the earth, jute or plastic protective coverings are used to assist in reducing sheath corrosion. In some parts of the country it is essential to add a metal covering outside the lead sheath and the jute to protect the cables against the operations of ground squirrels or pocket gophers. In certain areas these animals have been found to carry away long sections of the jute covering and will chew holes in the lead sheath unless other metal protection is provided.

Coaxial cables are in regular operation between New York and Philadelphia, and between Minneapolis and Stevens Point, Wisconsin, a total distance of nearly 300 miles. A network of such cables totaling about 7,000 route miles is being planned over additional routes. It will be noted that there is included in the program a transcontinental cable route which, on the basis of present tentative plans, might be

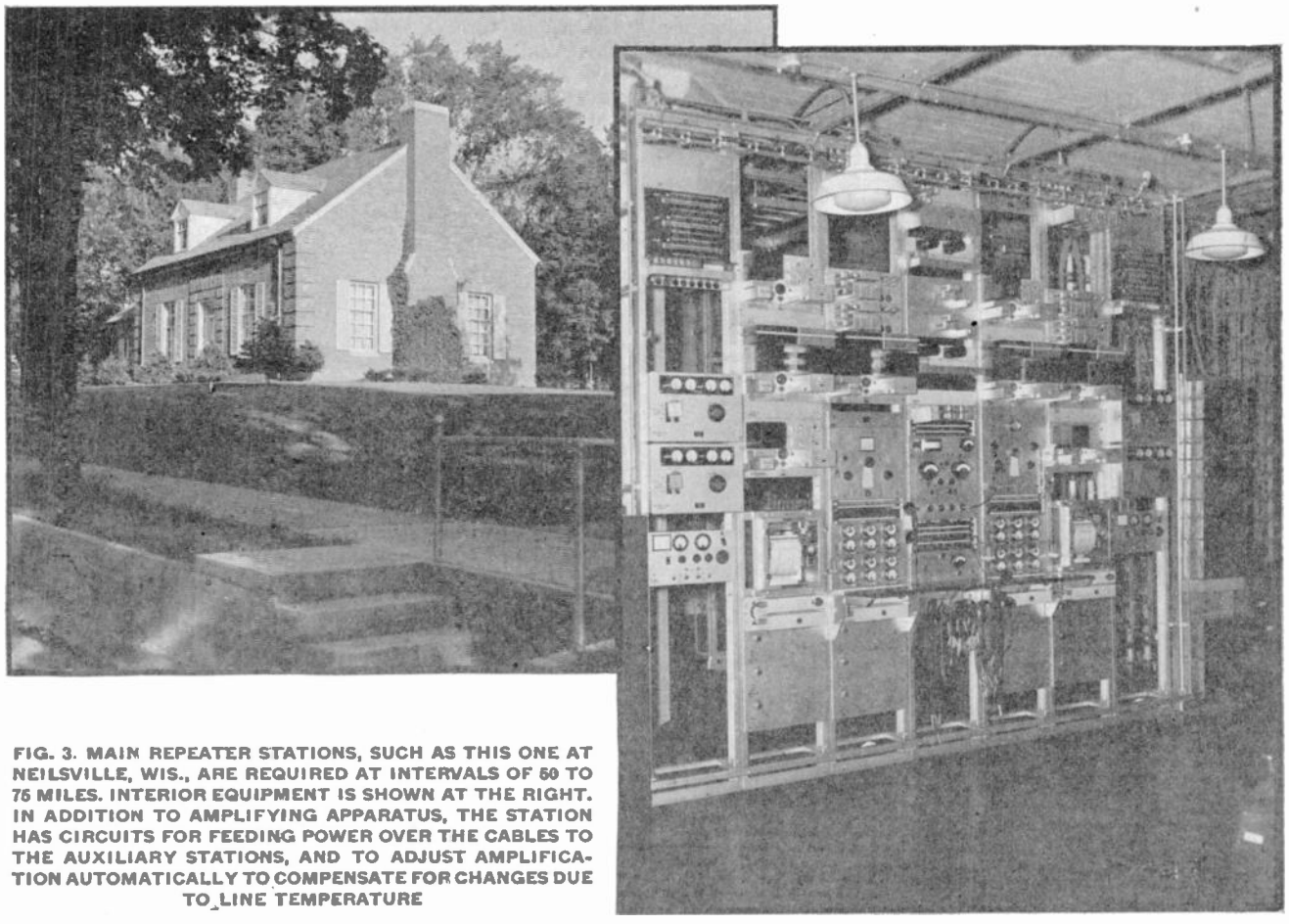


FIG. 3. MAIN REPEATER STATIONS, SUCH AS THIS ONE AT NEILSVILLE, WIS., ARE REQUIRED AT INTERVALS OF 50 TO 75 MILES. INTERIOR EQUIPMENT IS SHOWN AT THE RIGHT. IN ADDITION TO AMPLIFYING APPARATUS, THE STATION HAS CIRCUITS FOR FEEDING POWER OVER THE CABLES TO THE AUXILIARY STATIONS, AND TO ADJUST AMPLIFICATION AUTOMATICALLY TO COMPENSATE FOR CHANGES DUE TO LINE TEMPERATURE

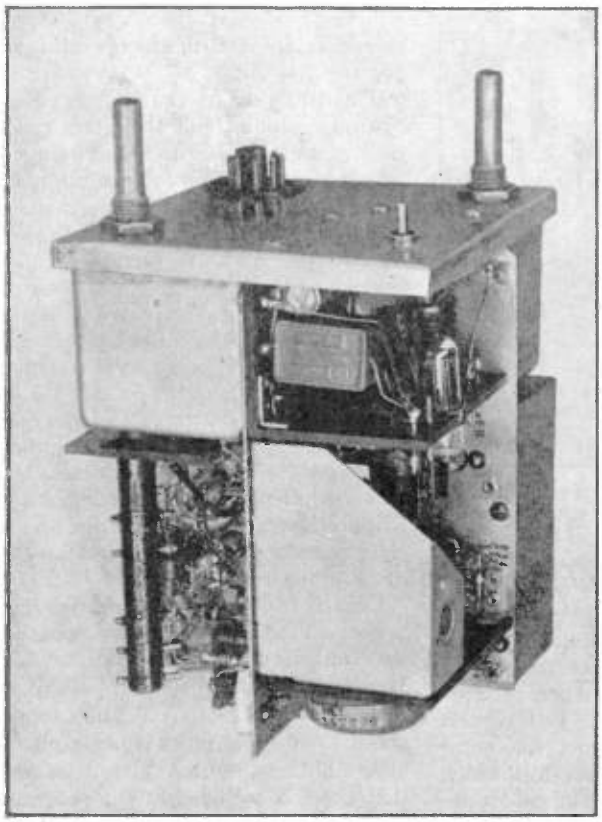


FIG. 7. A COMPLETE BROAD-BAND AMPLIFIER UNIT FOR 3-MC. BAND. TWO ARE USED IN ASSEMBLY IN FIG. 6.

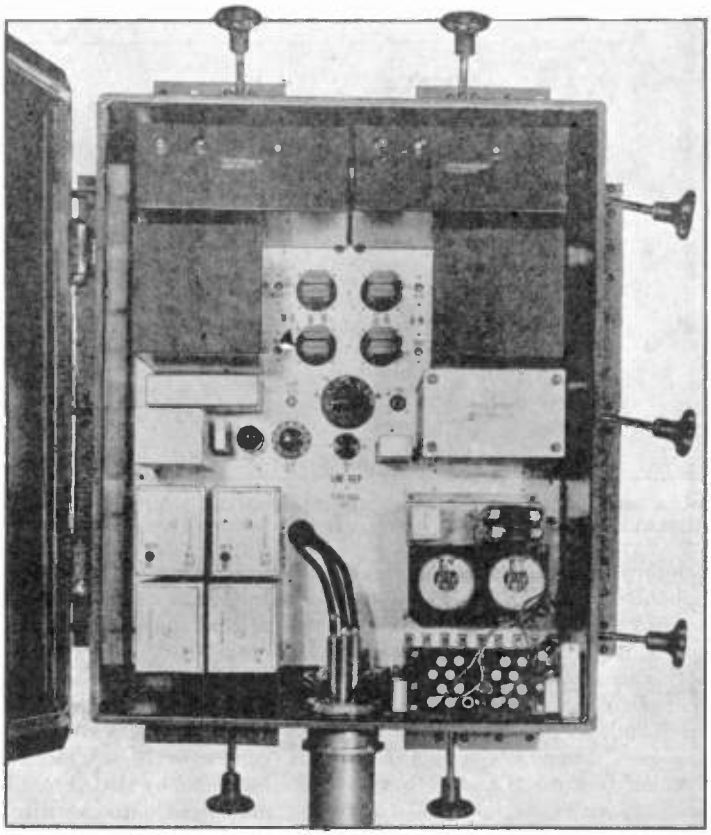
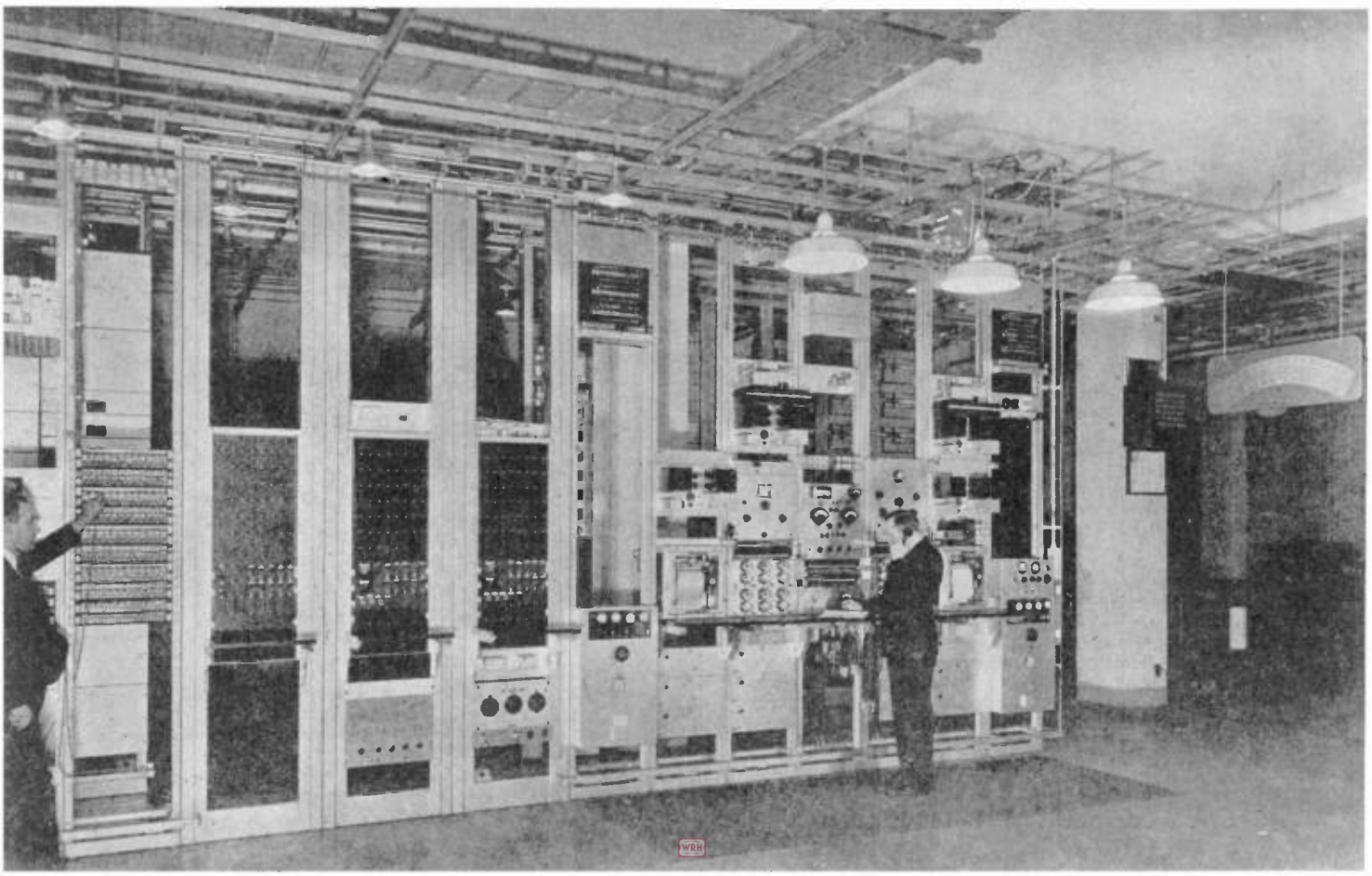


FIG. 6. THIS IS THE AMPLIFIER EQUIPMENT USED IN THE AUXILIARY STATIONS. DUAL UNITS HANDLE TWO COAXIAL LINES.

completed in the period 1948 to 1950 along with the rest of this program. The routes are still subject to review just prior to the time construction would be started. The requirements of the armed forces, general business conditions, the volume and distribution of long distance telephone messages, the availability of the necessary manufactured cable and equip-

FIG. 8. PART OF TERMINAL EQUIPMENT FOR MINNEAPOLIS-STEVENS POINT CABLE. TERMINAL REPEATER EQUIPMENT IS AT RIGHT; AT EXTREME LEFT IS PATCHING PANEL USED FOR MAINTENANCE AND TO REARRANGING CIRCUITS.



ment, and other factors may modify the extent of this construction, the time of starting, and the routes which will be undertaken.

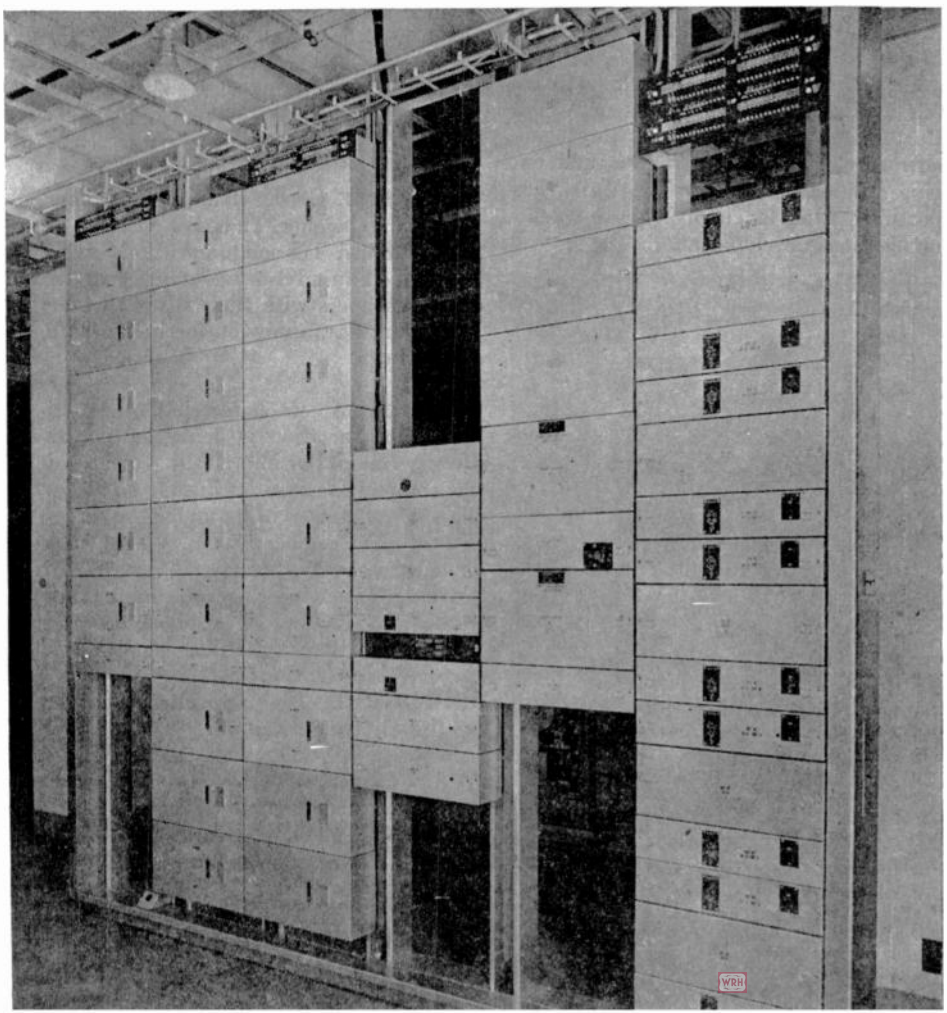
Repeaters in the coaxial system are located at intervals of about 5 miles. Repeaters are also located at the main stations which are 50 to 80 miles apart. Most of the testing and maintenance adjustments are made from these points. A typical main station and its equipment for coaxial cable circuits are shown in Fig. 3. The repeater points spaced about 5 miles apart between the main stations are called auxiliary stations, and are arranged so as to require a minimum of attendance. Two types are illustrated in Figs. 4 and 5. Except for occasional trouble conditions, maintenance work is handled by infrequent, scheduled visits. Power for repeaters in the auxiliary stations is supplied from the adjacent main stations at 60 cycles over the coaxial conductors themselves. At each repeater, the 60-cycle power is taken from the coaxial conductors through power separation filters, is stepped down for use on the vacuum tube heaters, and is rectified for use on the plates.

Two coaxial tubes are used for providing systems of two-way telephone circuits, one tube being used for transmission in each direction. The present designs employ two of these tubes to provide for 480 telephone circuits, or a band of about two million cycles, in each direction. When such a coaxial system is used for television, an effective video band of about 2,700 mc. is transmitted over the line using frequencies up to about 3,000 kilocycles. Fig. 6 shows the complete repeater equipment unit used for two coaxial tubes, and Fig. 7 shows one of the wide-band amplifying units removed from the repeater equipment.

At the transmitting end of a coaxial line, as many as 480 voice bands are positioned one above the other in the frequency band of 68 to 2,044 kc. for transmission over the line. At the receiving end, the wide band of frequencies is broken down into a corresponding number of individual voice channels. Part of the terminal equipment employed for this purpose is shown in Figs. 8 and 9. This is not necessary, of course, for the transmission of television programs, since such transmission is handled as a single conversation in one direction, occupying perhaps the entire frequency band.

Another transmission method is the recently announced experimental trial of a radio relay system between New York and Boston by the Bell System, while a third method which is being investigated is the wave guide, involving the use of a hollow tube without a central conductor.

FIG. 9. ADDITIONAL TERMINAL EQUIPMENT. HERE VOICE BANDS ARE STACKED INTO FREQUENCY GROUPS FOR TRANSMISSION OVER A COAXIAL CABLE.



TESTIMONY AT ALLOCATIONS HEARING

The text of Major Armstrong's testimony at the FCC Allocations Hearing, published in the October issue of *FM* and TELEVISION, was taken directly, as the footnote indicated, from the stenographer's transcription. Thus, there will undoubtedly be some discrepancies between that text and the official record of the Hearing, when it is published. That is because each witness is given the opportunity of correcting the transcript of his testimony since, at times, there is confusion due to interruptions by the FCC counsel or the Commissioners. If there are any points that seem ambiguous in our published text, therefore, they will undoubtedly be cleared up by reference to the official text of the Hearing.

ARMY-NAVY LIST OF RADIO ELECTRON TUBES

(CONTINUED FROM PAGE 21)

c. Equipments that are reorders without change of existing models.

d. Equipments in the design stage before the effective date of adoption of this Preferred List.

NOTE: The foregoing statements in Paragraphs 3 and 4 above are explanatory in nature and are not intended to be all-inclusive.

5. In the event that it is believed that a tube other than one of those included in this Preferred List should be used in the design of new equipments for either the Signal Corps or Navy, specific approval of the Service concerned must be obtained. Such approval, when Signal Corps equipment is concerned, is to be requested from the Signal Corps Laboratory concerned with such equipment; the said Laboratory will then make known its recommendations in the matter to the Signal Corps Standards Agency where the final decision will be made and returned to the laboratory for transmittal to the party requesting the exception. When Navy equipment is concerned, the request for exception shall be addressed to the Radio Division, Bureau of Ships, Code 930-A, Navy Department.

6. The publication of this list is in no way intended to hamper or restrict development work in the field of radio electron tube or radio electron tube applications.

7. This list is to take effect immediately.

Office of the Chief Signal Officer, Headquarters, Army Service Forces, War Department.

Chief of the Bureau of Ships, Navy Department.

SPOT NEWS NOTES

Items and comments, personal and otherwise, about manufacturing, broadcasting, communications, and television activities

FCC: Paul A. Porter, publicity director of the Democratic National Committee in the recent campaign, and former Washington attorney for CBS, has been nominated by President Roosevelt to fill Mr. Fly's 7-year term which expires June 30, 1949. Following Senate confirmation, he will be appointed Chairman by the President.

Mr. Porter, rated as a staunch New Dealer, was born in Joplin, Mo., on October 6, 1904. Son of a Baptist minister, his childhood was spent in Winchester, Ky., where, later, he attended Kentucky Wesleyan College. He also studied law at the University of Kentucky. The Porters have two daughters, Betsy, 13 and Ann, 7.

The President has asked Commissioner Elwell K. Jett to serve as interim Chairman. Thus, the work on frequency allocations will proceed without interruption, although it is not expected that conclusions will be reached until after January 1st. No announcement has been made concerning the remaining vacancy created by the resignation of Commissioner T. A. M. Craven.

As previously forecast, Mr. Fly has assumed the chairmanship of the board of Associated Music Publishers, owned by William B. Benton, who also owns Muzak.

New Licensee: As another step toward preparing to reënter the home radio field, Westinghouse has taken out a Hazeltine license, according to Walter Evans, vice president in charge of the Westinghouse radio division. A war plant in Sunbury, Pa., will be used for set production and as headquarters for the new radio division.

Promised for Postwar Television: RCA says they are now prepared to manufacture commercial home television receivers which will be far superior to pre-Pearl Harbor models. Specifically: "They will be superior from the standpoint of picture size. They will be superior from the standpoint of picture detail. They will be superior from the standpoint of picture brightness and they will be superior from the standpoint of picture contrast. They will be easier to operate. They will be equipped with automatic frequency control. Miniature tubes and components will make possible smaller, more compact designs and, consequently, better styling. Flat-face picture tubes on direct-viewing models will make possible better pictures. This vast improvement will be given to the public at prices which will be substantially below the prices that prevailed before the war."

FM C.P's. Granted: Six construction permits have been granted by FCC for FM developmental stations. They are to:

Voice of Alabama, Birmingham, Ala., 2 stations of 250 w.
The Atlanta Journal, Atlanta, Ga., 700 w.
Temple V. Ehmsen, 0346 S. W. Texas St., Portland, Ore., 1 kw.
Maryland Bcstg. Co., Baltimore, Md., 1 kw., 43.2 mc.
Matheson Radio Co., 62 Boylston St., Boston, Mass., 1 kw., 49.9 mc.

The Maryland Broadcasting Company station will be used in conjunction with Jansky & Bailey's station W3XO, at a new site, for field intensity measurements, first with vertical and then with horizontal polarization.

Laverne M. Poast: After three years at the Bureau of Standards, has resigned to join the staff of Worthington C. Lent, consulting engineers, located in the International Building, Washington, D. C.

Meet Your Navy: That is the title of a new Blue Network program sponsored by Raytheon Manufacturing Company. Shown below, on opening night, are: L. K. Marshall, president of Raytheon; Admiral A. S. Carpender, Commandant of 9th Naval District, and agency man Burton Browne of Chicago. Raytheon, now employing 16,000 workers and engineers in plants at Newton, Mass., has postwar plans for high-frequency communications development.

L. K. MARSHALL, ADMIRAL CARPENDER, AND BURTON BROWNE OPEN RADIO SHOW

FMBI Conference: Under authority from the board of directors, FMBI President Walter Damm has decided not to hold the 2nd Annual Conference in January, as originally planned. Reason is that a program planned now might be out of date in January due to changes resulting from Allocations Hearing and possible developments in European war. *FM* AND TELEVISION is heartily in favor of this decision.

L. J. Chatten: Director of WPB Radio & Radar Division, discussing civilian production: "Eight months after the defeat of Germany there will be production capacity for turning out 1½ million sets per month, but tubes and electrolytics will be particularly short, and there may not be components enough for more than 3 million sets per year, presumably while we are at war with Japan. Wood for cabinets, also, will be seriously limited."

Stock Issue: By Electronic Laboratories, Inc., of Indianapolis, totalling 150,000 shares at $5, was over-subscribed. Underwriters were Brailsford & Co. and Shillinglaw, Crowder & Co., Inc., Chicago.

Morris H. Cook: Formerly of Western Electric's Hawthorne works, has been appointed director of specialty products development for Bell Telephone Laboratories, New York. He will make his home at Summit, N. J.

Home Facsimile: George H. Payne, former FCC commissioner, and now vice president of Finch Telecommunications, Inc., has formed an advisory committee to assist newspapers with their plans to take up facsimile transmission for home radio reception.

Railroad Radio: A new engineering, sales, and service organization is being set up by Bendix Radio, Baltimore, Md., to expand the company's activities in railroad radio. This department will be under the direction of chief engineer W. L. Webb, sales manager John W. Hammond, with R. B. Edwards as engineering coördinator, according to William P. Hilliard, general manager of Bendix Radio.

L. M. Leeds: Has been appointed manager of the electronics laboratory of General Electrics electronics department. W. C. White, formerly in charge of this laboratory, has been appointed electronics engineer of the research laboratory.

(CONCLUDED ON PAGE 42)

NEWS PICTURE

ACCORDING to this newspaper advertisement, the P.R.R. will spend $1,000,000 for train communications equipment on the Harrisburg to Pittsburgh divisions — *but it isn't radio!* This decision against radio was forecast in our issues of July 1943 and June 1944. Here, indeed, is a challenge to radio engineers and manufacturers, for railroad radio can add 50 to 75 million dollars of new business to the industry's annual volume and, in the opinion of most experts, deliver a more dependable communications service at lower maintenance cost than the wire-operated induction system.

RELATION OF CONTRAST TO WIDTH OF TELEVISION BAND

Why So-Called High-Definition Images May Show Less Detail

BY MADISON CAWEIN*

SOMEONE once said, "Information is information, no matter how it is come by!" The quotation may be inaccurate, and certainly it is trite, but nevertheless expresses a truism which should be of more than passing interest to communications engineers. The business of the communications industry is the transmission of information. Specifically, the business of the television industry is the transmission of visual information, concerning the nature of which a great deal has been and is in process of being said.

Visual information has for its domain a two-dimensional field. Television is the art of reconstructing on a two-dimensional field of the image of a distant object, by means of properly controlled pulses of light. The pulses of light are confined to relatively small areas which are called "picture-elements", the size of a picture element being a measure of the resolution, or fineness of structure, of the image. In general, this type of visual information is described in engineering circles by the word "detail". The subject of the relation of detail-information in television images to the bandwidth required for transmission of this information has been discussed at some length in the literature of the past decade. It has become general to express television resolution in terms of the number of lines (of information) which are transmitted in the bandwidth allotted, and subject to a given set of standards.

At the present writing it is in general agreement among engineering [1] representatives of the television industry that a line-structure of approximately 500 lines will result in equal resolving power for both dimensions of the image, within the allotted bandwidth, which is somewhat less than 4.5 mc. This means that approximately one-quarter of a million picture-elements are transmitted in each frame of the picture. Many formulae have been presented by various observers,[2] who are more or less in agreement, to express the required bandwidth for equal resolution in terms of the number of lines, N, and the frame repetition frequency, F. The formula which is probably most representative of engineering thinking gives the cut-off frequency in terms of the other parameters, as:

$$f = \frac{0.7\ AN^2F}{2} \qquad (1)$$

where A is the ratio of width to height of picture (1.33 by present standards). Calculation from equation (1), which gives the bandwidth from zero to cut-off frequency, for present standards in which 525-line pictures are transmitted at 30 frames per second, shows that:

$$f = 3.85 \text{ mc.} \qquad (2)$$

approximately. Other factors beyond the scope of this discussion result in slight numerical modifications of (2).

Most laymen who have observed television transmissions on receivers which are capable of accepting this band of frequencies have been heard frequently to admit that the detail is probably sufficient for commercial purposes (and some think so enthusiastically). The layman is seldom heard, however, to admit that the subjective quality of a television image is equivalent to that of a photograph, or of a motion picture. Most engineers, when not attempting to prove a point, will admit that television images lack something which photographic images generally have. Probably the best descriptive term is to say that television images, even brilliant ones, are "flat", or lacking in contrast.

Certain writers [3] have commented on the fact that low contrast in the detailed regions of a television image is responsible for apparent loss of definition in the picture. Most observers who have witnessed demonstrations of color transmissions (with identical bandwidth, but on lower standards than monochrome: i.e., with 75% of the line-structure and 57% of the picture-elements) have commented on the fact that the "lift in contrast" which is contributed by color offsets the loss in resolution due to coarser line-structure, which is necessary if the bandwidth is not increased, because the frame-rate must be increased to prevent color flicker.

It is the purpose of this brief paper to inquire into the philosophic roots of the facts in the case, without going too deeply into a mathematical analysis. Actually, the investigators who have developed the frequency bandwidth formulae for transmission of visual information, of which equation (1) is a prototype, have not considered the problem of "contrast" as superposed on the problem of "detail". Contrast is a form of visual information in which the light intensity within the picture-element area is varied, in order to convey information in addition to the purely geometric information conveyed by the two-dimensional array. Frequency formulae which are concerned with the transmission of detail-information have been developed on the assumption of "black-white" alternations, in which only two levels of contrast are involved instead of the many levels which exist in ordinary scenes.

In 1928, R. V. L. Hartley [4] of the Bell Telephone Laboratories published a very fundamental paper on the subject of the transmission of information in its relation to bandwidth. The implications of his analysis are at least as fundamental as those growing out of concepts which describe the physical limitations of our universe, such as the conservation of momentum and other conservation laws. In this paper Hartley inquired minutely into the transmission of visual information as well as that of aural information, in regard to the relation to bandwidth, or frequency-range. He came to the conclusion that although he could not define a quantitative unit of information, he could define a proportionality between information and a fictitious room required for its transmission through ether-space, if the time of transmission were specified. In the complex case for the transmission of selections of symbols, which he defined as secondary symbols, variations within these selections themselves can be considered as constituting primary symbols. As an example, the transmission of a dot-dash code (secondary symbols) may be varied by changing the tones (primary symbols); or, the transmission of a strip-image of picture-elements (secondary symbols) may be varied by changing the colors, or the contrast levels of the elements (primary symbols).

Hartley's general conclusions, which are classic in their nature, were as follows: Information is proportional to the number of selections and to the logarithm of

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* Manager of Research, Farnsworth Television & Radio Corporation, Ft. Wayne, Ind.

[1] *Television Standards and Practice*, edited by Donald G. Fink, McGraw-Hill, 1943.

[2] M. W. Baldwin, "The Subjective Sharpness of Television Images," *Bell Tech. Jour.*, 19 (4) p. 563, October 1940, p. 580 and references.

[3] Peter C. Goldmark, "Quality in Television Pictures," *I.R.E. Proc.*, Vol. 28, No. 8, p. 344, August 1940.

[4] R. V. L. Hartley, "Transmission of Information," *Bell Tech. Jour.*, 7 (3) p. 535, July 1928.

the number of primary symbols in each selection. Specifically, he showed that the amount of information transmitted is proportional to the product of bandwidth (frequency-range) and time, or to the product of wave-number-range (reciprocal or wave-length) and distance. The process of forming an equation from the above sentence is the mechanism by which television bandwidth formulae (such as (1)) are derived:

$$frequency\text{-}range = \frac{wave\text{-}number\text{-}range \times distance}{time} \quad (3)$$

Wave-number-range is determined by the size of each selection (picture element) and the logarithm of the primary symbols (contrast levels) within the selection. Hartley did not assign a base (x) to his logarithmic system, because he was unable to define a measure of information; he did state, however, that information is proportional to this logarithm, so it is not necessary to know the absolute value of the base in order to obtain useful information. Inasmuch as investigators have tacitly assumed *two* levels of contrast within each picture element, then if it is required to transmit *ten* such levels, the information is multiplied by $\log_x 10 / \log_x 2$, which is 3.3 for any base. Thus, it should require 3.3 times the bandwidth to transmit a picture showing ten faithful levels of contrast, as compared to one showing only two.

This means that if a 525-line-standard picture is capable of showing 500-line, black-white detail, when transmitted within a certain bandwidth, then the contrast will be correct for only two levels, that is, black and white, in those regions of the picture exhibiting 500-line detail, but will be correct to ten levels in those regions exhibiting 276-line detail (divide 500 by $\sqrt{3.3}$); or, to five levels in the regions of 329-line detail (divide 500 by $\sqrt{\log 5/\log 2}$).

It thus appears that there is a good theoretical reason for lack of contrast in the detailed regions of a television picture. This would explain the apparent flatness of fine-structure pictures. On the other hand, it is a fact that close-ups, or pictures which do not exhibit excessive detail, are more satisfactory from the standpoint of contrast; and that color pictures, though not capable of transmitting a resolution chart with the same fidelity as in monochrome, are still capable of conveying an equivalent amount of information, equally satisfactory to the observer. It is of significance that resolution charts for television, which are always black-white in the detailed structure, exhibit a notable tendency toward uniform gray in those portions of the wedge where the resolution starts to vanish.

The general subject of the relation of contrast to television bandwidth yields some rather interesting results when examined on a rigid mathematical basis. It has been somewhat neglected primarily because television pick-up tubes, in general use, are not capable of showing all the grades of contrast which are present in most scenes, particularly outdoors, or where there are several people. •

FIRST T.B.A. CONFERENCE

Program of Television Broadcasters Association, Inc., Dec. 11, 12

THE first Annual Conference of Television Broadcasters Association, Inc., to be held at Hotel Commodore, New York City, on December 11th and 12th, will give the broadcasters and manufacturers an opportunity to get a complete and up-to-date picture of television progress, and to appraise the situation as it relates to their own plans and activities.

For this reason, it is expected that the attendance of executives and engineers will break all records of other radio industry meetings. A large representation of radio advertisers and advertising agencies is expected also, for the speakers and panel discussions will cover all phases of television, as indicated in the program below.

The Conference Committee, of which Jack Poppele is chairman, has announced that everyone interested in any aspect of television will be welcomed. In drawing up plans for this event, every effort has been made to provide a program that will be both informative and entertaining, and will answer all the different kinds of questions which will be in the minds of those who attend the Conference.

Following is the timetable of events:

MONDAY, DECEMBER 11TH

9:00 A.M. — Registration

10:00 A.M. Opening session
Address of Welcome
Dr. Allen B. DuMont, T.B.A. Pres.

New Horizons in Television
Dr. W. R. G. Baker, G.E.
E. W. Engstrom, RCA Labs.

Television Programming
J. F. Royal, NBC
R. L. Gibson, G.E.
T. H. Hutchinson, RKO Tele.

Establishing Television Networks
H. S. Osborne, AT & T

12:30 P.M. — T.B.A. Luncheon
Speaker and subject to be announced

2:00 P.M. — Panel Discussions
D. D. Israel presiding
1. Broadcasters, S. H. Cuff, Chmn.
2. Manufacturers, C. H. Priest, Chmn.
3. Producers, T. H. Hutchinson, Chmn.
4. Agencies, W. H. Weintraub, Chmn.
5. Newspapers, C. Denton, Chmn.
6. Talent, W. Morris, Chmn.
7. Theatres, P. Larsen, Chmn.

5:30 P.M. — Social Hour & Cocktail Party
Hosts are Philco, RCA, and G.E.

7:30 P.M. — T.B.A. Conference Banquet (informal)
Speaker and subject to be announced
Demonstrations of television program reception at the banquet room
Presentation of T.B.A. Award of Merit

TUESDAY, DECEMBER 12TH

9:30 A.M. — Address
What I See in Television
Speaker to be announced

10:30 A.M. Roundtable Discussion
Questions and answers
Dr. A. N. Goldsmith presiding with
O. B. Hanson, NBC
Dr. A. B. DuMont, DuMont Labs.
Dr. C. F. Jolliffe, RCA
F. J. Bingley, Philco
J. E. Keister, G.E.
H. Lubke, Don Lee
J. R. Poppele, WOR
A. H. Brolly, Balaban & Katz
K. Landsberg, Tele. Prods.

12:30 P.M. — T.B.A. Luncheon
Speaker to be announced

2:30 P.M. — Annual T.B.A. Meeting for T.B.A. members only

3:00 P.M. to 8:00 P.M. — Visits to Television Studios
Arrangements have been made for T.B.A. members and guests at the Conference to visit the CBS, DuMont, and NBC stations

The registration fee of $15.00 includes attendance at all meetings (except the 2:30 session on Tuesday), both luncheons, the cocktail party, and the banquet. Ladies will be welcomed.

Those planning to attend this Conference should send their checks as early as possible to Television Broadcasters Association, Inc., 500 Fifth Avenue, New York 18, N. Y., attention: Will Baltin, Secretary-Treasurer.

COMMON CARRIER RADIO RELAY SYSTEMS

Plans for Development of Systems to Carry Multiplex Telephony, Television, and Sound Programs

BY DR. RALPH BOWN*

OVER the first 25 years of its service life, radio telephony has evolved toward ever higher frequencies. At each frequency advance new uses for the benefit of the public have been opened, and in each major advance the telephone companies have taken a leading part. The war developments of 1917–18 were followed by country-wide broadcasting. The short-wave discoveries of the mid-twenties led to world-wide public telephone service and international broadcasting. Development of ultra-short-wave techniques brought FM and television broadcasting, marine, mobile, and military radio telephony, and point-to-point multiplex radio telephone extensions of the wire network. In the large expanses of microwave frequency space now opened before us by the electronic developments of more recent years, the use of radio relays for overland transmission as a supplement or alternative to wires or cables is clearly foreshadowed.

The present view among radio and telephone engineers is that microwave radio relaying offers a very promising method of obtaining broad-band transmission circuits for multiplex telephony, television, and similar services furnished by telephone companies. It is important to have this question thoroughly tested in actual practice, so that the facts may be fully developed in the engineering, economic, and service aspects. For this reason, the Bell System has undertaken a large program of research and experimental trial of microwave radio relay systems, and is now engaged in the establishment of an experimental system between New York and Boston.

Our purpose is to engineer and build this system as soundly as possible, to try it out carefully under actual service conditions, and to learn as thoroughly as we can by experience what are the advantages and disadvantages of this method of transmission for use in communication services. We want to be in a position to proceed in accordance with the conclusions reached by our research and experience. If the radio relay system will enable us to give better service or to reduce the cost, we would hope to employ it as far as it is justified under the circumstances then prevailing.

With such a program in mind, I want to develop the frequency needs for radio relay transmission as we see them, and I can do that best by giving first a brief résumé of the technical situation:

In present types of broad-band wire facilities such as coaxial cable, the signals are severely attenuated as they go along the line, and vacuum tube amplifiers or repeaters are placed at intervals of 5 or 10 miles to renew or relay the signals. In microwave radio relay systems, the highly directive radio beams carry the signals across county in line-of-sight spans, so that the relaying amplifier stations are placed about every 25 to 35 miles. These radio relay stations are not little amplifier boxes which can be stowed in roadway manholes or other small space. They are relatively large and expensive structures, involving elevated precision antennas, and the housing, maintenance, and power-supply problems characteristic of small, isolated radio stations. The comparative economic factors cannot be estimated satisfactorily at this stage of research and development, but there is a good chance that the microwave radio method of broad-band transmission will prove in. Performance, i.e., transmission quality, reliability, and flexibility, is obviously a very important factor in any comparison with wire transmission. This can be ascertained only by extensive development and trial.

At these very high frequencies, the radio transmission path itself places no material limitations on band width. This fact sometimes leads people to jump to the conclusion that radio relays can inherently carry broader-band signals than wire systems. Actually on either type of system the most definite band limitations are imposed by the cumulative effect of the multiplicity of amplifier stages required in a long circuit to overcome the attenuation, and only careful trial and engineering study will show the comparative merits of the two types on this score.

The radio relay system is characterized by an entirely different kind of vulnerability to interruption by storms, fires, or accidents than are wire systems. Crippling damage must occur at the relay stations in order to affect service. The long jumps in between contain no man-made structures to suffer damage. On the other hand, radio antenna structures may be more exposed to damage by storm or sleet than cable facilities, especially where cables are underground.

Whether microwave radio transmission will be affected by weather variations to a greater extent than wire transmission is yet to be determined, but it seems clear that, whatever the effect, it will be quite a different one. All these factors indicate the desirability of using both broad band cable and microwave radio developments to give the most flexible and reliable network for serving the needs of the country.

The frequencies best adapted for microwave radio relay systems are believed to be from about 500 mc. on up to 20,000 mc. or more. At the present time, there is a greater variety of suitable electronic tools available at the lower end of this broad expanse, while toward the higher end it is more easily possible to obtain the advantages of directivity. A natural trend of development therefore would be to start experimentation at the lower frequencies and progress upward as knowledge of the art permits. The American Telephone and Telegraph Company and Bell Telephone Laboratories are looking toward carrying on research to explore the merits of this entire frequency territory.

The channel width which will be required in radio relaying has been the subject of some discussion. Obviously the width depends upon the signals being transmitted and the technique employed. While sooner or later it will be necessary to consider much wider bands, it seems appropriate to assume for the immediate present that a signal frequency band up to about 5 mc. is what most systems will be called upon to transmit. This would accommodate either television or a multiplex group of telephone circuits. Straightforward modulation of such a band onto a microwave carrier frequency by amplitude modulation, or frequency or phase modulation, or other method will result in sidebands having a minimum spread of ± 5 mc. from the carrier, or a total minimum band of 10 mc.

Frequency control at these extremely high frequencies is not easy, and a variation of ± 1 or 2 mc. may not be unreasonable for some time to come. Some guard band is also necessary and, furthermore, not all methods of modulation can achieve the minimum sidebands assumed above. Based on this reasoning, it seems sensible

(CONTINUED ON PAGE 72)

* Director of Research, Bell Telephone Laboratories, 463 West St., New York City. A statement delivered at the FCC Allocations Hearing.

DETAILS OF TELEVISION STATION WRGB

Part 1. Plan of the Building Which Houses General Electric's Schenectady Studio

BY JAMES D. McLEAN*

THE facilities and equipment of General Electric's television station WRGB, at Schenectady, N. Y., have been developed over a period of five years of continuous operation. Our 5th anniversary was celebrated on November 6th. During that time, over 900 different live-talent programs were telecast at WRGB, and almost an equal number of film programs originated at its studios. In addition, weekly programs are relayed from WNBT, the National Broadcasting Company's television station in New York City.

Introduction ★ It is evident, therefore, that this station, comprising the studio and its associated equipment, the studio-to-transmitter relay, and the main transmitter, represent a great fund of experience accumulated in handling many programs and in meeting the problems encountered in a wide variety of programs. In fact, it was with this specific purpose in mind that WGRB was originally established.

Accordingly, this paper has been planned to present the details of our television facilities for the information of those who may have in mind the question: "Exactly what is involved in a television setup such as WGRB?" For the benefit of those who are interested in the business of television broadcasting, or engineering and operation, the installation will be described fully, so that it can serve as a guide in planning new facilities.

Facilities at the Studio ★ WRGB's studios, Fig. 1, are located in downtown Schenectady in a building formerly occupied by the Edison Club. The building is approximately 110 ft. long, 45 ft. wide, and 25 ft. high. In modifying this brick structure for use as a television studio all of the large window areas were filled in with glass block, as will be seen in Fig. 1.

Figs. 4 and 5 show the layout of the main floor and upper level of the studio building. The main studio occupies the full height and width of the building and covers over half its length. The studio is 70 ft. long, 40 ft. wide, and 20 ft. high. This large room is windowless and has been acoustically treated with sound absorbent material. The floor is covered with light-colored asphalt tile to provide a maximum of light reflection from the floor. The studio is completely air conditioned to provide comfortable working conditions for the program and technical staff, the cast, and the studio audience.

Fig. 2, is a line drawing showing the general layout of the interior of the studio building. The sponsors' room is in the foreground, with the main studio, the projection room and the maintenance shop on the lower level in the rear, and the control room on the upper level at the back of the studio. Special lighting units, seemingly suspended in mid-air, are actually secured to the ceiling, and can be positioned by remote control. Referring now to Fig. 5, the main studio 2 is large enough to accommodate a number of stage sets for the production of television programs requiring complicated scenery. The layout shows one set on the floor of the studio, with the cameras 2A, microphone boom 2B and floor lights 2D.

Controls for all studio lights, by which they can be rotated and turned with respect to the floor, are located at a small console 2E at one end of the studio, just below the control room window. A trap door 2F connects the studio with the basement scenery shop to facilitate the movement of sets and properties from the workroom or store-room to the studio floor.

Still referring to Fig. 5, the front part of the building is devoted to the entrance lobby 1A, the office of the program manager 1B, and the office of the engineer in charge of the station 1C. In the rear of the main floor of the studio is the maintenance shop 3, showing the location of the film pick-up cameras 3A, the workbench and test equipment set up 3B and the small air conditioning unit 3C for the shop. projection room and control room.

Adjacent to the maintenance shop is the projection room 4 with the motion picture projectors at 4A and 4B, and the film editing, splicing and storage equipment at 4C. Windows open through a fire wall between the projection room and the maintenance room so that the motion pictures can

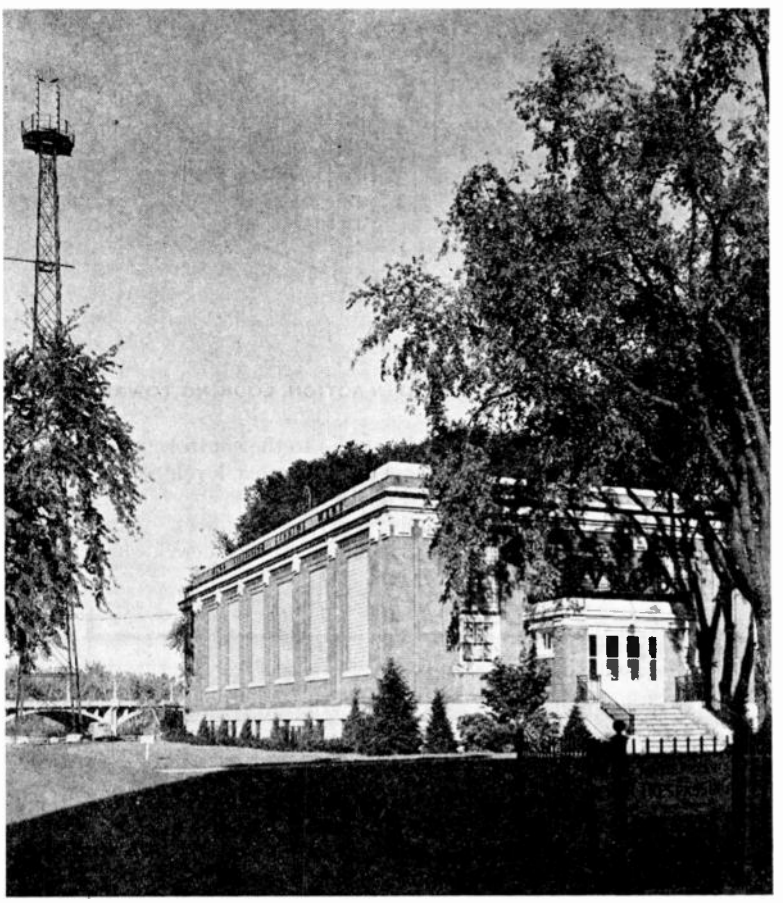


FIG. 1. PROVING GROUND FOR EQUIPMENT AND PROGRAM TECHNIQUES

*Electronics Department, General Electric Company, Schenectady, N. Y.

FIG. 2. BIRD'S-EYE VIEW OF THE TELEVISION STUDIO IN ACTION, LOOKING TOWARD THE CONTROL SECTION

be projected into the film pick-up cameras. Figs. 7 and 8 show the projection equipment and film pick-up cameras, located in the projection room and maintenance workshop respectively. A stairway leads from the rear of the studio to the control and equipment room on the upper level, as indicated at 5, Fig. 4.

The camera amplifiers, video amplifiers, and power supply racks for the camera channels are located at 5A, the consoles for the producer, video operator, and audio operator at 5C, D, E, and the camera monitors, line monitors, and shading desk at 5B.

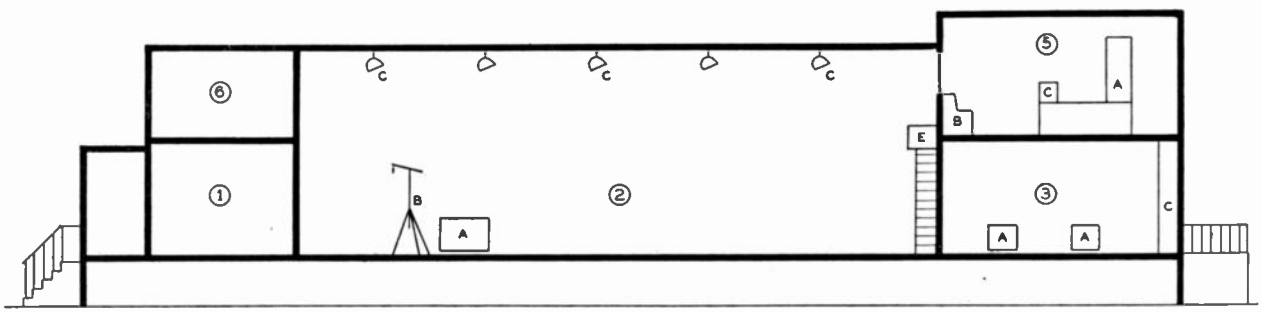


FIG. 3. ELEVATION VIEW, SHOWING THE RELATIVE LOCATIONS OF THE STUDIO AND THE TWO FLOORS AT EACH END

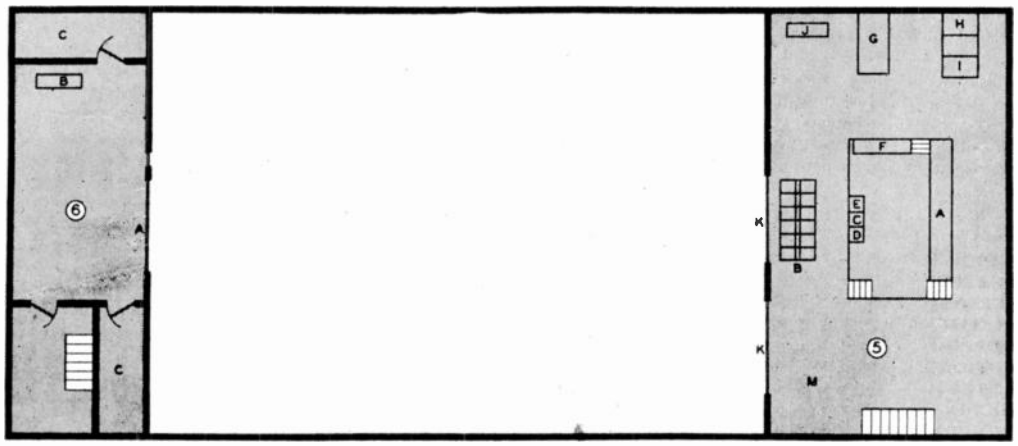


FIG. 4. PLAN OF THE SPONSOR'S ROOM, 6, AND THE CONTROL ROOM, 5, AT THE REAR OF THE BUILDING

The synchronizing pulse generator and the low-power transmitters which carry both picture and sound to the main transmitter, located in the Helderberg Mountains near Schenectady, are also placed in the control room 5G, H, I. Fig. 9 shows a part of these control room facilities.

Referring again to Fig. 4, the sponsor's room is located in the front end of the studio building on the upper level 6. Large windows 6A allow visitors to watch

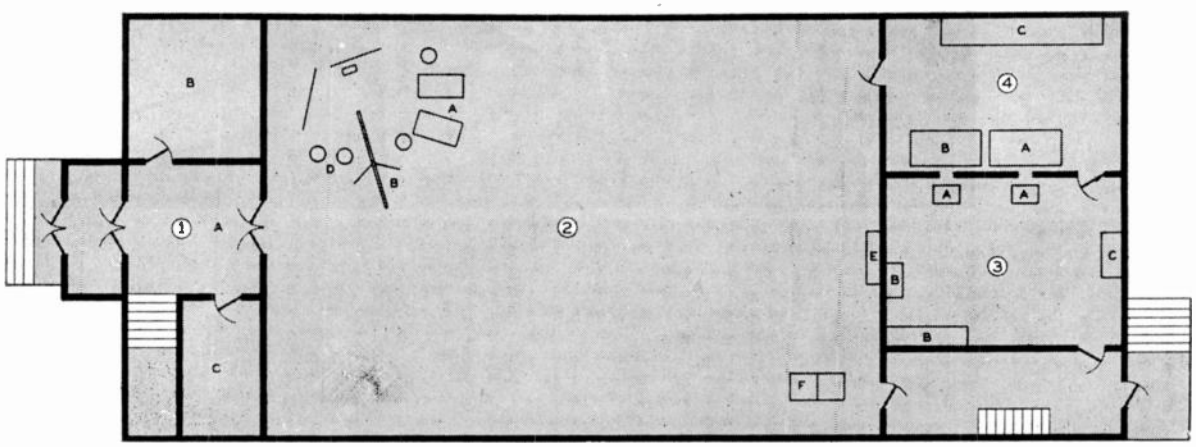


FIG. 5. PLAN OF THE GROUND FLOOR, OCCUPIED BY THE OFFICES, STUDIO, PROJECTION ROOM, AND SHOP

the action on the studio floor and a monitor receiver 6B also shows the picture as it is being broadcast to the television audience. Storage space is provided adjacent to the visitors' lounge 6C.

Windows between the visitors' lounge and the studio 6A, as well as between the control room and the studio 5K are built of double glass for sound insulation. In addition, they are covered with a dark plastic material which excludes most of the intense studio illumination in order that sufficient contrast can be obtained to allow observation of the television images on the monitors and receivers.

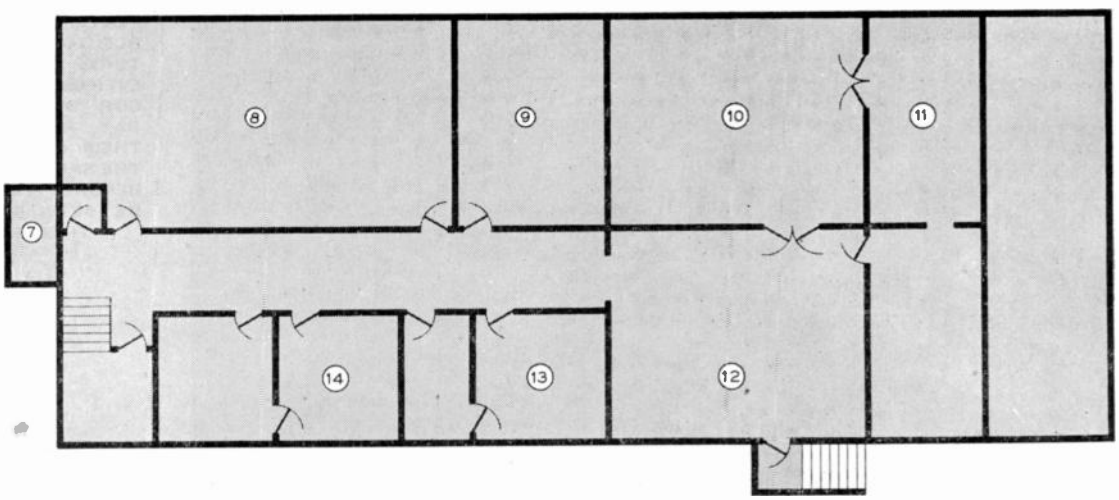


FIG. 6. THE ARRANGEMENT OF THE BASEMENT PROVIDES FOR DRESSING ROOMS AND SPACE FOR PROPERTIES

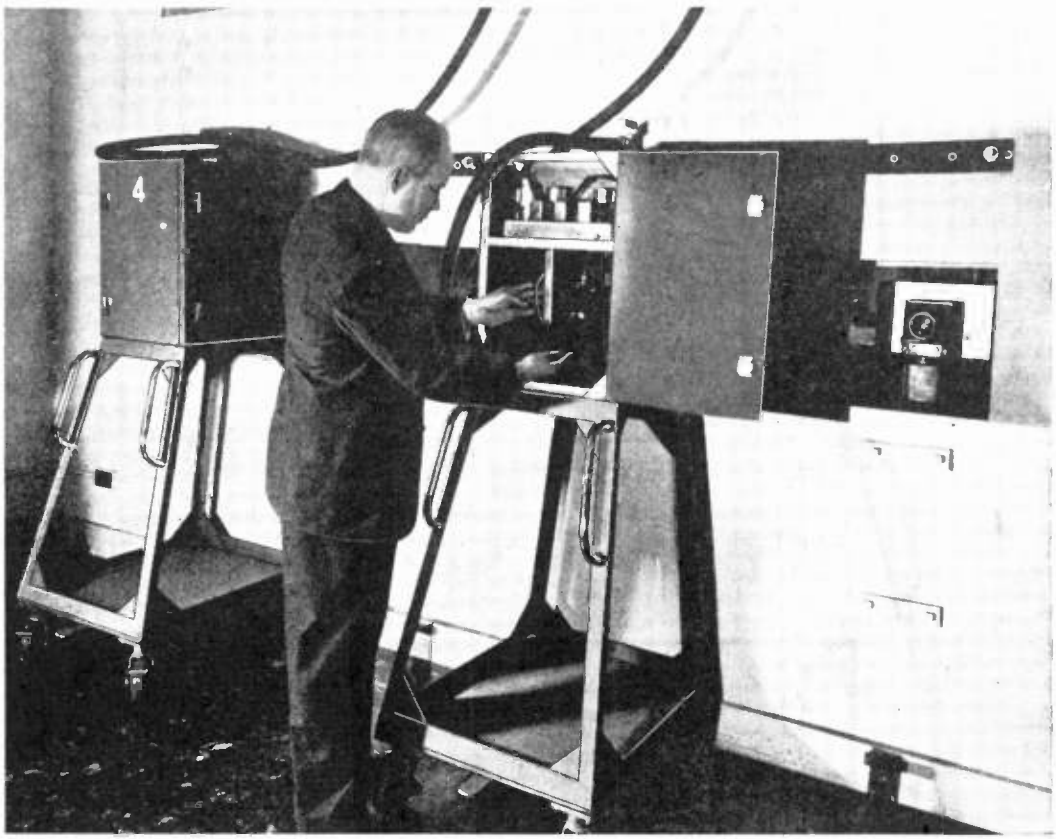


FIG. 7. FILM PICK-UP CAMERAS ARE SET UP IN FRONT OF OPENINGS IN THE FIRE WALL, OPPOSITE THE MOTION PICTURE PROJECTORS. WITH DUPLICATE SETS OF EQUIPMENT, THE TRANSITION FROM ONE REEL TO ANOTHER CAN BE ACCOMPLISHED WITHOUT INTERRUPTING THE PICTURE

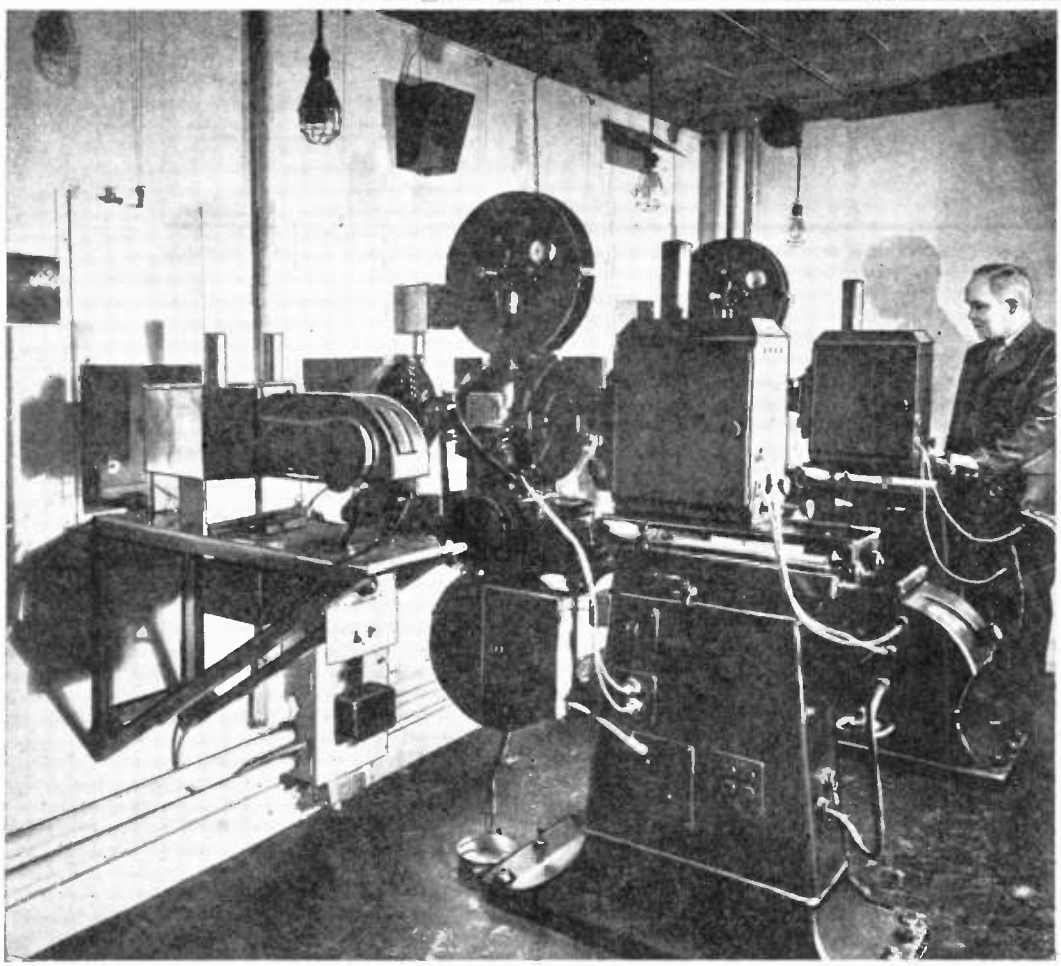


FIG. 8. MOTION PICTURE PROJECTORS ARE AN ESSENTIAL PART OF THE STUDIO EQUIPMENT, FOR, IN ADDITION TO TELECASTING MOVIE SHORTS AND PLAYS, IT IS POSSIBLE TO TAKE PICTURES OF SPECIAL EVENTS WHICH OCCUR DURING THE DAY, AND TO PUT THEM ON THE AIR THE SAME EVENING, BEFORE THEY CAN BE SEEN IN THE THEATRES

FIG. 9. THE PRODUCER, VIDEO OPERATOR, AND AUDIO OPERATOR, AT THE RIGHT, LOOK INTO THE STUDIO OVER THE HEADS OF THE OPERATORS WHO HANDLE THE CONTROLS OF THE CAMERA AND LINE MONITORS, AND THE SHADING DESK

Fig. 3 shows the side elevation of the studio building with the office space 1, the main studio 2, projection and maintenance rooms 3, control room 5, and the visitors' lounge 6.

A stairway leads from the entrance foyer to the basement of the studio building. The layout of the rooms in the basement is shown in Fig. 6. This space is used for program offices 8, rehearsal room and office space 9, property shop 12 and the ladies' and men's dressing, shower, and wash rooms, 13 and 14 respectively. The incoming power control equipment is located at 7. The main blower for the studio air-conditioning equipment is located in room 10, together with the transformer and switching equipment for the studio lighting apparatus. Compressor and brine tanks for studio cooling, and the storage batteries for signal and telephone power are placed in the basement area 11, while furnaces for heating the building are in an adjoining room. The property shop 12 is not only equipped for woodworking and stage set construction, but also provides a small storage space for properties and stage sets.

Referring back to Fig. 1, the antennas for relaying the picture and sound signals to the main transmitter are located on a 128-ft. steel tower, adjacent to the studio building. A wooden enclosure protects the antennas from the weather and keeps them clear of sleet.

A Typical Installation ★ Here, then, are the essential elements required in a studio for originating live-talent shows and motion pictures. These facilities, modified as to arrangement or expanded and elaborated if desired, might be located in the heart of any one of our metropolitan centers, and connected by radio relay to a main transmitter erected at a remote point affording maximum elevation for the antenna.

Part 2 of this paper will deal with the equipment at the WRGB studio. Details of the main transmitter and relay station will be described subsequently.

BOOK REVIEW

RADIO DIRECTION FINDERS, by Donald S. Bond. 272 pages, 163 illustrations, cloth bound, 8½ by 5½ ins. Published by McGraw-Hill Book Company, 330 W. 42nd St., New York 18, N. Y.

Here is an excellent book for those who want quite complete information on standard direction-finding equipment, and on the theory underlying this very important apparatus group.

The three equipments described in detail are the RCA-Sperry Mark I and the Bendix model MN-31 automatic direction finders, and the RCA model AVR-8F right-left type. Complete schematic diagrams are given for these installations.

Thus this book serves the needs of engineers engaged on direction-finder developments, the advanced students, and operators who are called upon to use and operate such apparatus, and desire to know more about what makes it work.

Seven chapters cover: general considerations, wave propagation, direction antenna systems, aural nul direction finders, performance characteristics of loop input circuits, visual direction finders, and radio navigation aids. There is also an appendix devoted to explanatory mathematics.

WHY THE OTHER FIVE LETTERS WEREN'T MAILED

What Happened When Station WABD Undertook to Interest Advertisers in Television

BY SAMUEL H. CUFF*

NO MATTER what technical advances are achieved by television, it will still remain a scientific curiosity unless there is revenue to pay the cost of operating television broadcast stations.

Engineers may not have the time or inclination to conjure with this stark reality. Right now, the matter of choosing frequencies may seem of paramount importance to them. To the producers, directors, and impresarios, nothing counts but the program. But management knows that no programs will be put out on any frequencies unless television station operation can be made a sound economic venture.

From its inception, it was assumed that television would pay its own way. By the time that scientific progress had reached the point of providing reception of acceptble quality, it seemed certain that the combination of sight and sound would offer a superior medium to advertisers.

A few attempts were made, here and there, to test the effectiveness of television as an advertising medium, but advertisers and agencies were not invited to come in and try their hands at making use of it.

No One Really Knew ★ On the contrary, it was taken for granted that, when the time came, the advertisers and their agencies would beat a path to the door of television, like the cash customers who sought out the inventor of the proverbial mousetrap.

Then came the realization that television was not a better mousetrap. In fact, it wasn't a mousetrap at all, and no one had proved that it had the sales appeal necessary to capture the interest of time buyers.

Television could provide entertainment. That much was known. But could it sell merchandise and, if so, how could television commercials ask for action?

The Six Letters ★ That was the situation at the Du Mont station WABD in the spring of 1943. Like everyone else, we *thought* that television would be not only an effective advertising medium but a superior medium. We were certain of it, yet we realized that this was merely opinion, without substantiation.

So we decided to find out. We realized that the only way to determine whether or not the operation of a television station could be built into a profitable business was to build up a record of case histories from the experiences of advertisers who had actually made use of television. Further, such a plan would be of great value to prospective television broadcasters, for it would enable them to gain experience in the technique of handling this medium.

In June, 1943, we had worked out our plan. A series of six letters was prepared. The series would be mailed to a carefully selected list of sixty-odd leading advertising agencies. The whole series was promotional in a sense, but we kept away from the idea of trying to sell a bill of goods. Rather, we undertook to present the idea of experimenting with the potentialities of commercial television broadcasting.

The letters were to go in six mailings, spaced three weeks apart. This would cover a period of four months. It was our considered opinion at the time the letters were prepared that favorable replies would not come in until after the fourth or fifth mailing.

Our theme was: here is a new advertising medium that is being talked about and theorized about. Why don't you see just what it will do for your client's products? You can try television without cost for time or technical facilities.

Results ★ The first letters of the series were mailed on June 3, 1943. And the first letters were the last. We never mailed the other five!

In less than a week, there were 22 replies — everyone favorable to our proposal. Within five days, executives from the advertising agencies commenced to pay regular visits to our studios to study the techniques of television programming. Within 6 weeks, three advertising agencies had programs on the air. In 5 months, Ruthrauff & Ryan were on the air with a weekly program for three Lever Brothers products. The procession gained momentum. Requests for time on the air exceeded our schedule of transmission, and we finally increased it to six times our original number of operating hours. At present, WABD has more requests for time than we can accommodate, and plans are now being made for a further increase in our transmitting schedule.

This experience, I believe, is unparalleled in the history of advertising. An important aspect of this activity is that the brand of television which these advertisers are using is definitely prewar. In point of technical facilities and picture quality which their clients have been seeing on receiver screens, this is television of 5 years ago. The equipment they are working with is out-moded and decrepit — but they have found the results to be satisfactory!

In their own way, the advertising executives have proved to their own satisfaction that the impact of a sales message delivered by television is terrifically potent. To us, their experiences have proved that, as an inevitable sequel, postwar television will bring a still greater enthusiasm. This will come when new receivers, incorporating war-born improvements, reach the market, and when new telecasting equipment, including more powerful transmitters, superior cameras, and super-sensitive iconoscopes, are used for studio and remote programs.

Let me repeat again that our experience established a precedent in advertising history which prospective television broadcasters will do well to consider. Whereas, in the past, advertisers and their agencies have sat back to wait for the public acceptance of any new medium before considering its use, in this case they have moved in on television while it is still under wartime limitations and are not only making ready for its peacetime release to the public but are contributing in a substantial way toward accelerating its progress when it can step out in public service.

It's Different Now ★ Remember, it was years after the inception of sound broadcasting before it was used as an advertising medium, and thousands upon thousands of sets were in use long before the first time contract was signed. But television is being used by advertisers right now. In fact, the most elaborate shows on the air today are those being produced by advertising agencies on behalf of their clients, and the advertisers are paying the entire cost of talent and production. Frequently, these costs have run up to figures exceeding sound programs which are broadcast over networks. As an example, the program put on for *Esquire* by the Storm agency cost slightly over $10,000. Many other agencies

(CONCLUDED ON PAGE 42)

* General Manager, Du Mont Television Station WABD, 485 Madison Avenue, New York City.

welding with a paint brush?

Alloy flows easily and weld is quickly completed under arc.

To solve a difficult welding problem, Eimac laboratory technicians compounded a welding alloy that could be applied with a paint brush. The alloy flows easily under an arc to complete the weld, yet subsequent heating to temperatures as high as 2900 degrees Centigrade will not destroy the weld.

Such is but an example of the application of the Science of metallurgy in the "science behind the science of electronics." The extent to which Eimac Engineers went to solve this relatively small problem reveals two important facts:—(1.) The thoroughness of Eimac Engineering, and (2.) The completeness of their engineering facilities. The leadership which Eimac tubes enjoy throughout the world in all phases of electronics is attributable to the soundness of this engineering.

Performance of any electronic equipment is a direct reflection of the performance of its vacuum tubes. Hence it is advisable for users and prospective users of electronics to look first to the vacuum tube requirements. Because Eimac makes electron vacuum tubes exclusively their advice to you is unbiased and can be of great value. A note outlining your problem will bring such assistance without cost or obligation.

EITEL-McCULLOUGH, INC., 870 San Mateo Ave., San Bruno, Calif.
Plants located at: San Bruno, California and Salt Lake City, Utah
Export Agents: FRAZAR & HANSEN, 301 Clay St., San Francisco 11, California, U. S. A.

Write for your copy of Electronic Telesis—a 64 page booklet fully illustrated—covering fundamentals of Electronics and many of its important applications. Written in layman's language.

Follow the leaders to

Eimac TUBES

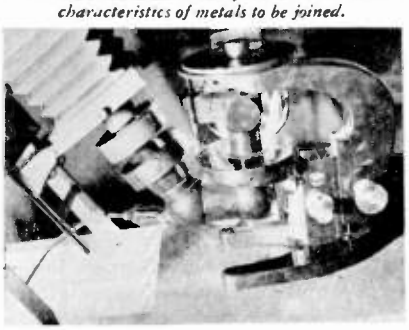
870

The Science Behind the Science of Electronics

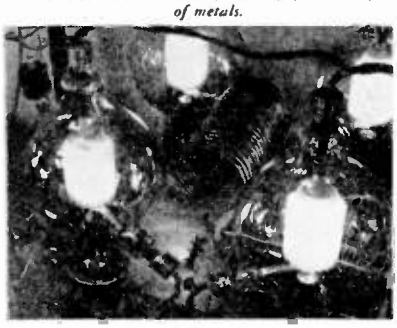
is the focusing of all branches of science upon the development and improvement of electron vacuum tubes.

SPECTROGRAPH... Analysis determines exact characteristics of metals to be joined.

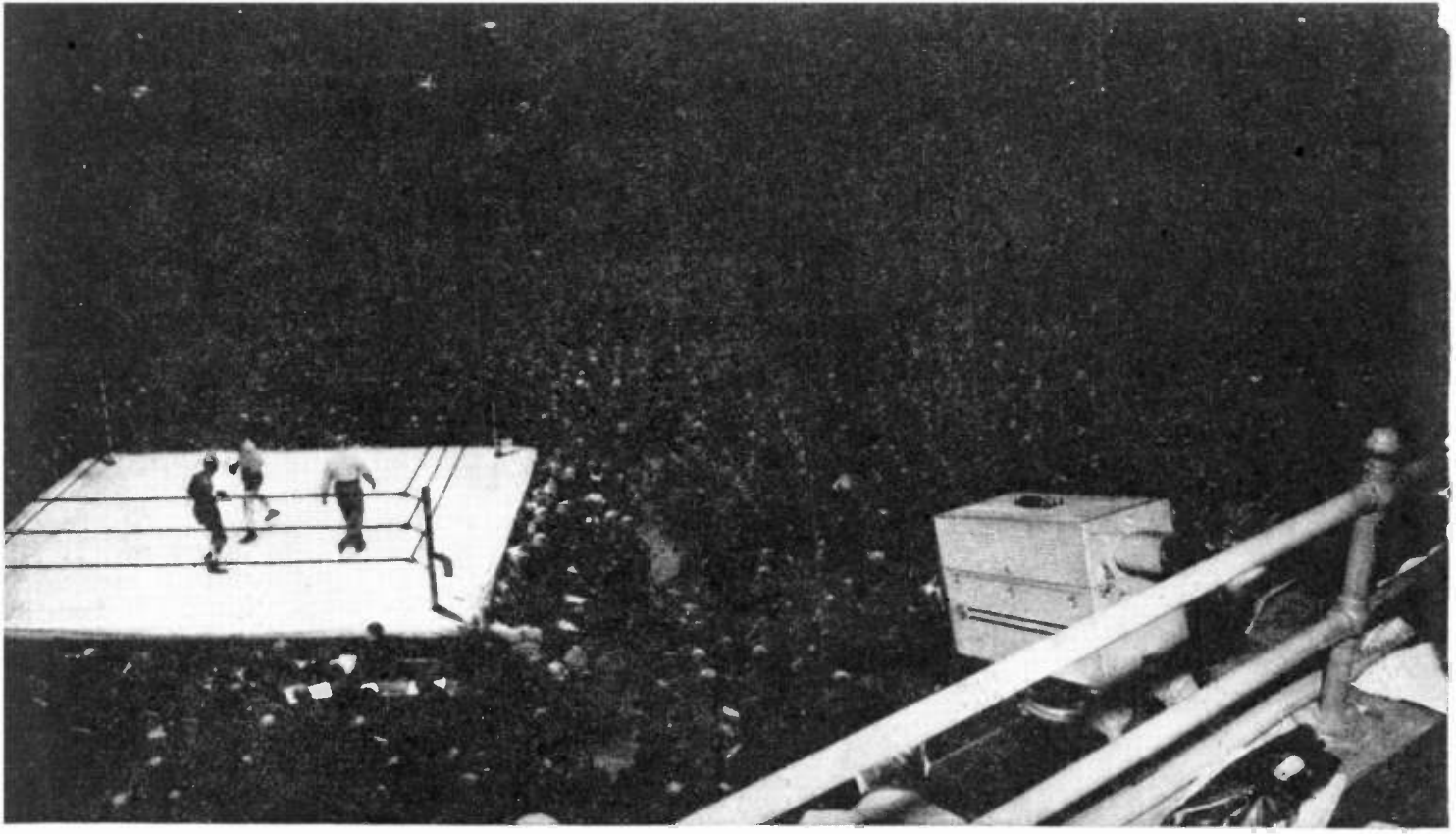
METALLURGY... Compounding special alloys of metals.



OPTICS... For studying the effects of processing.



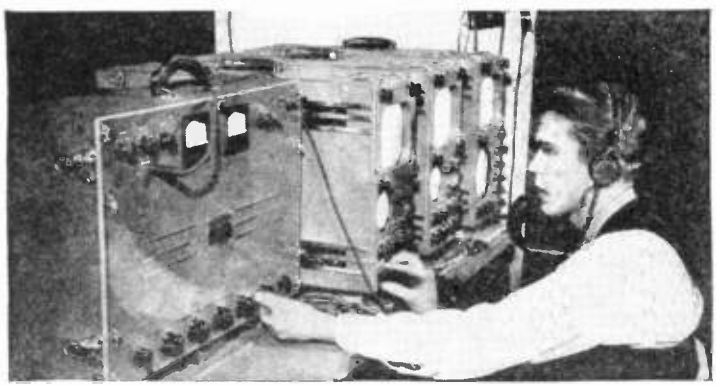
ELECTRONICS... Welded elements in electron vacuum tubes withstand tremendous heat.



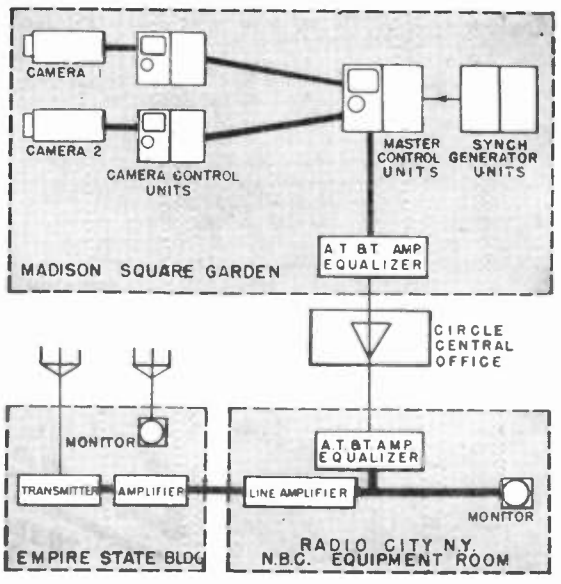
RCA "Orthicon" Camera picking up boxing bouts at Madison Square Garden, New York.

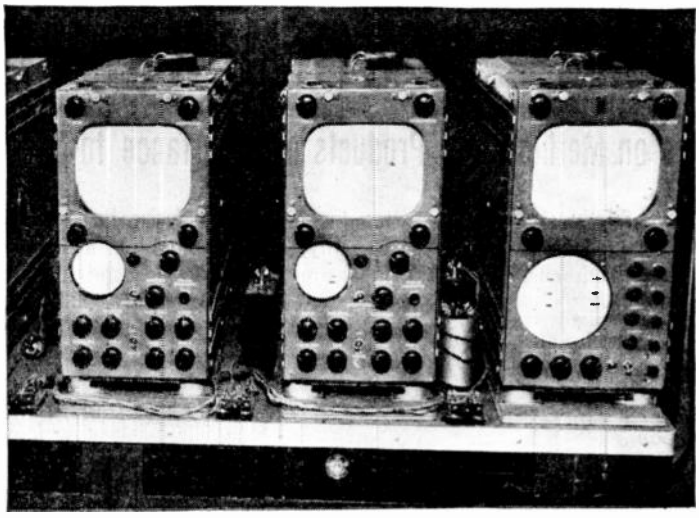
MADISON SQUARE GARDEN

Using RCA Television Field Pickup Equipment is relatively easy. Units are arranged as shown in diagram. Video and audio output are fed over an ordinary telephone cable (especially equalized) to Radio City, a mile away.



RCA control equipment used by NBC at Madison Square Garden. The audio control unit is at the left, video units at the right, power supply units beneath table. This corresponds to the "remote equipment" used by regular broadcasting stations in outside pickups.





Main units of the RCA Television Field Pickup Equipment. The two units at the left are "camera control" units. They provide monitoring of pictures picked up by each individual camera. At the right is the "master" monitoring and switching unit. Push-buttons allow operator to select, for transmission, the camera pickup desired.

TELEVISION!

RCA Portable Television Camera (below) which made outside pickups practical. Uses "Orthicon" pickup tube (an exclusive RCA development) which, because of its much higher sensitivity, makes possible operation with far less light than with other types of pickup tubes.

BOXING, basketball, radio, ice follies, circus—enjoyed at ease in your living room. In the New York area it has been a fact for the past year! Not just as an occasional experiment, but regularly, on a weekly schedule.

These broadcasts are picked up at Madison Square Garden by NBC, using RCA's standard Television Field Pickup Equipment, and are put on the air through NBC's Television Station WNBT. Some idea of the advanced design of this equipment and the ease with which it is used can be gained from a study of the accompanying illustrations. Not so obvious, but equally important is the experience behind this design. Before the war RCA built apparatus of this type for NBC, CBS, Don Lee and others. After the war RCA will introduce still further improvements—*based on actual experience in building commercial-type television equipment.*

BUY MORE WAR BONDS

1919—1944

25 Years of Progress in Radio and Electronics

RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

In Canada, RCA VICTOR COMPANY LIMITED, Montreal

RADIO DESIGNERS' ITEMS

Notes on Methods and Products of Importance to Design Engineers

Cam Lever Switch: Of midget size has been introduced by General Control Company, Boston 34. Dimensions behind panel are

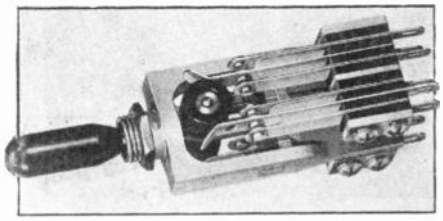


FIG. 1. SWITCH OF MINIATURE SIZE

2¾ ins. long, 1¼ ins. wide, 1¼ ins. high. Weight is 3½ oz. with 12 contact springs. The single-hole mounting has a lock to prevent turning. Rated at 5 to 10 amperes at 125 volts AC, is available with any contact combination on 2 or 3 positions.

Relays & Solenoids: Are illustrated in a new catalog from Guardian Electric, Chicago 7. Of special interest are the illustrations and specifications of solenoids for various electro-mechanical applications.

Microphones: For station, studio, and mobile use are detailed in a new catalog from Electro-Voice Corporation, South Bend 24. Fig. 2 illustrates a hand-held dynamic model equipped with a finger switch. Response is rated as uniform from 200 to 4,000 cycles. Somewhat similar in appearance is a model incorporating features of the lip microphone, for use where ambient noise is high, such as is encountered in locomotive cabs, and where the instrument may be subjected to temperature extremes.

FIG. 2. NEW DESIGN FOR MICROPHONE

Antenna Tuning Unit: Shown in Fig. 3, is used to couple a vertical radiator with a coaxial transmission line. Built by Andrew Company, Chicago 19, it employs an L network with elements adjustable for optimum performance. Housed in a weather-proof steel cabinet, an isolation filter permits connection of a coaxial line to a phase-sampling loop or an FM antenna on a standard broadcast tower. The cabinet also contains a tower-lighting

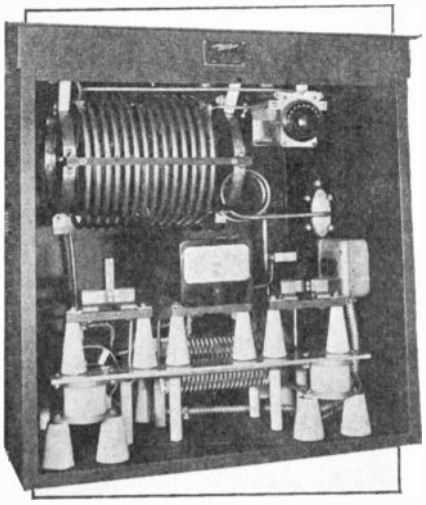


FIG. 3. HF ANTENNA TUNING UNIT

filter, and plug-in meter positions for checking all branches of the circuit during adjustment.

New Power Units: Special Magmotors produced by Carter Motor Company, Chicago, are designed to power railroad radio equipment. The unit at the left in Fig. 4 operates from 28 volts DC, and delivers 350 volts at .1 ampere. Ball bearings in these units are designed to take up end-thrust resulting from severe vibration in the locomotive cab or the tender when in motion.

Another series of Magmotors comprises generators only of 80 watts intermittent or 35 watts continuous output AC or DC, with voltages up to 500. The AC line includes 100-cycle models. A drive shaft ¼ in. in diameter by 1 in. long is provided for a pulley or direct coupling. Overall size is 5¾ ins. long, 3 1/16 ins. wide, 2½ ins. high. Weight is 4¾ lbs.

Illustrated at the left in Fig. 4 is a 3,000-volt, .05 ampere dynamotor for operation on 12 volts DC. A similar model has a double output of 1,500 volts at .05 ampere. Explosion-proof covers enclose the brushes. Dimensions are 11½ ins. long, 4½ ins. diameter, 5 ins. high. Weight is 18 lbs. without filter.

Tropic-Proofed Resistors: Of tolerances suited to general or precision use are available

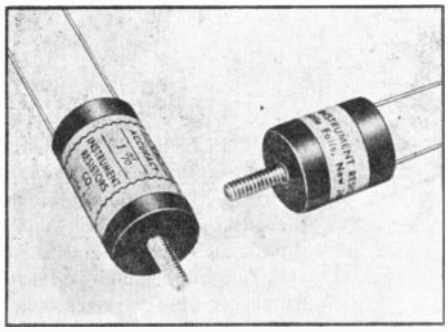


FIG. 5. RESISTORS DESIGNED FOR TROPICS

from Instrument Resistors, Inc., Little Falls, N. J. These resistors, Fig. 5, are completely enclosed by a Bakelite case and cover, dehydrated, and sealed against fungus growth, electrolysis, or corrosion. The anti-fungus coating is designed to meet Signal Corps 71-2202-A Specifications, and to be effective for about 1 year. Heavy, bare wires are provided for terminals, and a 6-32 screw for mounting.

Dynamic Microphone: First new model brought out by Universal Microphone Company, Inglewood, Calif., is designed for 50 to 8,000 cycles. Described as model D-20 series, four different impedance values are offered. Universal will also resume production on dynamic models KD and 15MM, the 200 series of handi-mikes, and carbon types X-1 and XX. Distribution will be through parts jobbers.

Special Tubes: A very interesting catalog issued by Sylvania Electric Products, Inc., Salem, Mass. lists specifications on Stro-

(CONTINUED ON PAGE 57)

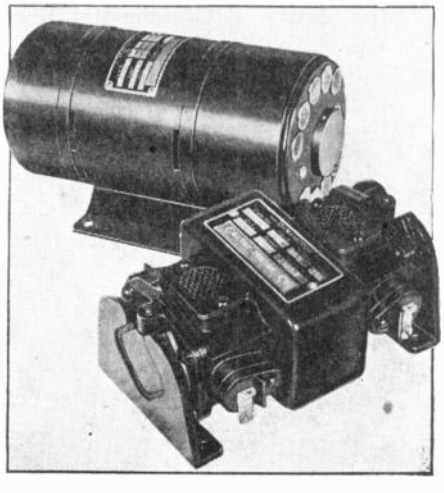
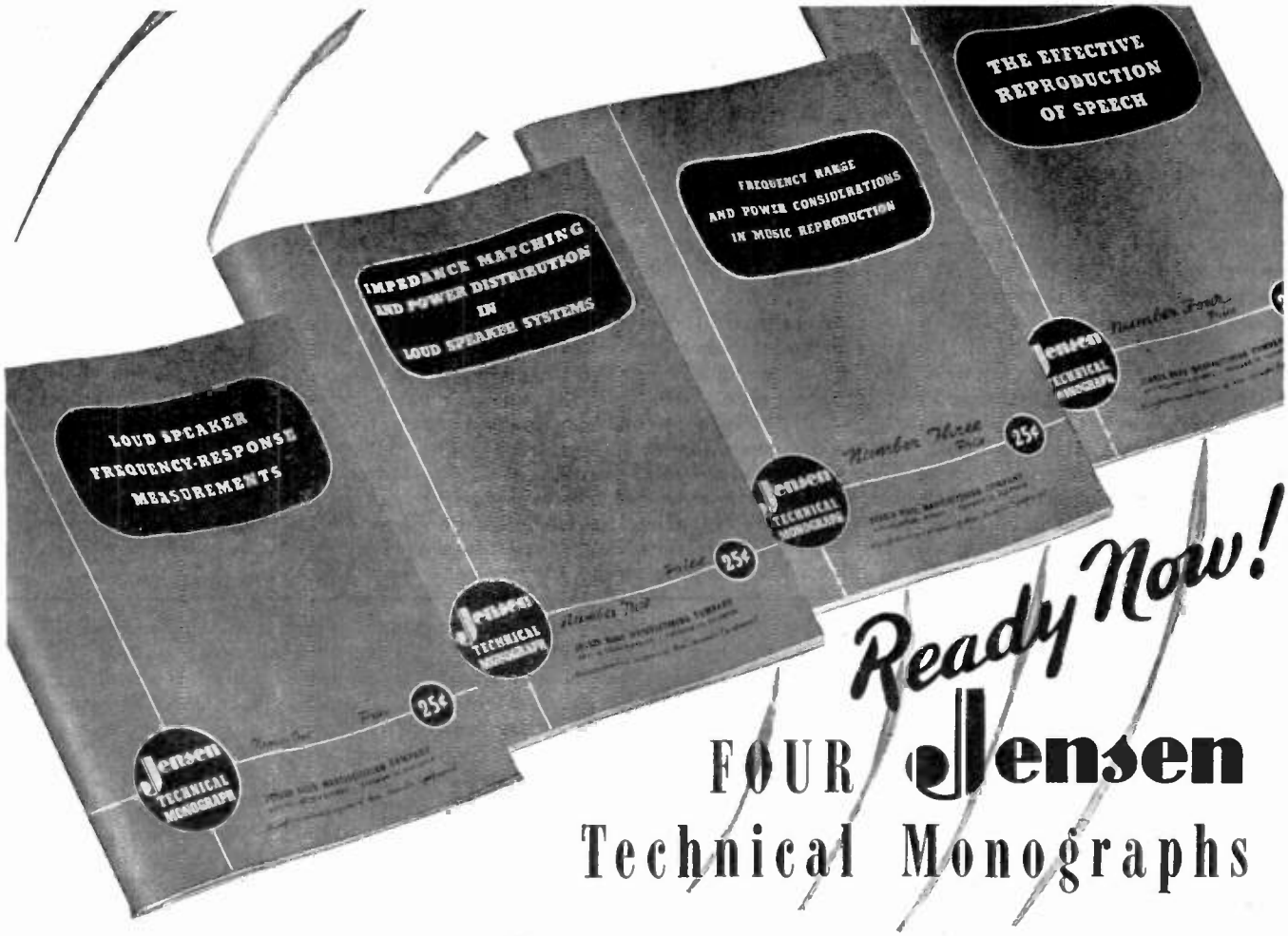


FIG. 4. TRANSMITTER POWER SUPPLIES



Ready Now!

FOUR Jensen Technical Monographs

EVERYONE interested in the reproduction of sound — engineer, tradesman, instructor, student or layman — should own these four Monographs. Published by the Jensen Technical Service Department in the interest of improved sound reproduction, they are the first four numbers of *a series*. Up-to-date in factual information, replete with useful charts, graphs and tables, they supply a world of data, heretofore unobtainable, to guide in the selection, installation and operation of loud speakers. You will want *not only these four* numbers *but the rest of the series* as announced from time to time.

MONOGRAPH No. 1: *"Loud Speaker Frequency-Response Measurements."* Deals with one of the most interesting and controversial subjects in the field of acoustics. Discusses, among other topics, frequency response of the human ear, the influence of environment on frequency response, the practical aspects of frequency-response measurements. Amply illustrated with charts and graphs.

MONOGRAPH No. 2: *"Impedance Matching and Power Distribution."* Discusses such subjects as multiple speaker connection, volume control, design of efficient transmission lines, and conversion of volume levels to power and voltage. The text is supported by twenty-eight drawings and tables. More than a score of questions are described, illustrated and solved, including a comprehensive sound system for a military installation.

MONOGRAPH No. 3: *"Frequency Range in Music Reproduction."* What frequency range is needed for high fidelity reproduction? What are the maximum, useful audio frequency ranges under actual listening conditions? What are the practical limitations on high fidelity reproduction even if perfect transmission, reception and reproduction were possible? How much change in high frequency cut-off is required to be just noticeable to the listener? All these and many more questions are answered in this Jensen Monograph.

MONOGRAPH No. 4: *"The Effective Reproduction of Speech."* Explains why *faithful* speech reproduction requires a frequency band almost as wide as for music, while amplified speech for strictly *communication* purposes may be reproduced satisfactorily within a narrower band because in this case the principal emphasis is on such things as articulation, loudness, masking, and power requirements. Presents useful conclusions and practical information for everyone interested in speech reproduction.

Get any or all of these Monographs today from your Jensen jobber or dealer. Fill in the coupon and send with it 25c for each copy desired, or clip a dollar bill to the coupon and get all four.

Jensen

FREE to men in the Armed Services, and to Colleges, Technical Schools and Libraries.

RADIO MANUFACTURING COMPANY
6609 South Laramie Avenue, Chicago 38, Illinois

Send me:

- ☐ Loud Speaker Frequency-Response Measurements
- ☐ Impedance Matching and Power Distribution
- ☐ Frequency Range in Music Reproduction
- ☐ The Effective Reproduction of Speech

(Check one or more. Send 25c for each book ordered.)

NAME_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

THE OTHER FIVE LETTERS

(CONTINUED FROM PAGE 36)

are putting on weekly television programs for their clients which run into substantial sums.

This has been done by advertisers with the full knowledge of the limitations of the present audience. They have known from the very beginning that current telecasts would not pay their own way.

Why? ★ What, then, is the purpose of this activity? Without exception, the answer is the same: Each advertiser, after his first two or three shows, is convinced that television has enormous possibilities as a medium of advertising. He and his agency want to explore it to the fullest, to acquire all available information and first-hand experience in its use so that, when television hits its stride, he will 1) assure himself of a position of leadership in the parade of sponsors and 2) he will know how to build the audience into a market for his products.

Progress ★ It is interesting to look back and compare the first television commercials with those of the present. But a few months ago, they were clumsily built affairs with little or no relation to the programs. Now, they are smooth-running visual presentations or demonstrations of merchandise.

A variety of techniques are used — some good, others still better. I don't pretend to know all the answers which the agencies and their clients have obtained from their experiences at WABD, but I know that one thing is a demonstrated fact: The audience accepts the commercials as a matter of course. In some cases, where the commercial has a service value, they actually enjoy the commercial as much as the show. Two particular examples which come to my mind are the Botany Worsted Mills weather predictions presented over the NBC station WNBT, and the Spry cooking demonstrations over WABD.

The conclusion is obvious. Advertisers are learning what television is all about. Through actual use they are learning what it can do for their products. They are actively encouraging the rapid advancement of television by their participation.

The problem of the television station operators, at least so far as the evening hours are concerned, is not going to be how to get sponsors but rather how he can accommodate the advertisers who will want to buy time.

SPOT NEWS NOTES

(CONTINUED FROM PAGE 26)

1945 I.R.E. Officers: President: Dr. William L. Everitt, Chief of Operational Research Branch, Office of Chief Signal Officer, U. S. Army, and recently appointed head of Department of Electrical Engineering, University of Illinois. He succeeds Prof. Hubert M. Turner. Vice president: Dr. Hendrick J. Van der Bijl, Johannesburg, S. A. Three directors elected for a 3-year term: Stewart L. Bailey of Jansky and Bailey; Keith Henney, editor of *Electronics;* and Dr. Benjamin Shackelford, engineer in charge of RCA Frequency Bureau.

16th Anniversary: Celebrated by Universal Microphone Company of Inglewood, Calif.

Thomas F. Joyce: General manager of RCA's radio, phonograph, and television department, sounded this warning in his testimony before the FCC allocations hearing: "The output of the radio industry during the war period, in terms of manufacturers' billing prices, has increased from $300,000,000 to $3,000,000,000. It is RCA's considered opinion that, with the present increased plant capacity and decreased consumer requirements from the 1941 production level, substantial over-production of radio sets will exist by the end of the industry's first full consumer radio production year."

That this fear of over-production is shared by other radio executives is indicated by plans to keep a tight run on credits, and on pyramiding of dealer's orders. These were the two principal factors contributing to the failures among manufacturers, jobbers, and dealers and the dumping of merchandise in the 1920–29 period.

However, the 3rd Survey of Consumer Requirements by WPB, on which Mr. Joyce based his statement as to a decrease in postwar demand for radio sets compared to 1941, is subject to further analysis.

The WPB survey indicates that if radio sets were available now, 5 million less would be purchased than in 1941. Assuming that figure to be correct, then 8,500,000 sets will be sold in the first year of postwar production, a reduction of 37% in number of units.

However, experience of the manufacturers licensed to manufacture FM-AM receivers and FM-AM phone combinations showed that the average retail price of such receivers was about $250, compared to the average of $80 for AM sets. With FM as principal sales-promotion feature of postwar models, it is reasonable to expect that the average unit sale will be at least doubled. Therefore, even though the number of units sold in the first year of radio set production is 5 million less than in 1941, the dollar volume will be equal to an increase of 3½ million units at average 1941 prices, or nearly 10 million units above the 1935–39 average of 7,536,000 sets per year.

A. L. Herron: Appointed manager of cabinets for the new Westinghouse radio receiver division. Prior to the war, he was cabinet engineer for Stewart-Warner.

Peter Copeland: Industrial designer who won the $5,000 first prize in the Westinghouse radio set design contest, has moved from 10 E. 40th Street, New York City, to 745 Fifth Avenue.

I.M.S.A.: Newly elected officers of the International Municipal Signal Engineers Association, Inc., are: president, G. E. Wood, city electrician, Houston, Tex.; 1st vice president, John J. Alles, Wilkes-Barre, Pa.; 2nd vice president, William F. Qualls, South Bend, Ind.; 3rd vice president, Adin W. Chase, Niagara Falls, N. Y.; secretary, Irwin Shulsinger, 8 E. 41 Street, New York 17; treasurer, Charles S. Downs, Altoona, Pa.

A. J. Hall: Has joined Universal Microphone, Inglewood, Calif., as production and research engineer. He was formerly in charge of design and research at Kellogg Switchboard & Supply Company, Chicago.

Philip Pearl: Testifying on behalf of AFL at FCC allocations hearing: "Television, Frequency Modulation, and facsimile mean to the American people an enlargement and enrichment of life from which all will benefit. . . . We fear that a bottleneck preventing the speedy launching of this new industry may develop from uncertainty concerning Government allocation of the necessary frequencies."

FM-Facsimile Duplex: Lieut. Temple V. Emsen, 0346 South West Texas Street, Portland, Ore., has been granted a C.P. for the erection of an FM station where sound and facsimile programs will be transmitted simultaneously, using a 75-kc. swing. Facsimile equipment for this experiment is being furnished by Finch Telecommunications, Inc., Passaic, N. J. Results will be followed with the greatest interest because of the difference of engineering opinion about duplex operation on the standard FM broadcast swing.

Frank A. Turnquist: Has joined National Union Radio Corporation as production manager. He was formerly manager of industrial engineering at RCA's Harrison plant.

In planning your radio or facsimile "newspaper" avail yourself of the FINCH PATENT STRUCTURE

Anyone planning a radio or facsimile edition of a newspaper is invited to study the opportunities given by patents issued to Finch relating to radio communication, especially those here shown.

Study These Patents on Finch Facsimile

1,932,579
Re. 19,575
of
1,985,654
2,008,389
2,032,558
2,034,015
2,036,128
2,047,863
2,048,604
2,049,169
2,051,511
2,051,693
2,057,773
2,060,778
2,063,870
2,066,261
2,066,262
2,066,463
2,067,181
2,069,061
2,071,227
2,075,604
2,082,692
2,083,160
2,089,846
2,095,929
2,097,392
2,098,802
2,100,161
2,106,245
Des. 108,281
Des. 108,282
2,108,983
2,109,109
2,109,627
2,110,548
2,118,917
Re. 20,767
of
2,061,457
2,123,721
2,133,811
2,136,209
2,136,789
2,141,973
2,141,974
2,141,975
2,145,717
2,149,136
2,152,348

Finch Facsimile broadcasting licenses have been issued to the following:

WLW	Cincinnati, Ohio	Crosley Radio Corp.
WOR	Newark, New Jersey	Bamberger Broadcasting
WGN	Chicago, Illinois	WGN Inc., Chicago Tribune
WHO	Des Moines, Iowa	Central Broadcasting
WSM	Nashville, Tenn.	National Life & Ins. Co.
KSTP	St. Paul, Minn.	National Batteries Broadcasting
WWJ	Detroit, Mich.	Detroit News
WSAI	Cincinnati, Ohio	Crosley Radio Corp
WCLE	Cleveland, Ohio	Cleveland Plain Dealer
WHK	Cleveland, Ohio	Cleveland Plain Dealer
WOKO	Albany, New York	WOKO Inc.
W8XAL	Cleveland, Ohio	Crosley Radio Corp.
W8XAN	Jackson, Mich.	Sparks Withington Co.
W8XIR	Cleveland, Ohio	Crosley Radio Corp.
WGHF (FM)	New York, New York	W. G. H. Finch
W2XUP	New York, New York	Bamberger Broadcasting
W8XNU	Cincinnati, Ohio	Crosley Radio Corp.
W8XNT	Cleveland, Ohio	Cleveland Plain Dealer
W8XWJ	Detroit, Mich.	Detroit News

Manufacturing Licenses

Non-exclusive licenses to make, use and sell Facsimile equipment under Finch patents have been granted to certain concerns in The United States and many foreign countries, including:

ENGLAND
FRANCE
AUSTRALIA
SOUTH AFRICA
PORTUGAL
ITALY
BRAZIL
INDIA
TURKEY
CHILE
RUSSIA
CHINA
SWEDEN
SPAIN

You are cordially invited to use the services of our advisory committee on Facsimile Publishing, George Henry Payne, chairman.

FINCH TELECOMMUNICATIONS, INC.
PASSAIC, N. J.

Automatically synchronizing

finch facsimile

CATHODE RAY TUBE APPLICATIONS

SOME of the outstanding work done by the BROWNING LABORATORIES has been in the development of special equipment for new applications of cathode ray tubes.

The cathode ray tube can be used to produce a continuous picture of the operation and functioning of mechanical equipment or electrical equipment, at any required distance.

Action too fast for the eye to follow can be examined and analyzed on the screen by operating the tube at a sub-multiple speed.

By calibrating the screen, the extent of movement in any direction as well as the rate of movement can be observed, or changes in the characteristics of light or sound can be read directly or compared with a standard.

It is even possible to watch the movement of people, parts, or packages past any given point by looking at the screen of a cathode ray tube.

If you have a problem to which this versatile device can be applied, the BROWNING LABORATORIES probably have the solution both as to the method and the type of equipment necessary. We invite your inquiries.

BROWNING LABORATORIES INC.
WINCHESTER MASSACHUSETTS

FINEST PICTURE QUALITY IN BLACK AND WHITE AND IN FULL COLOR!

Sharper, more brilliant pictures than ever before possible are now a reality with Federal's new broadband television technique . . .

In a revolutionary contribution to the television art, Federal's system permits combining *sight and sound* on one carrier frequency . . .

For the broadcaster—a single transmitter, and consequently, lower first cost, lower power consumption, less space requirement, and fewer high power tubes . . .

For the television audience — a simpler, less expensive receiver, more compact and efficient, and requiring fewer tubes.

This great forward stride is the logical outcome of Federal's long list of achievements in the field and the contribution of Federal's engineers to the development of the "Micro-ray" more than a decade ago . . . the forerunner of modern television technique.

And as a result . . . Federal has been selected by the Columbia Broadcasting System for the construction of its new television transmitter atop the Chrysler Tower in New York.

Federal's modern television technique will also be reflected in an equally advanced Federal television receiver for the home . . . producing the finest picture quality.

Federal has the experience, the facilities, the technique, needed to build television equipment for any broadcasting requirement. For the best in television — see Federal first.

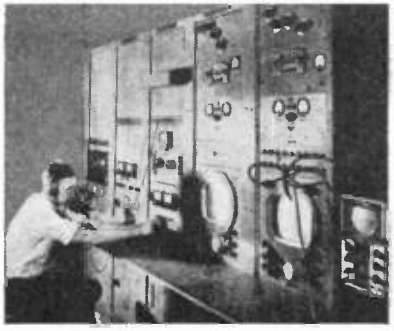
FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

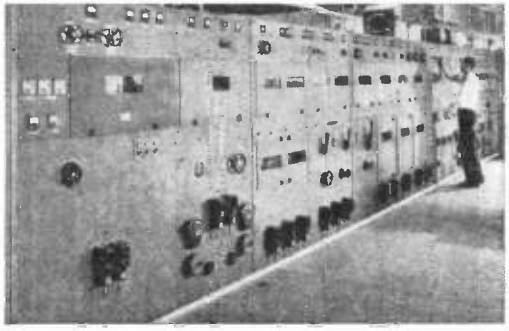
AN IT&T ASSOCIATE

Newark 1, N. J.

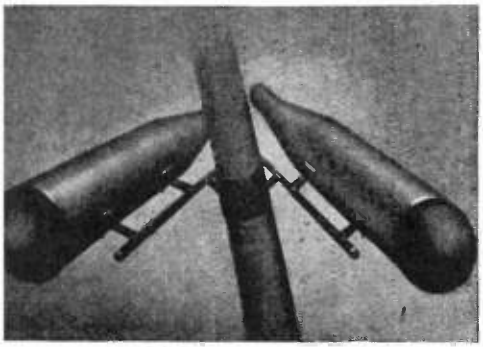
G-E control and monitoring consoles.



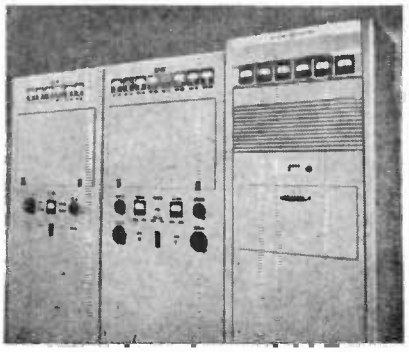
G-E transmitter monitor control board.



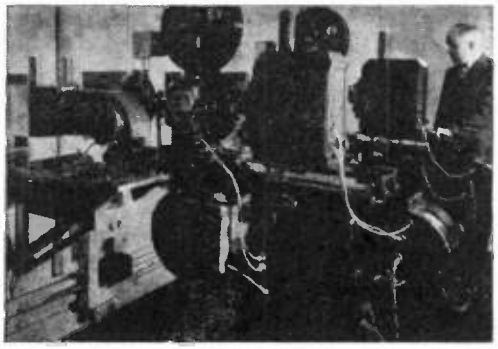
G-E transmitter (picture and sound units).



G-E "V" television broadcast antenna.



G-E S-T transmitters to relay signals from studio to transmitter.



G-E television projector for motion pictures.

G-E television studio cameras.

Other equipment (not illustrated): Transmitter tubes, studio spot lamps, heating and air-conditioning units, point-to-point relay equipment, portable pick-up units.

To you—the future television broadcaster—General Electric offers two important services:

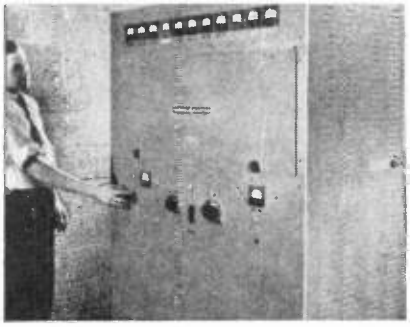
1. The complete television system—consisting of apparatus and accessories of coordinated design—to simplify the job of setting up your station.
2. The opportunity to see and study television equipment in action at the country's most powerful and best-equipped television station—WRGB in Schenectady.

At WRGB you can see the equipment required for a complete television station—the equipment shown on these pages. Here is the world's most powerful television transmitter. Here you can study the programming methods used in over 600 separate programs of all types, from Grand Opera to wrestling matches. Here you can see your future television station *in action*. Come to Schenectady . . . we invite you to see for yourself the work that is setting the pattern for tomorrow's television broadcasting. Thursdays and Fridays are "open-house" days at WRGB.

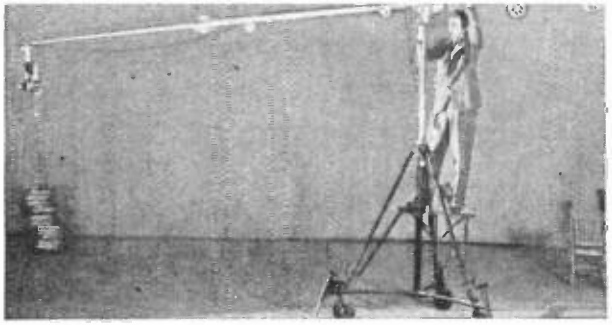
As shown on these pages, General Electric can provide all of the components you will need for a *complete television system for your station*. We welcome your inquiries. Write Electronics Department, General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

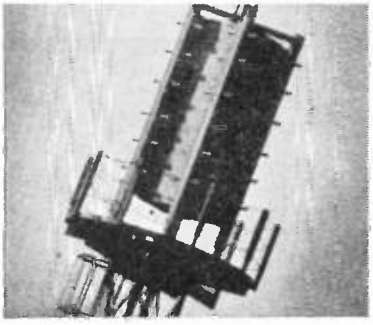
156-C4



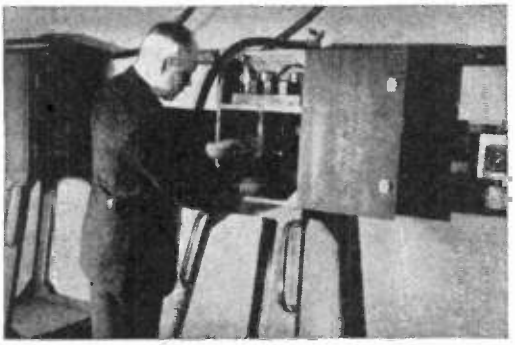
G-E visual relay receiver-converter.



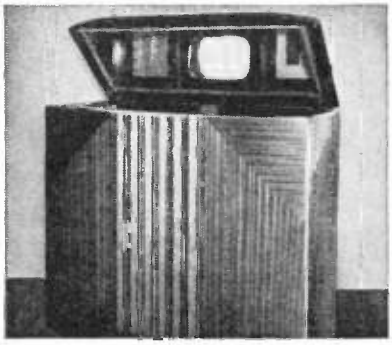
G-E motion-picture type studio microphone boom.



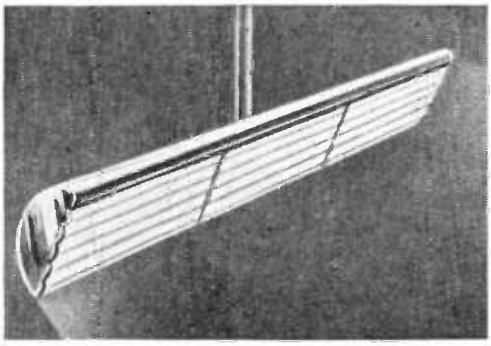
G-E ultra-high-frequency four-bay S-T antenna.



G-E film pick-up cameras.



G-E television home receiver.



G-E water-cooled mercury-vapor ceiling lamp (operated by remote control).

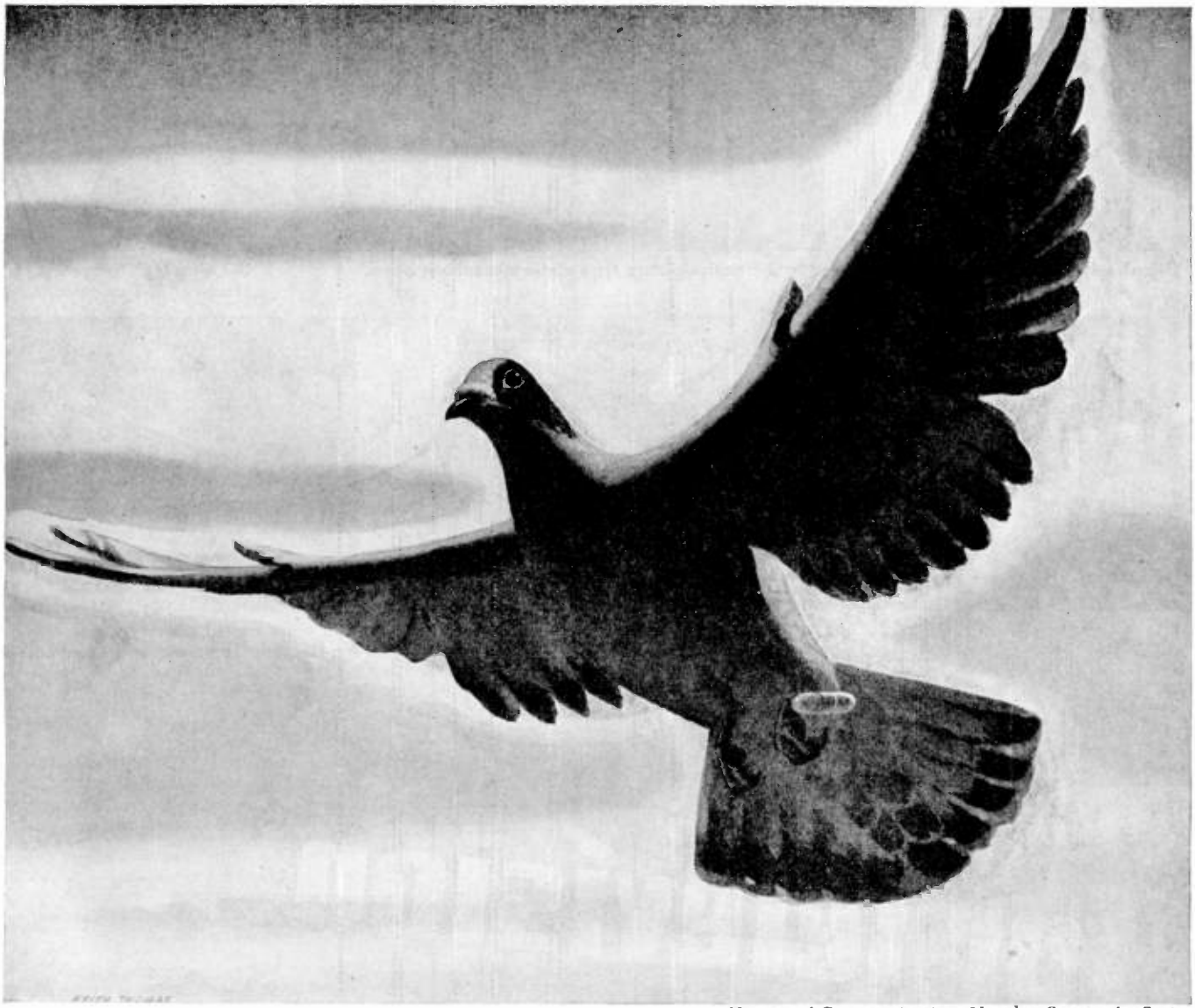
for Television...

Tune in General Electric's "The World Today" and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS network. On Sunday evening listen to the G-E "All Girl Orchestra" at 10 E.W.T. over NBC.

THE G-E EQUIPMENT RESERVATION PLAN and the brochure "Television Broadcasting Post-War" will be sent to anyone interested in television broadcasting. Write for this information. *Electronics Department, General Electric, Schenectady, New York.*

STUDIO AND STATION EQUIPMENT • TRANSMITTERS • ANTENNAS
ELECTRONIC TUBES • RECEIVERS

FM · Television · AM *See G.E. for all three!*



History of Communications Number Seven of a Series

EARLY COMMUNICATIONS BY AIR

While electronics use the ether and other media, one of the most speedy methods of communications in the early days was through the air by carrier pigeon. With a finely printed note fastened to the leg, these birds faithfully reached home to bring in the latest news events and stock market reports.

Today news commentary reaches into your homes in a flash of a second via electronic voice communications making use of the various types of Universal broadcast microphones. This being a modern age, the battle front is brought into the homes of the informed peoples of the democracies via military microphones such as those now being manufactured by Universal for the Allied Armed Forces.

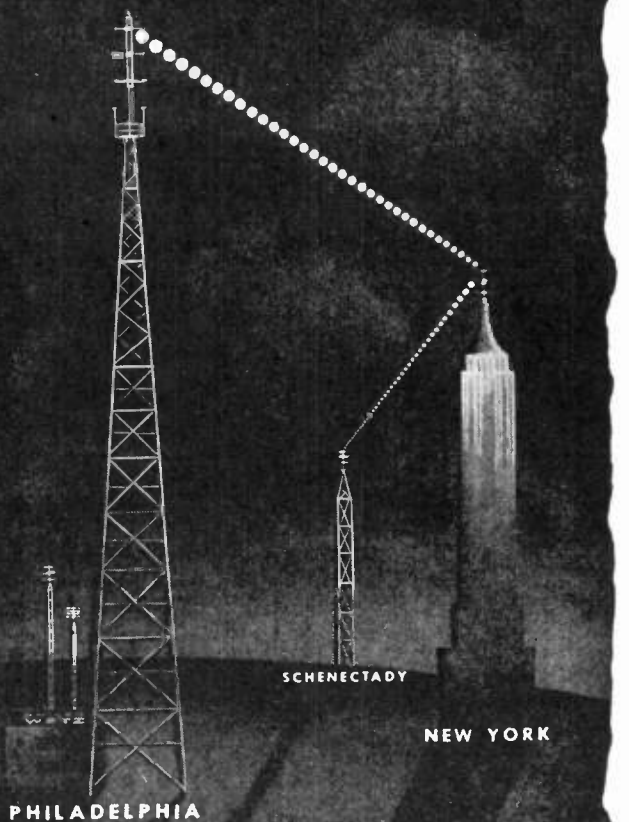
< Model 1700-UB, illustrated at left, is but one of several military type microphones now available to priority users through local radio jobber

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

FOREIGN DIVISION: 301 CLAY STREET, SAN FRANCISCO 11, CALIFORNIA ·· CANADIAN DIVISION: 560 KING STREET WEST, TORONTO 1, ONTARIO, CANADA

The First Network!

ANOTHER MILESTONE IN THE PROGRESS OF TELEVISION



CHAIN television is here! With the recent dedication of the new Philco Relay Transmitter at Mt. Rose, N. J., the first Television Network, linking Philadelphia, New York and Schenectady, is in actual operation today. Now Philadelphians enjoy clear reception of programs from New York through their local Philco television station. Thus the first step has been taken through which millions will eventually witness events that take place thousands of miles away . . . *by television.*

HOW PHILCO RESEARCH SPEEDS THE ADVANCE OF TELEVISION

This first television network is an example of how Philco research is working to establish transmission principles which can extend chain television broadcasting from coast to coast. At the same time, Philco research is improving the clarity, sharpness and detail of the television picture . . . so that future television sets will have the greatest possible sales appeal. Thus in two ways . . . by helping to broaden the market for television, and by designing a more saleable product for that market . . . Philco leads toward the goal of television as tomorrow's "billion dollar industry."

Radio Hall of Fame Orchestra and Chorus.
Tune in Sundays, 6 P. M., E. W. T., Blue Network.

★

BACK THE ATTACK—BUY WAR BONDS

WITH PROGRAMS LIKE THESE, PHILCO TELEVISION STATION WPTZ HAS PIONEERED IN TELEVISION BROADCASTING

Since 1932, Philco has owned and operated its own television station, a rich laboratory of research and experience for television progress.

The Philco station has televised football, boxing, wrestling and other sports as well as news events direct from the scene of action.

Movies, variety acts, dramatic sketches, illustrated news talks and civic programs have been televised from the Philco studios.

PHILCO

THE OVERWHELMING LEADER IN RADIO FOR 12 STRAIGHT YEARS

DIRECTORY OF MANUFACTURERS

General Managers and Chief Engineers of Companies Manufacturing FM and Television Equipment, Laboratory Apparatus, Components, Materials, Supplies, Molded Parts, and Production Machinery

The name of the General Manager appears at the left; the name of the Chief Engineer is at the right.

DIRECTORY OF MANUFACTURERS

— A —

Abbott Inst Co 8 W 18 St N Y C 3
Acadia Synthetic Prods 4031 Ogden Av Chicago Ill
Accurate Spring Mfg Co 3817 W Lake St Chicago Ill
Ace Mfg Corp Erie Av & K St Phila 24 Pa
G M Jones F C Schutz
Acme Elec & Mfg Co Cuba N Y
C H Bunch J A Comstock
Acme Elec Heating Co Boston Mass
Acme Wire Co New Haven 14 Conn
T G Nee J G Kreis
Adams & Westlake Co Elkhart Ind
W T Brassil R S Warren
Advance Elec Co 1260-A W 2 St Los Angeles Calif
F W Falck
Advance Recording Prods Co L I City N Y
Aero Communications Inc 231 Main St Hempstead N Y
F Ruth E Ruth
Aero Elec Corp Los Angeles Calif
Aerovox Corp New Bedford Mass
S I Cole L Kahn
Airadio Inc Stamford Conn
J B Cobrain D S Basim
Air Associates Inc Airport & Century Blvds Los Angeles 43 Calif
J A Rhoads Jr
Air Communications Inc 2233 Grand Av Kansas City Mo
D D Darnell C L Omer
Aircraft Accessories Corp Fairfax & Funston Rds Kansas City Kans
R C Walker C N Kimball
Aircraft-Marine Prods Inc 1523 N 4th St Harrisburg Pa
V E Carlson
Aircraft Radio Corp Boonton N J
Aircraft Radio Equip Corp 6244 Lex Av Hollywood Calif
Air King Prods Co Inc 1523 63 St Brooklyn
J Frank A D Sobel
Airplane & Marine Inst Inc Clearfield Pa
W F Diehl G E Pray
AirWay Elec Appl Corp 2101 Auburn Av Toledo O
C A Lindberg
Air-Way Mfg Co Toledo O
Akron Porcelain Co Akron O
Alden Prods Co 117 N Main St Brockton Mass
M Alden A D MacLeod
Aladdin Radio Industries 501 W 35 St Chicago Ill
Allen-Bradley Co Milwaukee Wis
Allen Mfg Co Hartford Conn
Alliance Mfg Co Alliance O
R F Doyle E V Schneider
Allied Control Co Inc 2 E End Av N Y C
Allied Radio Corp 833 W Jackson Blvd Chicago Ill
A D Davis L M Dezettel
All-American Tool & Mfg Co 1014 Fullerton Av Chicago Ill
Alrose Chemical Co Providence R I
Aluminum Co of America Pittsburgh Pa
American Automatic Elec Sales Co 1033 W Van Buren St Chicago Ill
American Brass Co Waterbury Conn
American Coils Co 26 Lex Newark N J
American Communications Corp 306 B'way N Y C
American Condenser Co 4410 Ravenswood Av Chicago 40 Ill
I Menschik H C Kreinick
American Cyanamid Co 30 Rockefeller Plaza New York City
American Elec Heater Co 6110 Cass Av Detroit 2 Mich
E W Doherty
American Felt Co Glenville Conn
Amer Instr Co 8030 Ga Av Silver Spring Md
W H Reynolds
American Insulator Corp New Freedom Pa
N E Gage B F Hants
American Lava Corp Chattanooga Tenn
F J Stevens
American Microphone Co 1915 S Western Av Los Angeles 7 Calif
F A Yarbrough H C Hornickel
American Molded Prods Co 1644 N Honore St Chicago Ill
K A Bevington
American Phenolic Corp 1830 S 54 Av Chicago
A J Schmitt C Quackenbush
American Radio Hdwre Co Inc 152 Macquesten Pkwy S Mt Vernon N Y
D T Mitchell J Donato
American Rolling Mill Co Middletown Conn
American Screw Co Providence R I
American Spring & Mfg Corp Holly Mich
American Steel & Wire Co Rockefeller Bldg Cleveland O
American Steel Package Co Defiance O
G F Behringer K A Duerk
American Television & Radio Co St Paul Minn
American Transformer Co 178 Emmet Newark N J
S Marvin W Garlick
Amperex Electronic Prods 79 Washington St Brooklyn N Y
Amperite Co 561 Broadway N Y C
Amplifier Co of America 398 B'way N Y C
N M Haynes
Amplex Engineering Inc New Castle Ind
Amy Aceves & King 11 W 42 St N Y C
E V Amy
Anaconda Wire & Cable Co 25 B'way N Y C
Andrea Radio Corp 43–20 34 St L I City N Y
F A D Andrea H J Heindel
Andrew Co 363 E 75 St Chicago 19 Ill
V J Andrew C R Cox
Ansonia Elec Co Ansonia Conn
Arkwright Finishing Co Providence R I
Arnessen Elec Co 116 Broad St N Y C
Arnold Engineering Co 147 E Ontario St Chicago Ill
Art Radio Corp 115 Liberty N Y C
Astatic Corp Youngstown O
Atlair Machinery Corp 55 Van Dam N Y C
Atlas Condenser Prods Co 548 Westchester Av N Y C
S Pariser
Atlas Resistor Co 423 Broome St NYC 13
W A Merrill E Merrill
Atlas Sound Corp 1443 39 St Brooklyn 18
C R Blumenthal R C Reinhardt
Auburn Button Works 48 Canoga Auburn N Y
J Lawler
Audio Development Co 2833 13 Av S Minneapolis 7 Minn
C W Messer W E Lehnert
Audio Devices Inc 1600 Broadway N Y C
Ault & Wiborg Corp 75 Variek St N Y C
J R Esposito J G Morris
Austin Mfg Co 3911 S Mich Av Chicago
Autocall Co Shelby O
Automatic Electric Co 1033 Van Buren St Chicago Ill
K W Graybill
Automatic Radio Mfg Co Inc 122 Brookline Av Boston Mass
A J Housman J S DeMetrick
Automatic Winding Co Inc E Newark N J
J R Mazzola
Avery Adhesives 453 E 3 St Los Angeles 13
R S Avery E D Graves
Avia Prods Co 737 N Highland Av Los Angeles

— B —

Bakelite Corp 30 E 42 St N Y C 17
J E Brister Wire & Cable Materials
T W Sharp Sheet & Foil
C W Patton Coatings & Adhesives
G Shaw Calendering & Molding Materials
R E Brannon Molding Materials
H Smith Varnish Resin
Baker & Co 113 Aston Newark N J
Ballantine Labs Inc Boonton N J
F R Zayac E Osterland
Barber-Colman Co Rockford Ill
Barker & Williamson 235–9 Fairfield Av Upper Darby Pa
H C Valentine R C Weise
Barnes Co Wallace Bristol Conn
Bassett Inc Rex 500 S E 2 St Ft Lauderdale Fla
R E Bassett
Bausch & Lomb Optical Co Rochester N Y
C L Bausch
Belden Mfg Co P O Box 5070A Chicago 80
C S Cragmile H H Wernine
Belmont Radio Corp 5921 W Dickens Av Chicago 39 Ill
H C Mattes W L Dunn
Bendix Radio Div Bendix Aviation Corp Morford Pl Red Bank N J
C S Townsend
Bendix Radio Div Bendix Aviation Corp E Joppa Rd Towson 4 Md
W P Hilliard W L Webb
Bendix Aviation Corp 11600 Sherman Way N Hollywood Calif
P Nichols D Brown
Bentley-Harris Mfg Co Conshohocken Pa
Benwood Linze Co 1811–19 Locust St St Louis Mo
H J Wrape C E Peters
Biddle James G 1211 Arch St Philadelphia
Bird Richard H Waltham Mass
Birnbach Radio Co 145 Hudson St NYC 13
N Birnbach
Bitzcher Corp 5087 Huntington Dr Los Angeles
Black & Decker Mfg Co Towson Md
Blake Radio Equip Co Great Barrington Mass
L S Thomas
Blaw-Knox Co Pittsburgh Pa
Bliley Electric Co Union Sta Bldg Erie Pa
F D Bliley J M Wolfskill
Bluff City Distributing Co 905–7 Union Av Memphis 3 Tenn
A L Cowles J H Viser Jr
Blum & Co Inc Julius 532 W 22 St N Y C
Bodine Electric Co 2254 W Ohio St Chicago
C A Rail
Boes Co W W 3001 Salem Ave Dayton 1 Ohio
W W Boes J R Wall
Boonton Radio Corp Boonton N J
Boots Aircraft Nut Corp Ponus Ridge Rd New Canaan Conn
R W Johnson W Wootton
Borg-Gibbs Lab The G W Borg Corp Delavan Wis
M E Brown
Boston Insulated Wire & Cable Co Boston
Brach Mfg Corp L S 55 Dickerson St Newark N J
W A Robinson A Hood
Brainin Co 233 Spring St N Y C 13
C S Brainin
Brand & Co Wm 276 4th Av N Y C
Brandywine Fibre Prods Co 14 & Walnut Sts Wilmington Del
E E Maneck T Breunich
Breeze Corps Inc 41 S 6th St Newark 7 N J
J T Mascuch K G Strunk
Brilhart Co Arnold Great Neck N Y
Bristol Co Waterbury Conn
L G Bean
Brown & Brother Arthur 67 W 44 St N Y C
Browning Labs Inc 742–750 Main Winchester Mass
C H Day G H Browning
Brush Development Co Cleveland Ohio
Bud Radio Inc 2118 E 55 St Cleveland 3
M L Haas B T Waltmead
Bunnell & Co J H 81 Prospect St Brooklyn
J D McLellan F D Webster
Bunting Brass & Bronze Co Toledo Ohio
Burke Electric Co Erie Pa
E E Crompton C E Humble
Burndy Engineering Co Inc 107 Bruckner Blvd New York City 54
M Lee
Burnett Radio Lab 4814 Idaho St San Diego
Burstein-Applebee Co Kansas City Mo
Burton-Rogers Co 857 Boylston St Boston
V S Church

— C —

Callite Tungsten Corp 540 39 St Union City N J
R Lowit
Cambridge Inst Co Grand Central Term N Y C
Camburn Prods Co 490 Broome St N Y C
J Leidner F Klein
Camfield Mfg Co 718 N 7 St Grand Haven Mich
R H Lilyblad
Camloc Fastener Corp 420 Lex Av NYC 17
J M Summers S W Hennessey Jr
Cannon Mfg Corp 3209 Humboldt St Los Angeles
R J Cannon E Neiling
Cannon Co C F Springwater N Y
Carbide & Carbon Chem Corp 30 E 42 St N Y C
Carborundum Co-Globar Div Niagara Falls N Y
K E Rogers B A Bovee
Cardwell Mfg Corp Allen D 81 Prospect St Brooklyn N Y
D A Cardwell A D Cardwell
Carnegie-Illinois Steel Corp Pittsburgh Pa
Carrier Microphone Co Inglewood Calif
Carron Mfg Co 415 S Aberdeen St Chicago 7
M M Cohon C S Linell
Carter Motor Co 1608 Milwaukee Av Chicago 47
R W Carter
Catalin Corp 1 Park Ave N Y C
Celanese Corp 180 Madison Av N Y C 16
W R Donaldson
Centralab Div of Globe-Union Inc 900 E Keefe Av Milwaukee Wis
H W Rubinstein
Central Screw Co 3501 Shields Av Chicago 9
D S Jennings W P Roche
Chace Co W M 1600 Beard Av Detroit Mich
S R Hood
Champion Radio Works Danvers Mass
Chandler Prods Corp Cleveland Ohio
Chicago Molded Prods Corp 1025 N Kolmar Chicago Ill
Chicago Telephone Supply Co W Beardsley Av Elkhart Ind
N C Schellenger
Chicago Transformer Corp 3501 Addison St Chicago Ill
D Schwennesen
Churchill Cabinet Co 2119 Churchill Av Chicago Ill
Cinaudagraph Speakers Inc 3911 S Mich Av Chicago Ill
P H Tartak
Cinch Mfg Co 2335 W Van Buren St Chicago
Cinema Eng Co Burbank Calif
Clare & Co C P 4719 Sunnyside Av Chicago
C P Clare G F Weinreich
Claromat Mfg Co Inc 130 Clinton St Brooklyn
G J Mucher
Clements Mfg Co Chicago Ill
Collins Radio Co Cedar Rapids Ia
A A Collins L M Craft
Collyer Ins Wire Co Pawtucket R I
Colonial Kolonite Co 2212 W Armitage Av Chicago Ill
Colonial Radio Corp 254 Rano St Buffalo N Y
A H Gardner H C Forbes
Commercial Radio Sound Corp 570 Lex Av New York City 22
A W Schneider A A Sylvone
Communication Equip & Eng Co 504 N Parkside Av Chicago Ill
R A Clark Jr
Communication Measurements Lab 120 Greenwich New York City 6
D A Griffin N B Smalley
Communication Products Co Jersey City N J
Communications Co Inc 300 Greco Av Coral Gables 34 Fla
G E Smith G A Leap
Communications Equip Corp 134 W Colorado St Pasadena 1 Calif
R Kimball R Kimball
Condenser Corp of America S Plainfield N J
Condenser Prods Co 1375 N Branch St Chicago 22 Ill
A Fisher M H Levenberg
Conn Ltd C G Elkhart Ind
O E Beers L B Greenleaf
Conn Tel & Elec Meriden Conn
H W Harwell W R Curtiss
Cons Diamond Saw Blade Corp Yonkers Av Yonkers 2 N Y
Cons Radio Prod Co 350 W Erie Chicago
E A Heppner
Cons Wire Co 1634 Clinton St Chicago
Continental Carbon Inc 13900 Lorain Av Cleveland 11 Ohio
G F Benkelman W M Kohring
Continental Diamond Fibre Co Newark Del
Continental Elec Co 903 Merchandise Mart Chicago Ill
Continental Elec Co Geneva Ill
H A McIlvaine J H Hutchings
Continental Elec Co Newark N J
Continental Radio & Telev Corp 3800 W Cortland St Chicago Ill
Continental Screw Co New Bedford Mass
Cook Electric Co 2700 Southport Av Chicago
Copperweld Steel Co Glassport Pa
W J McIlvane C H Jensen
Corbin Screw Corp New Britain Conn
J P Baldwin
Cornell-Dubilier Elec Corp 1000 Hamilton Blvd S Plainfield N J
W M Bailey
Corning Glass Works Corning N Y
W C Decker Bulb & Tubing Div
C J Phillips Electronic Dept
E F Ling Product Engineering
T S Wood Jr Lamp Dept
Cornish Wire Co Inc 15 Park Row N Y C 7
J Cook M T Mallard
Cosmic Radio Corp 699 E 135 St N Y C
S Fishberg
Coto-Coil Co Providence R I
Cover Dual Signal Systems Inc 5215 Ravenswood Av Chicago 40
J J Bailey W R Schum
Creative Plastics Corp 963 Kent Av Brooklyn
Crescent Industries Inc 4140 W Belmont Av Chicago Ill
V Russell
Crescent Ins Wire & Cable Co Trenton N J
Crosley Corp 1329 Arlington St Cincinnati
R C Cosgrove L M Clement
Crowe Nameplate Co 3701 Ravenswood Av Chicago Ill
Crowley & Co Inc Henry L 1 Central Av West Orange N J
H I Danziger H L Crowley
Crystal Prod Co 1519 McGee St Kansas City Mo
L A Elbi
Crystal Research Labs 23 Allyn St Hartford Conn
R K Blackburn
Curtis Devel & Mfg Co N Crawford Av Chicago
Cutler-Hammer Inc Milwaukee Wis
Cuyahoga Spring Co Cleveland O

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Daven Co 191 Central Av Newark N J
J P Smith
Dante Elec Mfg Co Bantam Conn
J J Dante
de Forest Labs Lee 5106 Wilshire Blvd Los Angeles Calif
Dejur-Amsco Corp 6 Bridge St Shelton Conn
F Moore
Delco Appliance Rochester N Y
H C Jones
Delco Radio Div General Motors Corp 303 N Buckeye Kokomo Ind
B W Cooper B A Schwarz
Detroit Power Screwdriver Co 2801 W Fort Detroit 16 Mich
R H Gladfelter
Detroia Corp 1501 Beard Detroit Mich
R M Daugherty
Deutschmann Corp Tobe Canton Mass
De Vry Herman A 1111 W Center Chicago
DeWald Radio Corp 440 Lafayette St N Y C
M Glaser
Dial Light Co of America Inc 900 B'way N Y C
Dictaphone Corp 375 Howard Av Bridgeport Conn
Diehl Mfg Co Somerville N J
P H Trickey
Dinion Coil Co Caledonia N Y
Dixon Crucible Co Jersey City N J
Dolph John C Newark N J
Dongan Elec Co 74 Trinity Pl N Y C
Doolittle Radio Inc 7421 S Loomis Blvd Chicago Ill
D Gray
Dow Chemical Co Midland Mich
W H Dow L J Richards

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It is not enough to design a Microphone that merely converts sound waves into electrical impulses. A Microphone, to be truly useful in modern broadcasting, should be discriminating enough to accept wanted sounds —and reject unwanted sounds. Shure Research was the first to develop a single unit uni-directional Microphone, both crystal and dynamic.

Shure Research is the reason why practically every major broadcasting station uses the Shure 556 Unidyne. Shure Research is your assurance of postwar microphone superiority.

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Designers and Manufacturers of Microphones and Acoustic Devices

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A J Foute H K Foute
Driver-Harris Co Harrison N J
F L Driver F E Bath
Dumont Elec Co 34 Hubert St N Y C
J Katzman
Du Mont Labs Allen B Passaic N J
A B DuMont P S Christaldi
Du Pont De Nemours & Co Arlington N J
Durez Plastics & Chemicals Inc North Tonawanda N Y
R M Crawford G Loomis
D-X Radio Prods Co 1575 Milwaukee Chicago

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Eastern Air Devices 585 Dean St Brooklyn 17
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A K Chapman F E Tuttle
Eby Inc H H 18-A W Chelton Av Philadelphia
Echophone Radio Co 540 N Mich Chicago 11
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Eckstein Radio & Telev Co 1400 Harmon Pl Minneapolis 3 Minn
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Erie Resistor Corp 640 W 12 St Erie Pa
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Espey Mfg Co Inc 305 E 63 St N Y C 21
N Pinsley J Rosenbaum
Essex Specialty Co Inc Broad St Newark N J
Etched Prod Corp 39-01 Queens Blvd Long Island City N Y
Eureka Vacuum Cleaner Co 6060 Hamilton Detroit 2 Mich
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Ever-Ready Label Corp 141 E 25 St N Y C
Extruded Plastics Inc Norwalk Conn

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Fansteel Metallurgical Corp North Chicago
R J Aitchison
Farnsworth Telev & Radio Corp 2701 E Pontiac Fort Wayne Ind
B R Cummings J Ferguson
Fast & Co John E 3123 N Crawford Av Chicago 41 Ill
L Kopinski W S Franklin
Faximile Inc 730 Fifth Av New York 19
R W Bristol J V L Hogan
Federal Engineering Co 37 Murray St N Y C 18
M J Kirsch M J Kirsch
Federal Mfg & Eng Corp 199–217 Steuben St Brooklyn 5 N Y
D H Engelson M Kaplowits
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Federal Screw Prods Co 224 W Huron St Chicago Ill
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Federal Telephone & Radio Co 200 Mt Pleasant Newark N J
E G Ports
Felker Mfg Co Torrance Calif
M N Felker M W Hinshaw
Fenwal Inc Ashland Mass
Ferranti Elec Inc 30 Rockefeller Plaza N Y C
Ferris Inst Co Boonton N J
Ferrocart Corp of America Hastings on Hudson New York
Finch Telecommunications Inc Passaic N J
Fisher Research Lab 1961–63 University Av Palo Alto Calif
E Smith G R Fisher
Follansbee Steel Corp Pittsburgh Pa
Ford Radio & Mica Corp 538 63 St Brooklyn
Formica Insulation Co Cincinnati O
Fox Electric Supply Co 67–69 N State St Elgin Ill
E E Hasselquist
Franklin Mfg Corp 175 Varick St N Y C
A W Franklin
Freed Radio Corp 200 Hudson St N Y C
A Freed M Weinstein
Freed Transformer Co 72 Spring St N Y C
L Freed D Gurevics

— G —

Galvin Mfg Corp 4545 W Augusta Blvd Chicago Ill
F J O'Brien D H Mitchell
Garden City Lab 2744 W 37 Pl Chicago Ill
Gardiner Metal Co 4820 S Campbell Av Chicago 32 Ill
R A Gardiner A F Sternad
Gardner Elec Mfg Co Oakland Calif
W W Wahlgren
Garner Co Fred E 43 E Ohio St Chicago
Garod Radio Corp 70 Washington St Brooklyn
B S Trott
Gates Radio Co 220 Hampshire Quincy Ill
P Gates
Gavitt Mfg Co Inc Brookfield Mass
Gear Specialties 2635 W Medill Av Chicago
E H Johnson C B Hale
General Aniline Wks 435 Hudson St N Y C 14
General Armature Corp Logan & Prospect Sts Lock Haven Pa
L Mervis J F Cullin
General Cable Corp 420 Lex Av N Y C
General Ceramics & Steatite Corp Keasbey N J
General Communication Co 530 Commonwealth Boston Mass
R Jones T M Hastings
General Control Co 1200 Soldiers Field Rd Boston 34 Mass
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I J Karr W M Angus
General Electric Co Lamp Dept Hoboken N J
General Electric Co Pittsfield Mass
General Electric Co Schenectady N Y
Electronics Dept
C A Priest J J Farrell
General Electronics Inc 101 Hazel St Paterson 3 N J
D E Replogle G C Engel
General Industries Co Elyria Ohio
D L Boyd
General Inst Corp 829 Newark Av Elizabeth N J
H M Detrick
General Insulated Wire Corp 53 Park Pl N Y C
General Radio Co 275 Massachusetts Av Cambridge 39 Mass
H B Richmond M Eastham
General Scientific Corp 4829 Kedzie Av Chicago Ill
General Telev & Radio Corp 1240 N Homan Av Chicago 51 Ill
J B Ricks
General Transformer Co 1250 W Van Buren Chicago Ill
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General Winding Co 420 W 45 St N Y C
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Gibson Co Wm D 1800 Clybourn Av Chicago
Gibson Elec Co 8350 Frankstown Av Pittsburgh
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S W Gilfillan C F Wolcott
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A R Stack C Lasswell
Girdler Corp Thermex Div Louisville Ky
P D Zottu
Gits Molding Corp 4600 Huron St Chicago
G-M Laboratories Inc 4300 N Knox Av Chicago
A J McMaster A J McMaster
Globar Div Carborundum Co Niagara Falls N Y
Goat Metal Stampings Inc 314 Dean St Brooklyn N Y
E F Staver
Gothard Mfg Co 1300 N 9 St Springfield Ill
R W Gothard G W Frost
Gould-Moody Co 395 B'way N Y C
Granite City Steel Co Granite City Ill
Graybar Electric Co Inc 420 Lexington Av New York City 17
C S Powell J W La Marque
Gray Mfg Co Hartford Conn
Gray Radio Co West Palm Beach Fla
G H DeShazo F E Gray
Green Elec Co Inc 130 Cedar St N Y C
Grenby Mfg Co Plainville Conn
C A Gray L H Whitney
Greyhound Equip Co 1720 Church Av Brooklyn
Guardian Elec Mfg Co 1400 W Washington Blvd Chicago Ill
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Guided Radio Corp 161 6 Av N Y C
F W Nickerson H C Dalrymple
Guthman & Co Edwin I 15 S Throop St Chicago

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Hadley Co R M 707 E 61 St Los Angeles Calif
Halldorsen Co 4500 Ravenswood Av Chicago Ill
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P D Ash W C Munro
Hamilton Radio Corp 510 6 Av N Y C
Hammarlund Mfg Co Inc 460 W 34 St N Y C
J K Johnson
Harco Steel Constr Co Inc 1180 E Broad Elizabeth N J
E Schaefer
Hardwick Hindle Inc Newark N J
Harper Co H M 2609 Fletcher Chicago
Harrison Radio Corp 12 W B'way N Y C
Harvey Machine Co Inc 6200 Avalon Blvd Los Angeles 3 Calif
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Harvey Wells Communications Inc Southbridge Mass
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Hartman Corp of America 6417 Dale Av St Louis Mo
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Hazeltine Electronics Corp 58–25 Little Neck P'kway Little Neck N Y
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Holyoke Wire & Cable Corp Holyoke Mass
Hopp Press Inc 460 W 34 St N Y C 1 N Y
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Hoyt Elec Inst Wks Boston Mass
H R S Products 5707 W Lake St Chicago
D Zmuda
Hubbard Spring Co M D Pontiac Mich
Hudson American Corp 25 W 43 St N Y C
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Hunt & Sons G C Carlisle Pa
Hunter-Hartman Corp St Louis Mo
Hunter Pressed Steel Co Lansdale Pa
Hygrade Sylvania Corp Salem Mass
Hytron Corp & Hytronic Labs Salem Mass

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Illinois Condenser Co 1160 N Howe St Chicago Ill
J J Kurland
Insco Copper Tube & Prods Inc Cincinnati O
A H Stubbers A J Pauly
Imperial Molded Prods Corp 2925 W Harrison Chicago 12 Ill
L H Amrine R E O'Neill
Indiana Steel Prod Co 6 N Mich Chicago
Induction Heating Corp 389 Lafayette N Y C
W E Rudd
Industrial & Com Electronics Belmont Calif
R C Shermund
Industrial Condenser Corp 1725 W North Av Chicago 22 Ill
K D Engle
Industrial Filter & Pump Mfg Co 1621 W Carroll Av Chicago Ill
J W MacAllister
Industrial Instruments Inc 17 Pollock Av Jersey City 5 N J
P M Gotthold N Schnoll
Industrial Molded Prods Co 2035 Charleston Chicago Ill
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A A Kaufman
Industrial Timer Corp 115 Edison Pl Newark N J
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International Screw Co Detroit Mich
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Isolantite Inc Belleville N J

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Jefferson Elec Co Bellwood Ill
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Jefferson-Travis Radio Mfg Corp 245 E 23 St New York City 10
E E Ellinger Jr W B Wilkens
Jelliff Mfg Corp Southport Conn
Jensen Radio Mfg Co 6601 S Laramie Av Chicago Ill
W F Maxson H S Knowles
Johnson Co E F Waseca Minn
E F Johnson L W Olander
Jones Co Howard B 2460 W George St Chicago Ill

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Karadio Corp 1400 Harmon Pl Minneapolis
Kato Engineering Co Mankato Minn
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Kellogg Switchb'd & Supply Co 6650 Cicero Chicago Ill
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Ken-Rad Tube & Lamp Corp Owensboro Ky
G W Bain
Kenyon Transformer Co Inc 840 Barry St N Y C
R B Shimer
Kester Solder Co 4209 Wrightwood Av Chicago
Keuffel & Esser Hoboken N J
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Knights Co James Sandwich Ill
L A Faver M A A Druesne
Kold-Hold Mfg Co 446 N Grand Av Lansing Mich
Kollsman Inst Div of Square D Co 80–08 45 Av Elmhurst N Y
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M H Kasch
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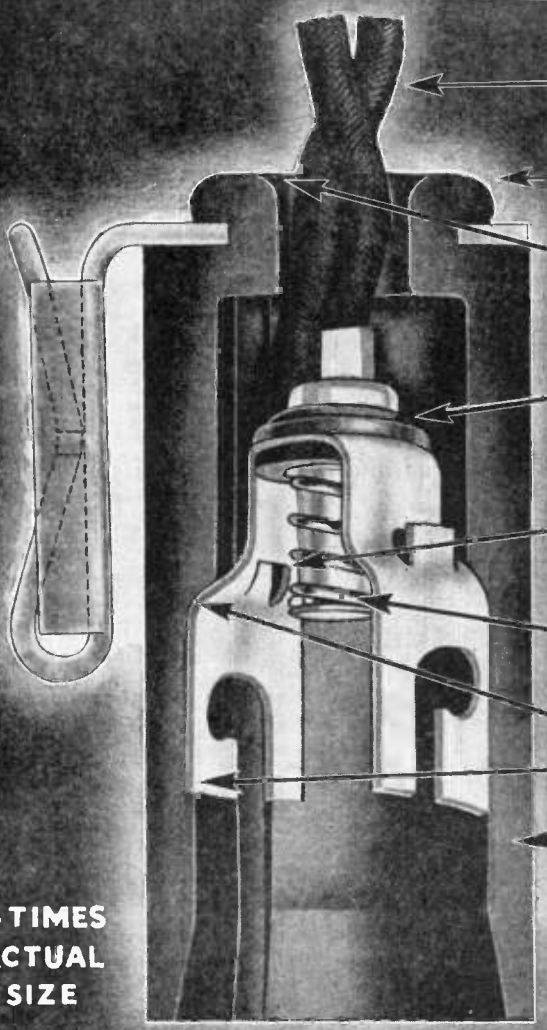
SCHEDULE OF DIRECTORIES IN *FM* AND TELEVISION

JANUARY	FEBRUARY	MARCH	APRIL
All Police and Emergency Stations in the U. S. A.—includes names of the Radio Supervisors. CLOSING DATE JAN. 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE FEB. 5	FM, AM, and Television Stations in the U. S. A. and Canada—includes general managers, chief engineers. CLOSING DATE MAR. 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE APR. 5
MAY	**JUNE**	**JULY**	**AUGUST**
Radio Manufacturers in the U. S. A.—includes the names of general managers and chief engineers. CLOSING DATE MAY 5	Railway Signal Engineers on all roads in the United States, Canada and Mexico. CLOSING DATE JUNE 5	All Police and Emergency Stations in the U. S. A.—includes names of the Radio Supervisors. CLOSING DATE JULY 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE AUG. 5
SEPTEMBER	**OCTOBER**	**NOVEMBER**	**DECEMBER**
FM, AM, and Television Stations in the U. S. A. and Canada—includes general managers, chief engineers. CLOSING DATE SEPT. 5	Radio Products Directory, listing manufacturers of equipment, components, materials, and supplies. CLOSING DATE OCT. 5	Radio Manufacturers in the U. S. A.—includes the names of general managers and chief engineers. CLOSING DATE NOV. 5	Railway Signal Engineers on all roads in the United States, Canada and Mexico. CLOSING DATE DEC. 5

a New and Superior DIAL LIGHT SOCKET



- Tensile strength of leads and connections far in excess of requirements.
- Tough, plastic shell molded around bracket providing a secure bond with mechanical strength far beyond any normal requirement.
- Rounded edge will not cut or fray wire insulation.
- Voltage Breakdown between contacts—1200 Volts. Voltage Breakdown to ground —5000 Volts.
- Lug on contact fits in groove in shell so that contact cannot be turned or twisted when inserting lamp.
- Center contact mounted so that it cannot protrude from shell and short on chassis when lamp is removed.
- Plastic shell is recessed for contacts, which cannot be pushed or pulled out of position.
- Stronger, tougher, heavy walled plastic shell.
- A variety of different mounting bracket styles available, suitable for practically any mounting.

For Your Present and Post-War Production

40th ANNIVERSARY
1904–1944

This year Lenz celebrates its 40th year of service to the communications industry.

Lenz Dial Light Sockets have always been known for their superior mechanical qualities and electrical characteristics.

Now these sockets are still further improved, with even greater mechanical strength. A stronger, tougher plastic shell is attached to the bracket with a new type of construction that provides a virtually unbreakable bond between shell and bracket. Its excellent electrical characteristics are maintained.

Consider these Lenz Dial Sockets for your present and post war production. Write for sample today.

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Lear Inc 1480 Buchanan Av S W Grand Rapids Mich
E R Crane L G Woycke
Lectrohm Inc 5123–5131 W 25 St Cicero 50 Ill
J J Cerny L J Lastovicka
Leeds & Northrup Co Philadelphia Pa
Lehigh Structural Steel Co 17 Battery Pl New York City
Leland Electric Co 1501 Webster St Dayton O
W F Lisman E B George
Lens Electrical Mfg Co 1751 N Western Av Chicago Ill
Lepel Labs 39 W 60 St N Y C
S L Teitler H Peterson
Lewis Electronics Los Gatos Calif
M Shaw G L Lewis
Lewyt Corp 60 B'way Brooklyn N Y
R McGinn A Wolf
Lingo & Son John E Camden N J
Link Radio Corp 125 W 17 St N Y C 11
F M Link F T Budelman
Littelfuse Inc Box 150 El Monte Calif
E V Sundt
Litton Engineering Labs Redwood City Calif
J G Copelin W C Wagener
Locke Insulator Corp P O Box 57 Baltimore Md
R G Bellezza R L McCoy
Lord Mfg Co Erie Pa
Louthan Mfg Co 2000 Harvey Av E Liverpool O
H S Russell C W Gerster
L-R Mfg Co Torrington Conn

— M —

Maas & Waldstein Co Newark N J
Macallen Co Boston Mass
Magnavox Co Fort Wayne Ind
R H Dreisbach
Magnetic Windings Co Div of Essex Wire Corp 16 & Butler Sts Easton Pa
N R Donohoe A Rittenhouse
Majestic Radio & Telev Corp 2600 W 50 St Chicago Ill
F Pacholke
Mallory & Co Inc P R 3029 E Washington St Indianapolis 6 Ind
J E Cain L Robbin
Mall Tool Co 7708 S Chicago Av Chicago
Mangold Radio Parts & Stamping Co 6300 Shelbourne St Philadelphia 11 Pa
F Strobel F Strobel
Manufacturers Screw Prods 216–222 W Hubbard Chicago 10 Ill
N R Sackheim W A Mosow
Marken Machine Co Keene N H
McClintock Co O B 139 N Lyndale Av Minneapolis Minn
L G Pattee E J Boucher
McElroy Mfg Corp 82 Brookline Av Boston
T R McElroy T R McElroy
Measurements Corp Boonton N J
H W Houck J B Minter
Meck Industries John Plymouth Ind
J S Meck C Wexler
Megard Corp 1601 S Burlington Av Los Angeles 6 Calif
J D Funderburg C E Taylor
Meissner Mfg Co 7 & Belmont Sts Mt Carmel Ill
G V Rockey E J Stanmyre
Mercoid Corp 4201 Belmont Av Chicago 41 Ill
H C Courteol I E McCabe
Merit Coil & Transformer Corp 4427 N Clark Chicago 40 Ill
C C Koch H Jones
Metals & Controls Corp Attleboro Mass
Metaplast Co 205 W 19 St New York
J Stein M A Prince
Mica Insulator Co 196 Varick St N Y C
Micamold Radio Corp 1087 Flushing Av Brooklyn 6 N Y
F A Whiting A DiGiacomo
Micarta Fabricators Inc 5324 Ravenswood Av Chicago Ill
E Metzger L Nordile
Micro Switch Div Freeport Ill
A L Riche P A Celander
Midwest Radio Corp 909 B'way Cincinnati 2
A G Hoffman P Smith
Millen Mfg Co Malden Mass
J Millen R W Caywood
Miller Co J W 5917 S Main St Los Angeles
P O'Connor
Minneapolis-Honeywell Regulator Minneapolis Minn
Minn Mining Co 155 6 Av New York City
Mitchell Rand Insulation Co 51 Murray N Y C 7
W B Stevens J J Finn
Mobile Refrigeration Div Bowser Inc 38–32 54 St Woodside N Y
C Passman E Lodwig
Molded Insulation Co 335 E Price Phila Pa
A Zilger
Monitor Piezo Prod Co Pasadena Calif
Monowatt Electric Corp 66 Bissell St Providence 7 R I
G B Benander
Monsanto Chemical Co Springfield Mass
Mossman Inc Donald P 612 N Michigan Av Chicago Ill
D P Mossman Sr J A Briggs
Muehlhausen Spring Corp Logansport Ind
J R Gustofson
Mueller Electric Co 1583 E 31 St Cleveland
S Mueller E H DeConingh
Murdock Mfg Co Chelsea Mass
Muter Co 1255 S Mich Av Chicago 5 Ill
L F Muter K E Rollefson
Mycalex Corp of Amer Clifton N J
A J Monack

— N —

National Co Inc 61 Sherman St Malden Mass
W A Ready D H Bacon
National Electronic Mfg Co 22–78 Steinway Long Island City N Y
J R Carpenter
National Fabricated Prods W Belden Ave Chicago Ill
National Screw & Mfg Co Cleveland Ohio
National Union Radio Corp 15 Wash Newark N J
Dr L G Hector
National Varnished Prod Corp Woodbridge N J
Ntl Vulcanized Fibre Co Wilmington Del
J K Johnston
Newark Transformer Co 17 Frelinghuysen Av Newark 5 N J
M J Herold O A Keefe
New England Mica Co Waltham Mass
New England Screw Co Keene N H
New Wrinkel Inc Dayton O
New York Transformer Co 26 Waverly N Y C
C Z Burzyoki
Noblitt Sparks Ind Inc 13th & Big 4 RR Columbus Ind
Q G Noblitt A E Silva
Noma Electric Corp 55 W 13 St N Y C
C W Otis J E Funk
No. American Philips Co 145 Palisade St Dobbs Ferry N Y
E J Kelly H G Boyle
Northern Engineering Labs 50 Church N Y C
J Zaleski
Northern Industrial Chem Co Boston Mass
Northam Warren Corp Stamford Conn
Norwalk Transformer Corp South Norwalk Conn
Nothelfer Winding Labs Trenton N J

— O —

Oak Mfg Co 1260 Clybourn Av Chicago 10
E Sandstrom E J Mastney
Ohio Carbon Co Cleveland O
A K Moulton L L Stoffel
Ohio Electric Co 74 Trinity Pl N Y C
Ohio Nut & Bolt Co 600 Front St Berea O
R A Reich Jr
Ohmite Mfg Co 4835 W Flournoy St Chicago
H Levy
Onan & Sons, D W 43 Royalston Av Minneapolis
J C Holby
Operadio Mfg Co St Charles Ill
J F McCraigh
Owens-Corning Fiberglas Corp Toledo O
Oxford-Tartak Radio Corp 3911 S Mich Av Chicago Ill
G Rusher

— P —

Pacific Metals Co Ltd San Francisco Calif
Packard Bell Co 1115 S Hope St Los Angeles
A R Ellsworth
Palnut Co 92 Cordier St Irvington N J
J R Hotchkin E Hill
Panoramic Radio Corp 245 W 55 St N Y C
H L M Capron J I Heller
Parisian Novelty Co 3510 S Western Av Chicago Ill
L J Komorous
Parker Co Charles Meriden Conn
Parker-Kalon Co 198 Varick St N Y C
Par-Metal Prod Corp L I City N Y
Patton-MacGuyer Co 17 Virginia Av Providence R I
J Teeden
Pawtucket Screw Co Pawtucket R I
Peck Spring Co Plainville Conn
Peerless Electrical Prod Co 6920 McKinley Los Angeles Calif
J Jauch
Perkins Machine & Gear Co Springfield Mass
Permoflux Corp 4916 W Grand Av Chicago
W E Gilman
Peterson Radio Council Bluffs Ia
Pheoli Mfg Co 5700 W Roosevelt Rd Chicago
E M Whiting F P Tisch
Philco Corp Tioga & C Sts Philadelphia 34
J Ballantyne P Craig Radio
F J Bingley Telev
Philharmonic Radio Corp 528 E 72 St N Y C
A R Fisher V Brociner
Philmore Mfg Co Inc 113 Univ Pl N Y C 21
R Burke
Phosphor Bronze Smelting Co Phila Pa
Photobell Corp 116 Nassau St N Y C
A Edelman
Pierce-Roberts Co Trenton N J
Pilot Radio Corp 37–06 36 St L I City N Y
I Goldberg L C Shapiro
Pioneer Gen-E-Motor 5841 W Dickens Av Chicago Ill
Plax Corp Hartford Conn
Polymet Condenser Co 701 E 135 St N Y C
S Fishberg
Potter & Brumfield Co Princeton Ind
Potter Co 1950 Sheridan Rd N Chicago Ill
E F Potter W F Potter
Power City Radio Co 224 S Main Av Sioux Falls S Dak
W B McKenzie G Hering
Powers Electronic & Comm. Co New St Glen Cove N Y
A J Sanial
Precision Fabricators Inc Rochester N Y
Precision Piezo Serv 427 Mayflower St Baton Rouge La
C E Pearce
Precision Tube Co 3824 Terrace St Phila Pa
E Turney
Premax Prods Div Chisholm-Ryder Co Inc Niagara Falls N Y
G O Benson
Premier Crystal Labs Inc 63 Park Row N Y C
A A Glass H M Bach
Premier Metal Etching Co 21–03 44 Av Long Island City N Y
Press Wireless Inc 1475 Broadway N Y C
A Warren Norton R A Hilferty
Press Wireless Inc Hicksville N Y
P D Zurian
Presto Elec Co New York Av Union City N J
Presto Recording Corp 242 W 55 St NYC 19
R C Powell G J Saliba
M M Gruber
Printloid Inc 93 Mercer St N Y C 12
G Margolish
Pyroferric 175 Varick St N Y C

— Q —

Quaker City Gear Wks Inc N Front St Phila
Quam-Nichols Co 33 Pl Av Chicago 16
J P Quam H F Breit
Quartz Labs 1512 Oak St Kansas City Kans

— R —

Racon Electric Co Inc 52 E 19 St N Y C 3
A I Abrahams A I Abrahams
Radell Corp Guilford Av Indianapolis Ind
Radex Corp 53 W Jackson Blvd Chicago Ill
R R Cook J A Snow
Radiart Corp W 62 St Cleveland Ohio
R Blauveit
Radiation Prods Inc 1142 Wall St Los Angeles
R Lewis G M Urey
Radio City Prods Co 127 W 26 St N Y C
M Reiner M Lieblich
Radio Condenser Co Camden N J
R E Cramer J S Robb
Radio Corp of America RCA Victor Div Camden 2 N J
Dr C B Joliffe
Radio Craftsman 1340 S Mich Av Chicago
Radio Engineering Labs Inc L I City N Y
C Srebroff F A Gunther
Radio Frequency Labs Boonton N J
R Corbin R W Seabury
Radio Mfg Engineers Inc 306 First Av Peoria Ill
R M Planck
Radiomarine Corp of America 75 Varick St New York City
I F Byrnes
Radio Receptor Co Inc 251 W 19 St N Y C
H Cohn E D Gibbs
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Radio Studios Inc 136 E 3 St Salt Lake City Utah
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Radio Transceiver Labs 8717 117 St Richmond Hill N Y
F Jacobs F Jacobs
Radio Elec Serv Co of Pa N W Cor 7 & Arch Sts Philadelphia 6 Pa
M Green
Radio Wire Telev Inc 100 6 Av N Y C 3
B Lehman L Marko
Rauland Corp 4245 N Knox Av Chicago 41
E N Rauland J J O'Callaghan
Raumond Mfg Co Corry Pa
E W Feidt P Goring
Raymond Rosen & Co Radio Eng Prod Div 32 & Walnut Sts Philadelphia 4 Pa
L P Clark D N Lapp
Raytheon Mfg Co Foundry Av Waltham Mass
L K Marshall P L Spencer
Readrite Meter Works Bluffton O
Rea Magnet Wire Co E Pontiac St Ft Wayne Ind
E I Snyder
R E C Mfg Corp 1250 Highland St Hollis-ton Mass
R E Chick N F Huntley
Redmond Co A G Owosso Mich
A G Redmond P Maurer
Reeves Sound Labs 62 W 47 St N Y C
H E Reeves
Rehtron Corp 2159 Magnolia Av Chicago
Reliance Die & Stamping Co 1260 Clybourn Chicago Ill
Remler Co Ltd 2101 Bryant St San Francisco
E G Danielson H A Greene
Republic Steel Corp Republic Bldg Cleveland
Revere Copper & Brass 230 Park Av N Y C
Richardson Co Melrose Park Ill
Richardson Allen Corp 15 W 20 St N Y C
F F Sylvester
Rider Labs John F 404 4 Av N Y C
J M Borst
Rockbestos Prods Corp New Haven 4 Conn
B H Reeves H S Moore
Roebling's Sons Co John Trenton N J
Rogan Bros 2001 S Michigan Av Chicago
Rohn & Haas Co Wash Sq Philadelphia Pa
Rola Co Inc 2530 Superior Av Cleveland O
J Q Tiedje
Roller-Smith Div Realty & Industrial Corp Bethlehem Pa
W S Gubelmann Jr A C Bates
Rothard Mfg Co N 9 Av Springfield Ill
Rowe Industries Inc Toledo O
Royal Engineering Co East Hanover N J
C K Rose
Ruby Chemical Co 68–70 McDowell St Columbus 8 Ohio
G C Baker G C Baker
Runzel Cord & Wire Co 4723 Montrose Av Chicago Ill
Russel, Burdsall & Ward Bolt & Nut Co Port Chester N Y
Russell Co Chicago Ill
Ryerson & Son Inc Jos T Chicago Ill

— S —

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J L Jenks Jr A Miller
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H L Kunz F C Holtz
Schott Co Walter L 9306 Santa Monica Blvd Beverly Hills Calif
W L Schott F Wilborn
Schuttig & Co 9 & Kearny Sts N E Washington 17 D C
L A Schuttig W S Williams
Scientific Radio Prods Co 738 W B'way Council Bluffs Ia
L I Meyerson A Shidler
Scientific Radio Serv 4301 Sheridan St University Pk Hyattsville Md
H D Eisenhauer
Scott Radio Labs Inc 4450 Ravenswood Av Chicago Ill
Scovill Mfg Co 99 Mill St Waterbury Conn
N A Cornell
Security Steel Equip Corp Avenel N J
Seeburg Corp J P 1510 Dayton St Chicago
M W Kenney
Selectar Mfg Corp 21–10 49 Ave L I City N Y
C E Richardson J W Powers
Selenium Corp of America 1719 W Pico Blvd Los Angeles Calif
M Burlin E Lidow
Sensitive Research Inst Co 9–11 Elm Av Mt Vernon N Y
D E Wolf V P Cronin
Sentinel Radio Corp Evanston Ill
Setchell Carlson Inc 2233 Univ Av St Paul 4 Minn
B T Setchell B T Setchell
Seymour Mfg Co Seymour Conn
Shakeproof Inc 2501 N Keeler Av Chicago
W M Hanneman
Shallcross Mfg Co Collingdale Pa
D H Shallcross F D V Mitchell
Shand Radio Specialties 203 W Kearsley St Flint 3 Mich
E H Shand
Sherman Mfg Co H B Battle Creek Mich
Sherron Metallic Corp Flushing Av Bklyn
Shure Bros 226 W Huron Chicago Ill
S N Shure B B Bauer
Sickles Co F W 165 Front St Chicopee Mass
M Cohen H J Benner
Signal Electric Mfg Menominee Mich
O H Henes R Winthers
Sigma Inst Inc 70 Celon St Boston Mass
H N L Boyle Jr R T Fisher
Signal Indicator Corp 140 Cedar St N Y C
Simplex Wire & Cable Co 79 Sidney St Cambridge 39 Mass
E W Davis
Simpson Electric Co 5208 W Kinzie St Chicago 44 Ill
H A Bernreuter H A Bernreuter
Slater Electric & Mfg Co Brooklyn N Y
Small Motors Inc 1308 Elston Av Chicago 22
A C Johnson G E Ditzler
Snyder Mfg Co 22 & Ontario Sts Phila
B L Snyder G Snyder
Sola Elec Co 2525 Clybourn Av Chicago 14
M A Tennyson
Solar Mfg Corp 23 St & Av A Bayonne N J
J I Cornell
Sonora Radio & Telev Corp 325 N Hoyne Av Chicago Ill
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Sound Equipment Corp 3903 San Fernando Rd Glendale 4 Calif
D Wright D Jones
Southeastern Radio Supply Co 11 E Hargett Raleigh N C
A Rothstein S H Kahn
Southern Wholesalers Inc 1519 F St N W Washington D C
W E O'Connor
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W Smith
Sparks Withington Co Jackson Mich
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Speer Resistor Corp St Marys Pa
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C E Sparling
Sperti Inc Norwood Station Cincinnati O
R A Lostro H Rinehardt
Sprague Specialties Co North Adams Mass
Stackpole Carbon Co Electronic Components Div St Marys Pa
J H Stackpole H Dressel
Stallman of Ithaca 210–212 N Tioga St Ithaca N Y
P F Loveless A C Stallman
Standard Piezo Co Carlisle Pa
F E Reader W E Richmond
Standard Pressed Stee Co Jenkintown Pa
Standard Radio Parts Co 1244 State Racine Wis
J A Swanson J A Swanson
Standard Spring & Mfg Co 236 42 St Brooklyn
F Costello A H Costello
Standard Transformer Corp 1500 N Halsted Chicago Ill
H H Krefft
Standard Winding Co 44–62 Johns St Newburgh N Y
F A Catanzariti
Stanley Tools 111 Elm St New Britain Conn
M A Coe
Star Porcelain Co Trenton N J
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Stewart-Warner Corp 1826 Diversey Pkway Chicago Ill
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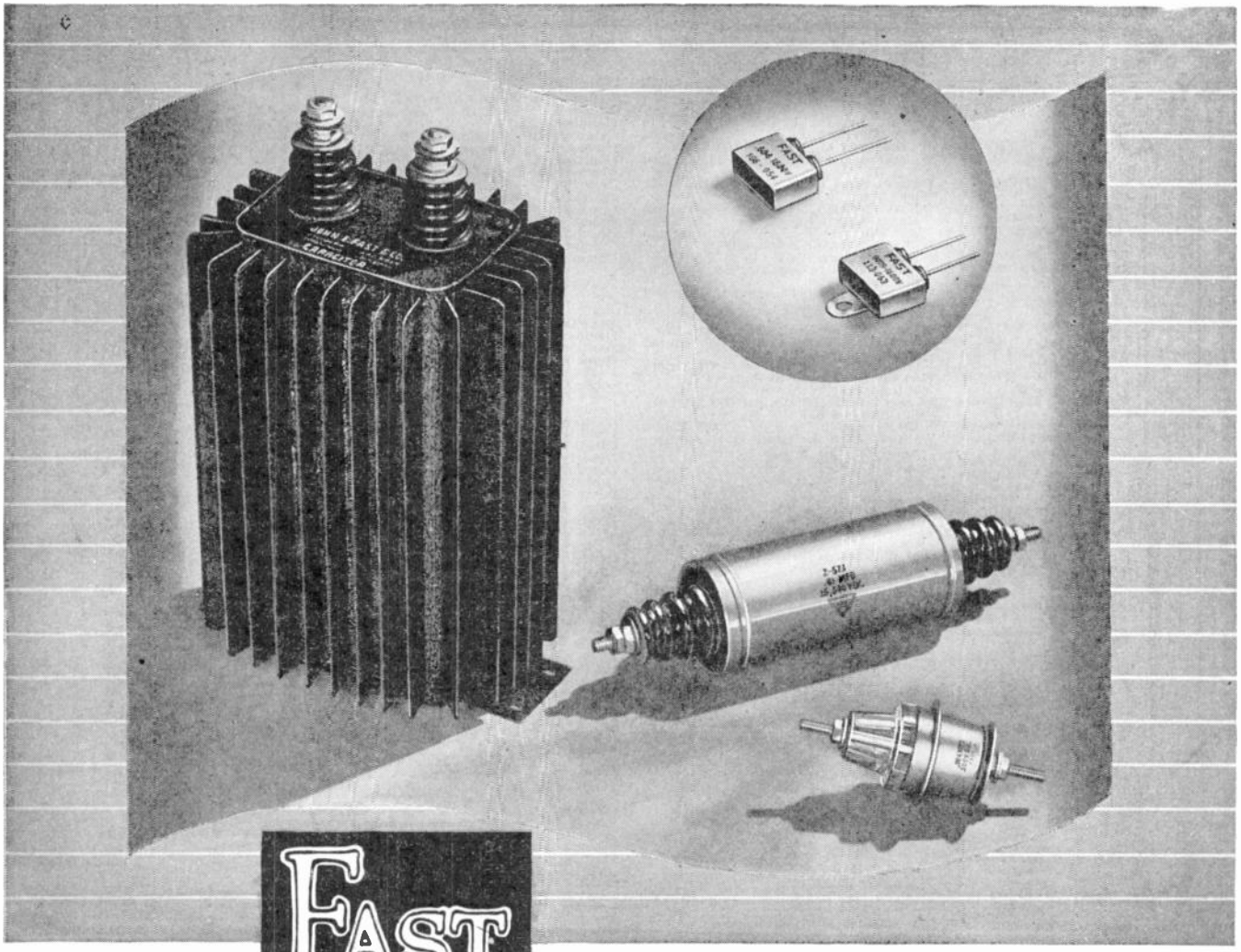
Stokes Rubber Co Joseph Trenton N J
Stokes Machine Co F J Philadelphia Pa
Stromberg-Carlson Co Rochester 3 N Y
R H Manson F C Young
Struthers-Dunn Inc 1321 Cherry St Phila
Stupakoff Ceramic & Mfg Co Latrobe Pa
S H Stupakoff S H Stupakoff
Sullivan Varnish Co 410 N Hart St Chicago
M Sullivan
Sun Radio Co 212 Fulton St N Y C
S Schwartz
Super Electric Products Corp 1057 Summit Jersey City N J
Superior Electric Co Bristol Conn
Superior Tube Co Norristown Pa
S L Gabel R L Nelms
Supreme Inst Co Greenwood Miss
E G Perkins R Soward
Surprenant Elec Insulation Co 84 Purchase Boston 10 Mass
E M Quill G E Forsberg



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Technical Labs 7 Lincoln St Jersey City N J
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Trent Co Harold E Philadelphia Pa
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United Transformer Co 150 Varick N Y C
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Universal Plastics Corp New Brunswick N J
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United Screw & Bolt Corp 71 Murray N Y C
U S Rubber Co 1230 6 Av N Y C
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— V —

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Varflex Corp 305 N Jay St Rome N Y
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Warwick Mfg Corp 4640 W Harrison Chicago 44
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Western Lithograph Co 600 E 2 St Los Angeles 54 Calif
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E R Mellen J H Miller
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P A Blandford T A Cohen
White Dental Mfg Co 10 E 40 St N Y C
Whitehead Metal Prods Co 303 W 10 St N Y C
Whitney Screw Corp Nashua N H
Wick Organ Co Highland Ill
Wilcox Electric Co Inc 1400 Chestnut St Kansas City 1 Kans
J V Wilcox A P Stuhrman
Williams & Co Inc Pittsburgh Pa
Willor Mfg Corp 794 E 140 St N Y C
Wilmington Fibre Specialty Co Wilmington Del
Wilson Co H A 105 Chestnut Newark N J
Wincharger Corp Sioux City 6 Ia
R F Weinig V C Miron
Winslow Co Inc Liberty St Newark N J
Winsted Div Hudson Wire Co Winsted Conn
O F Bitzer A E Griffin
Wirt Co 5221 Greene St Phila 44 Pa
P H Stuckey
Worner Electronic Devices 609 W Lake St Chicago 6 Ill
L L Worner A E Eldam
Wyatt Cornick Inc Grace at 14 St Richmond Va
G M Wyatt Jr

— Y —

Yancey Co Inc 340 W Peachtree St Atlanta Ga
M W Edwards

— Z —

Zack Radio Supply Co 1426 Market St San Francisco Calif
V N Zacharian R E McHale
Zeiss Inc Carl 485 Fifth Av N Y C
Zenith Radio Corp 6001 Dickens Av Chicago 39
E F McDonald Jr G E Gustafson
Zierick Mfg Co 385 Girard Av Bronx N Y
Zobrist Co Herb E 2125 Westlake Av Seattle 1 Wash
Zophar Mills Inc 112–130 26 St Brooklyn
A Saunders

GENERAL MANAGERS

— A —

Abrahams AI Racon Electric Co Inc
Abrams B Emerson Radio & Phono Corp
Aitchison RJ Fansteel Metallurgical Corp
Alden M Alden Prods Co
Allen JM Erie Resistor Corp
Amrine LH Imperial Molded Prods Corp
Amy EV Amy Aceves & King
Andersen RH Heintz & Kaufman Ltd
Andrea FAD Andrea Radio Corp
Andrew FJ Andrew Co
Ash PD Halstead Traffic Comm
Atkinson LH Elastic Stop Nut Corp
Avery RS Avery Adhesives

— B —

Bailey JJ Cover Dual Signal Systems
Baker GC Ruby Chemical Co
Balcom MF Sylvania Electric Prods Inc
Baldwin JP Corbin Screw Corp
Ballantyne J Philco Corp
Bassett RE Bassett Inc Rex
Beers OE Conn Ltd C G
Behringer GF American Steel Package
Belleza RG Locke Insulator Corp
Benander GB Monowatt Electric Corp
Benkelman GF Continental Carbon Inc
Benson GO Premax Prods Div Chisholm-Ryder Co
Berard AA Ward Leonard Elec Co
Berg RE Tech Art Plastics Co Inc
Berke SW Lafayette Radio Corp
Bernreuter HA Simpson Electric Co
Birnbach N Birnbach Radio Co
Blazer OF Winsted Div Hudson Wire Co
Bixler RM J-B-T Instruments Inc
Blandford PA Wheelco Instruments Co
Bliley FD Bliley Electric Co
Blumenthal CR Atlas Sound Corp
Boes WW Boes Co WW
Boyle HNL Sigma Inst Inc
Brannan RE Bakelite Corp
Brassil WT Adams & Westlake Co
Brister JE Bakelite Corp
Bristol RW Faximile Inc
Brown HH Technical Appliance Corp
Bunch CH Acme Elec & Mfg Co
Burlin M Selenium Corp of America
Burnside CJ Westinghouse Elec & Mfg
Burritt HW Eureka Vacuum Cleaner Co

— C —

Cain JE Mallory & Co Inc
Cannon RJ Cannon Mfg Corp
Capron HLM Panoramic Radio Corp
Carbonara VE Kollsman Inst Div
Cardwell DA Cardwell Mfg Corp
Carson RW Instrument Specialties Co
Carter RW Carter Motor Co
Cerny JJ Lectrohm Inc
Cezar A Electronic Transformer Co
Chapman AK Eastman Kodak Co
Chick RE R E C Mfg Corp
Church VS Burton-Rogers Co
Clare CP Clare & Co C P
Clark LP Raymond Rosen & Co
Cobrain JB Alradio Inc
Coe MA Stanley Tools
Cohen M Sickles Co F W
Cohn H Radio Receptor Co Inc
Cohon MM Carron Mfg Co
Cole SI Aerovox Corp
Collins AA Collins Radio Co
Conover RA Haydon Mfg Co Inc
Cook J Cornish Wire Co Inc
Cook RR Radex Corp
Copelin JG Litton Engineering Labs
Cooper BW Delco Radio Div
Corbin R Radio Frequency Labs Inc
Cosgrove RC Crosley Corp
Costello F Standard Spring & Mfg Co
Courteol HC Mercold Corp
Cowles AL Bluff City Distributing Co
Cragmile CS Belden Mfg Co
Cramer RE Radio Condenser Co
Crane ER Lear Inc
Cranston WE Thermador Electrical Mfg
Crawford RM Durez Plastics & Chem
Crompton EE Burke Electric Co
Cummings BR Farnsworth Telev & Radio

— D —

Dane O Templetone Radio Mfg Co
Danielson EG Remler Co Ltd
Danziger HI Crowley & Co Inc
Darnell DD Air Communications Inc
Davis AD Allied Radio Corp
Davis JW Watterson Radio Mfg Co
Day CH Browning Labs Inc
Decker WC Corning Glass Works
DeShazo GH Gray Radio Co
Diehl WF Airplane & Marine Inst Inc
Dine FE Higgins Industries Inc
Doherty EW American Elec Heater Co
Donohoe NR Magnetic Windings Co
Dow WH Dow Chemical Co
Doyle RF Alliance Mfg Co
Driver FL Driver-Harris Co
DuMont AB DuMont Labs Inc
DuVall FB Electronic Mechanics Inc

— E —

Eckstein EA Eckstein Radio & Telev Co
Edwards MW Yancey Co Inc
Eisenhauer HD Scientific Radio Serv
Ellinger EE Jefferson-Travis Radio Mfg
Elmore WA Utah Radio Prods Co
Engle KD Industrial Condenser Corp
Engelson DH Federal Mfg & Eng Corp
Esposito JR Ault & Wiborg Div
Evans RP Turner Co

— F —

Favor LA Knights Co James
Feidt EW Raumond Mfg Co
Felker MN Felker Mfg Co
Fisher AR Philharmonic Radio Corp
Fisher A Condenser Prods Co
Flanzer JA Electro Motive Mfg Co
Foute AJ Drake Mfg Co
Frank J Airking Prods Co
Franklin AW Franklin Mfg Corp
Fredericks WH Electrical Industries
Freed A Freed Radio Corp
Freed L Freed Transformer Co
Friedman J Trav-Ler Karenola Radio & Telev Corp
Funderburg JD Megard Corp

— G —

Gabel SL Superior Tube Co
Gage NE American Insulator Corp
Gardiner RA Gardiner Metal Co
Gardner AH Colonial Radio Corp
Garstand WW Electronic Labs Inc
Geri J Sonora Radio & Telev Corp
Gervais E Edwards Co W H
Gilfillan SW Gilfillan Bros Inc
Girard WE H-B Electric Co
Gladfelter RH Detroit Power Screw-driver
Glass AA Premier Crystal Labs Inc
Goldberg I Pilot Radio Corp
Goode JE Telegraph Apparatus Co
Gothard RW Gothard Mfg Co
Gotthold PM Industrial Inst Inc
Gray AS Insulation Mfgrs Corp
Gray CA Grenby Mfg Co
Green M Radio Elec Serv Co of Pa
Griffin DA Communication Measurements Lab
Griffin W Jefferson Inc Ray
Gubelman WS Roller-Smith Div

— H —

Haas ML Bud Radio Inc
Hall BW Western Lithograph Co
Halligan WJ Hallicrafters Co
Halligan WJ Echophone Radio Co
Hamilton HG Eastern Air Devices
Harnett DE Hazeltine Electronics Corp
Harvey LA Harvey Machine Co Inc
Harwell HW Connecticut Tel & Elec
Hasselquist EE Fox Electric Supply Co
Henes OH Signal Electric Mfg
Herald MJ Newark Transformer Co
Herrick GG Speer Resistor Corp
Hickok RD Hickok Electrical Inst Co
Hilliard WP Bendix Radio Div
Hoffman AG Midwest Radio Corp
Holmes JS Warwick Mfg Corp
Hopkins JC Girard-Hopkins
Hotchkin JR Painut Co
Houch HW Measurements Corp
Housman AJ Automatic Radio Mfg Co
Hoyt AE Herb E Zobrist Co
Huck A Knapp-Monarch Co

— J —

Jacobs F Radio Transceiver Labs
Jenks JL Sanborn Co
Jennings DS Central Screw Co
Johnson AC Small Motors Inc
Johnson AL Hexacon Electric Co
Johnson EF Johnson Co E F
Johnson EH Gear Specialties
Johnson RW Boots Aircraft Nut Corp
Johnston JK National Vulcanized Fibre
Jones CH Kato Engineering Co
Jones GM Ace Mfg Corp
Jones R General Communication Co

— K —

Kahn AR Electro-Voice Corp
Kahn MB Transmitter Equip Mfg Co
Karr IJ Genera Electric Co
Kelleigh WJ General Control Co
Kelly EJ No American Philips Co
Kimball R Communications Equip Corp
Kirkland HR Kirkland Co H R
Kirsch MJ Federal Engineering Co
Koch CC Merit Coil & Transformer Corp
Kopinski L Fast & Co John E
Krueger FG Krueger & Hudepohl
Kulka W Kulka Elec Mfg Co Inc
Kunz HL Sangamo Electric Co
Kurland JJ Illinois Condenser Co

— L —

Lack FR Western Electric Co Inc
Lavole SD Lavole Laboratories
Lee M Burndy Engineering Co Inc
Lehman B Radio Wire Telev Inc
Leidner J Camburn Prods Co
Levine JM Federal Screw Prods Co
Levingston GL Harwood Co
Lewis R Radiation Prods Inc
Ling EF Corning Glass Works
Link FM Link Radio Corp
Lisman WF Leland Electric Co
Lostor RA Sperti Inc
Loveless PF Stallman of Ithaca
Lyman F Harvey Radio Labs Inc

— M —

MacGrath K Eclipse-Pioneer Div
MacGregor D Webster Products
Maneck EE Brandywine Fibre Prods Co
Manson RH Stromberg-Carlson Co
Marcus DA Electronic Specialty Co
Marshall LK Raytheon Mfg Co
Marvin S American Transformer Co
Mascuch JT Breeze Corps Inc
Mattes HC Belmont Radio Corp
Maxson WF Jenson Radio Mfg
McDonald EF Zenith Radio Corp
McElroy TR McElroy Mfg Corp
McGiffin R Lewyt Corp
McIlvaine HA Continental Elec Co
McIlvane WJ Copperweld Steel Co
McKenzie WB Power City Radio Co
McLellan JD Bunnell & Co
McMaster AJ G-M Laboratories Inc
Meck JS Meck Industries
Mellen ER Weston Elec Inst Corp
Menschik I American Condenser
Merrill WA Atlas Resistor Co
Mervis L General Armature Corp
Messer CW Audio Development Co
Metzger E Micarta Fabricators Inc
Meyerson LI Scientific Radio Serv
Millen J Millen Mfg Co
Minch JA Electric Auto-Lite Co
Mitchell DT American Radio Hdwre Co
Morrison P Gibbs & Co Thomas B
Mossman DP Donald P Mossman Inc
Moulton AK Ohio Carbon Co
Murray AR Electrolux Corp
Muter LF Muter Co
Mueller S Mueller Electric Co

— N —

Nee TG Acme Wire Co
Nichols P Bendix Aviation Corp
Nickerson FW Guided Radio Corp
Novick SJ Electronic Corp of America
Noblitt QG Noblitt Sparks Inc
Norton AW Press Wireless Inc

— O —

O'Brien FJ Galvin Mfg Corp
O'Connor WE Southern Wholesalers Inc
Otis CW Noma Electric Corp

— P —

Pariser S Atlas Condenser Prods
Parkins EG Supreme Instruments
Passman C Mobile Refrigeration
Pattee LG McClintock Co
Patton CW Bakelite Corp
Phillips CJ Corning Glass Works
Pinsley N Espey Mfg Co
Potter EF Potter Co
Powell CS Graybar Electric Co Inc
Powell RC Presto Recording Corp
Priest CA General Electric

— Q —

Quam JP Quam-Nichols Co
Quill EM Surprenant Elec Insulation Co

— R —

Rauland EN Rauland Corp
Reader FE Standard Piezo Co
Ready WA National Co Inc
Redmond AG Redmond Co A G
Reeves BH Rockbestos Prods Corp
Reiner M Radio City Prods Co
Reptogle DE General Electronics Inc
Richardson CE Selectar Mfg Corp
Riche AL Micro Switch Div
Richmond HB General Radio Co
Robinson WA Brach Mfg Corp
Rockey GV Meissner Mfg Co
Rogers KE Carborundum Co
Rothstein A Southeastern Radio Supply
Rowell FF Guardian Elec Mfg Co
Russell HS Louthan Mfg Co
Ruth F Aero Communications Inc
Ruth F Erco Radio Labs Inc

— S —

Sackheim NR Mfgrs Screw Prods
Sandstrom E Oak Mfg Co
Sanial AJ Powers Electronic & Comm Co

(CONTINUED FROM PAGE 40)

batron tubes, Pirani and thermocouple tubes, voltage regulators, and tubes for facsimile recording on sensitive paper. Also listed are blacklight and near ultraviolet tubes for illuminating florescent instrument dials. While these tubes have been developed for various specific purposes, a study of their characteristics suggests many new application possibilities.

Flux Meter: A new instrument which gives a comparative indication of magnetic field strength, Fig. 6, has been announced by Hickok Electrical Instrument Company, Cleveland. Intended for either production testing or laboratory use, it operates from 105–120 volts AC, with a built-in voltage regulator. Tests are made with an exploring inductor which is inserted in the magnetic field or at the end of straight-core magnets. The standard exploring inductor permits checking the flux in a ½-in. gap, but other inductors

FIG. 6. FLUX METER FOR TESTING MAGNETS

are available on special order. Flux measurements can be compared with an accuracy of ± 3%, which is well within usual commercial requirements.

Saturated Glass Sleeving: Woven of glass fibres, is now offered by Wm. Brand & Company, New York 10. Non-moisture-absorbing and non-burning, this tubing does not fray, split, or crack. The various diameters are supplied in a variety of vivid permanent colors. Samples are available on request.

Small Motors & Blowers: A very complete portfolio of drawings and specifications on small motors and blowers has been published by Eastern Air Devices, Inc., Brooklyn 17. Operating on DC or AC of 60 or 400 cycles, these motors are rated at 1/250 H.P. and up, weighing as little as 15 oz. Centrifugal blower attachments deliver 6 to 13 cubic feet of air per minute.

Circuit Breaker: This device, Fig. 7, made by Littlefuse, Inc., Chicago, is intended for the control of motors and other devices on military equipment operating under a

(CONCLUDED ON PAGE 61)

General Managers, Cont.

Schier W Hofstatter's Sons Inc
Schmitt AJ American Phenolic Corp
Schneider AW Comm Radio Sound Corp
Schott WL Schott Co Walter L
Schuttig LA Schuttig & Co
Schwartz S Sun Radio Co
Seelig LJ General Transformer Co
Setchell BT Setchell Carlson Inc
Shallcross DH Shallcross Mfg Co
Shand EH Shand Radio Specialties
Sharp TW Bakelite Corp
Shaw G Bakelite Corp
Shaw M Lewis Electronics
Shepherd DG Electric Specialty Co
Shermund RC Induction Heating Corp
Shure SN Shure Bros
Smith E Fisher Research Lab
Smith GE Communications Co Inc
Smith H Bakelite Corp
Smith W Southington Hdwre Mfg Co
Snyder BL Snyder Mfg Co
Spielmann WA Tablet & Ticket Co
Srebroff C Radio Engineering Labs Inc
Stack AR Girard-Hopkins
Stackpole JH Stackpole Carbon Co
Staver EF Goat Metal Stampings Inc
Stein J Metaplast Co
Stengel JF Telephonics Corp
Stevens WB Mitchell Rand Insul Co
Stillman GW Radio Studios Inc
Strobel F Mangold Radio Parts & Stpg
Stubbers AH Ilsco Copper Tube & Prods
Stuckey PH Wirt Co
Stupakoff SH Stupakoff Ceramic & Mfg
Summers JM Camloc Fastener Corp
Sundt EV Littelfuse Inc
Swanson JA Standard Radio Parts Co

— T —

Tarr LW Ucinite Co
Tartak PH Cinaudagraph Speakers Inc
Taylor OF Electrical Research Labs Inc
Teeden J Patton-MacGuyer Co
Teitler SL Lepel Labs
Tillotson J Tillotson Furniture Corp
Tregenza AE Jefferson Elec Co
Triplett RL Triplett Elec Instrument

— U —

Ungar SD Ungar Inc Harry

— V —

Valentine HC Barker & Williamson
Valpey TS Valpey Crystal Corp
Vaughan VG Spencer Thermostat Co

— W —

Wahlgren WW Gardner Elec Mfg Co
Walker RC Aircraft Accessories Corp
Walker RE Walker-Jimieson Inc
Wallace WT Wallace Mfg Co Wm T
Wayman EL Hudson American Corp
Welning RF Wincharger Corp
Whiting EM Pheoll Mfg Co
Whiting FA Micamold Radio Corp
Wilcox JV Wilcox Electric Co Inc
Wolf DE Sensitive Research Inst Co
Wood TS Corning Glass Works
Worner LL Worner Electronic Devices
Wrape HJ Bentley-Harris Mfg Co
Wright D Sound Equip Corp
Wunderlich GF Eitel-McCullough Inc
Wyatt GM Wyatt Cornick Inc

— Y —

Yarbrough FA American Microphone Co
Young NT Hatry & Young

— Z —

Zachariah VN Zach Radio Supply
Zayac FR Ballantine Labs Inc
Zieber G Hewlett-Packard Co

CHIEF ENGINEERS

— A —

Abrahams AI Racon Electric Co Inc
Andersen DE J-B-T Instruments Inc
Angst W Kollsman Inst Div of Sq D
Angus EM General Electric Co
Applegate ID Ideal Com Dresser Co

— B —

Babcock SK Electronic Specialty Co
Bach HM Premier Crystal Labs Inc
Bacon DH National Co Inc
Badeau CA Thomas & Betts Co
Bailey WM Cornell-Dubilier Elec Corp
Bain GW Ken-Rad Tube & Lamp Corp
Baker GC Ruby Chemical Co
Barlow WA General Winding Co
Basim DS Airadio Inc
Bates AC Roller-Smith Div Realty & Industrial Corp
Bath FC Driver-Harris Co
Bauer B Hewlett-Packard Co
Bauer BB Shure Bros
Bausch CL Bausch & Lomb Optical Co
Bean LG Bristol Co
Benner HJ Sickles Co FW
Bennett AE Gentleman Prods Div Henney Motor
Bernreuter HA Simpson Electric Co
Bevington KA American Molded Prods Co
Bingley FJ Philco Corp
Bjorndal M Technical Appliance Corp
Blackburn RK Crystal Research Labs
Blauvelt R Radiart Corp
Blumenfeld A University Labs
Bolesky JD Spencer Thermostat Co
Borggrafe EW Electrical Prod Corp
Borst JM Rider Labs John F
Boucher EJ McClintock Co
Bovee BA Carborundum Co — Globar Div
Boyd DL General Industries Co
Boyle HG No American Philips Co
Brainin CS Brainin Co
Breit HF Quam-Nichols Co
Breunich T Brandywine Fibre Prods Co
Briggs JA Donald P Moesman Inc
Brociner V Philharmonic Radio Corp
Brown D Bendix Aviation Corp
Browning GH Browning Labs Inc
Brown ME Borg-Gibbs Lab
Budelman FT Link Radio Corp
Burke R Philmore Mfg Co Inc
Burroughs LR Electro-Voice Corp
Burzyoki CZ New York Transformer Co
Byrnes IF Radiomarine Corp of America

— C —

Cardwell AD Cardwell Mfg Corp
Carlson VE Aircraft-Marine Prods Inc
Carpenter JR Insuline Corp of America
Carr AH Fada Radio & Electric Co Inc
Caywood RW Millen Mfg Inc James
Cesar A Electronic Transformer Co
Carpenter JR Ntl Electronic Mfg Co
Catanzariti FA Standard Winding Co
Celander PA Micro Switch Div
Chauncey P Walker-Jimieson Inc
Christaldi PS Du Mont Labs, Allen B
Clark RA Comm Equip & Eng Co
Clement LM Crosley Corp
Clemons CW Knapp-Monarch Co
Cohen TA Wheelco Instruments Co
Cohn M Electro Motive Mfg Co
Comstock JA Acme Elec & Mfg Co
Conrad NL Webster Products
Cox CR Andrew Co
Cornell JI Solar Mfg Corp
Cornell NA Scovill Mfg Co
Costello AH Standard Spring & Mfg Co
Craft LM Collins Radio Co
Craig P Philco Corp
Cronin FP Sensitive Research Inst Co
Crowley HL Crowley & Co Inc Henry L
Cullin JF General Armature Corp
Curtiss WR Connecticut Tel & Elec

— D —

Dalyrmple HC Guided Radio Corp
Danisch MS Utah Radio Prods Co
Dante JJ Dante Elec Mfg Co
Daugherty RM Detrola Corp
Davis EW Simplex Wire & Cable Co
DeConingh EH Mueller Electric Co
DeHorn CE General Transformer Co
DeMetrick JS Auto Radio Mfg Co Inc
Detrick HM General Inst Corp
Dezettel LM Allied Radio Corp
DiGiacomo A Micamold Radio Corp
Ditrler GE Small Motors Inc
Donaldson WR Celanese Corp
Donato J American Radio Hdwre Co Inc
Doughman FC Electrolux Corp
Dreisbach RH Magnavox Co
Dressel H Stackpole Carbon Co
Druesne MAA James Knights Co
Duerk KA American Steel Package Co
Dunn WL Belmont Radio Corp

— E —

Eastham M General Radio Co
Eckstein EA Eckstein Radio & Telev Co
Edelman A Photobell Corp
Edwards WH Edwards Co
Elbi LA Crystal Prod Co
Eldam AE Worner Electronic Devices
Ellsworth AR Packard Bell Co
Engel GC General Electronics Inc
Enfing E Cannon Mfg Corp

— F —

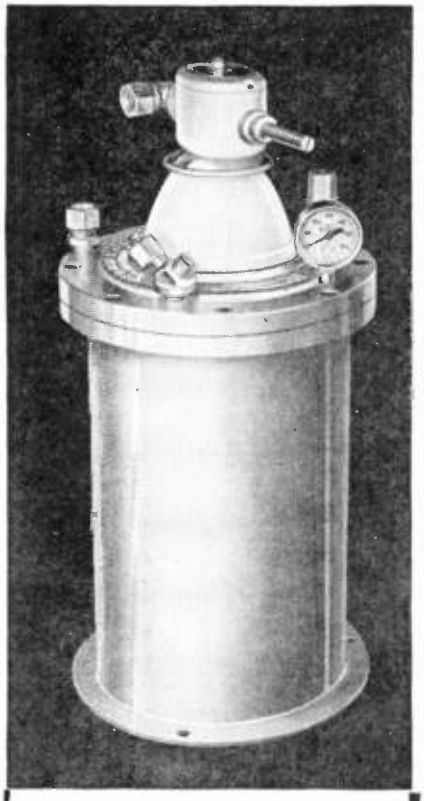
Falck FW Advance Elec Co
Farmer EB General Control Co
Farrell JJ General Electric Co
Ferguson J Farnsworth Telev & Radio
Fetterman D Sonora Radio & Telev Corp
Finn JJ Mitchell Rand Insulation Co
Fishberg S Polymet Condenser Co
Fishberg S Cosmic Radio Corp
Fisher GR Fisher Research Lab
Fisher RT Sigma Inst Inc
Forbes HC Colonial Radio Corp
Forsberg GE Suprenant Elec Insul Co
Foute HK Drake Mfg Co
Franklin WS Fast & Co John E
Frost GW Gothard Mfg Co
Frye RH Electronic Labs Inc
Funk JE Noma Electric Corp

— G —

Garlick W American Transformer Co
Gates HA Warwick Mfg Corp
Gates P Gates Radio Co
George EB Leland Electric Co
Gerster CW Louthan Mfg Co
Gibbs ED Radio Receptor Co Inc
Gilman WE Permoflux Corp
Glaser M DeWald Radio Corp
Glasser M United Scientific Labs
Goring P Raumond Mfg Co
Gratz FW Treitel-Gratz Co Inc
Graves ED Avery Adhesives
Gray D Doolittle Radio Inc
Gray FE Gray Radio Co
Graybill KW Automatic Elec Co
Greene HA Remler Co Ltd
Greenleaf LB Conn Ltd C G
Griffin AE Winsted Div Hudson Wire Co
Gruber MM Presto Recording Corp
Gunther FA Radio Engineering Labs Inc
Gurevics D Freed Transformer Co
Gustafson GE Zenith Radio Corp
Gustofson JR Muehlhausen Spring Corp

— H —

Hale CB Gear Specialties
Hamond GI Eagle Elec Mfg Co
Hanneman WM Shakeproof Inc
Hants BF American Insulator Corp



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Johnson Engineers were among the first to design and build Gas Filled Pressure Condensers in fixed, variable, and combination fixed and variable types.

Gas Filled Condensers offer a decided advantage in size where large capacities or high voltage ratings are necessary. In some cases Gas Filled Condensers make possible an instrument that would be a mechanical impossibility in an air type.

Johnson Gas Filled Pressure Condensers are available in several sizes of housings depending on the rating specifications. Prices are low, efficiency is high, gas leakage is nil over long periods of time.

Write today for more information and prices.

JOHNSON
a famous name in Radio

E. F. Johnson Co. Waseca, Minn.

Q METER MODEL 160-A

Direct Reading

A dependable direct-reading instrument for determining the Q or the ratio of reactance to resistance, of coils. Used in design and production engineering of Radio and Electronic equipment. Condensers and other components readily measurable.

Determines effective inductance or capacitance

BOONTON RADIO *Corporation*
BOONTON, N. J.

DESIGNERS AND MANUFACTURERS OF THE "Q" METER . . . QX-CHECKER . . . FREQUENCY MODULATED SIGNAL GENERATOR . . . BEAT-FREQUENCY GENERATOR . . . AND OTHER DIRECT READING TEST INSTRUMENTS

BROADCAST ENGINEERS — POLICE RADIOMEN

Write Now!

—on your phasing and tuning gear problems

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This release may come at any moment. Be sure that your needs are listed at the top of our peace-time back-log. The planning you do now will speed your own reconversion to the new high standards of the future.

Andrew engineers will gladly apply their years of skilled experience to the solution of your special problems in the field of directional antenna equipment:

- Phasing networks and equipment
- Antenna tuning units
- Remote reading antenna ammeters
- Phase monitors
- Coaxial transmission lines and accessories

ANDREW CO.
363 East 75th Street
Chicago 19, Illinois

Chief Engineers Cont.

Harmon RN Westinghouse Lamp Div
Harvey CA Harvey Wells Comm Inc
Hastings TM General Comm Co
Haynes NM Amplifier Co of America
Hatry LW Hatry & Young
Hector Dr LG Ntl Union Radio Corp
Heindel HJ Andrea Radio Corp
Heller JI Panoramic Radio Corp
Hennessey SW Camloc Fastener Corp
Heppner EA Cons Radio Prod Co
Hering G Power City Radio Co
Hilferty RA Press Wireless Inc
Hill E Palnut Co
Hinshaw MW Felker Mfg Co
Hogan JVL Faximile Inc
Holby JC Onan & Sons D W
Holtz FC Sangamo Electric Co
Hood A Brach Mfg Corp
Hood SR Chace Co W M
Hornickel HC American Microphone Co
Howes G Eitel-McCollough Inc
Hudepohl FH Krueger & Hudepohl
Humble CE Burke Electric Co
Huntley NF R E C Mfg Corp
Hutchings JH Continental Elec Co

— I —

Israel DD Emerson Radio & Phono Corp

— J —

Jacobs F Radio Transceiver Labs
Jauch J Peerless Electrical Prod Co
Jefferson R Jefferson Inc Ray
Jensen CH Copperweld Steel Co
Johnson AL Hexacon Electric Co
Johnson JK Hammarlund Mfg Co Inc
Jolliffe Dr CB Radio Corp of America
Jones CH Kato Engineering Co
Jones D Sound Equip Corp
Jones HC Delco Appliance
Jones H Merit Coil & Transformer Corp

— K —

Kahn L Aerovox Corp
Kahn SH Southeastern Radio Supply Co
Kalb RM Kellogg Switchb'd & Supply
Kaplowitz M Federal Mfg & Eng Corp
Karlby H Elastic Stop Nut Corp of Amer
Kasch MH Kurtz Kasch Inc
Katzman J Dumont Elec Co
Kaufman AA Industrial Synthetics Corp
Keefe OA Newark Transformer Co
Kenney MW Seeburg Corp JP
Kimball CN Aircraft Accessories Corp
Kimball R Communications Equip Corp
Kirsch MJ Federal Engineering Co
Klein F Camburn Prods Co
Knowles HS Jensen Radio Mfg Co
Kohring WM Continental Carbon Inc
Komorous LJ Parisian Novelty Co
Krefft HH Standard Transformer Corp
Kreinick HC American Condenser Co
Kreis JG Acme Wire Co
Kulka ER Kulka Elec Mfg Co Inc

— L —

LaMarsue JW Graybar Elec Co Inc
Lapp DN Raymond Rosen & Co
Lasswell C Girard-Hopkins
Lastovicka LJ Lectrohm Inc
Lawler J Auburn Button Works
Leap GA Communications Co Inc
Lebedeff G Heintz & Kaufman Ltd
Leddo NE Teleradio Engineering Corp
Lehnert WE Audio Development Co
Lester F Electronic Corp of America
Levenberg MH Condenser Prods Co
Levy H Ohmite Mfg Co
Lewis GL Lewis Electronics
Lidow E Selenium Corp of America
Lieblach M Radio City Prods Co
Lylyblad RH Camfield Mfg Co
Lindgerg CA Air Way Elec Appl Corp
Linell CS Carron Mfg Co
Lingel FJ Triplett Elec Instr Co
Lodwig E Mobile Refrigeration Div
Loomis G Durez Plastics & Chemicals Inc
Lowit R Callite Tungsten Corp
Lundahl T Technical Appliance Corp

— M —

MacAllister JW Ind Filter & Pump Mfg Co
MacDougall D Valpey Crystal Corp
MacLeod AD Alden Prods Co
Mallard MT Cornish Wire Co Inc
Margolish G Printloid Inc
Marko L Radio Wire Telev Inc
Marsten J International Resistance
Mastney EJ Oak Mfg Co
Matthey LH Hartman Corp of America
Maurer L Jefferson Elec Co
Maurer P Redmond Co
Mayer RH Turner Co
Mazzola JR Automatic Winding Co Inc
McCabe IE Mercoid Corp
McCoy RL Locke Insulator Corp
McCraigh JF Operadio Mfg Co
McElroy TR McElroy Mfg Corp
McHale RE Zack Radio Supply Co
McMaster AJ G-M Laboratories Inc
McNamara BF Insulation Mfgrs Corp
Merrill E Atlas Resistor Co
Meyer EM Victor Insulators Inc
Miller JH Weston Elec Inst Corp
Miller A Sanborn Co
Miller WW Ward Leonard Elec Co
Minnium BB Erie Resistor Corp
Minter JB Measurements Corp
Miron VC Wincharger Corp
Mitchell FDV Shallcross Mfg Co
Mitchell DH Galvin Mfg Corp
Moore F Dejur-Amsco Corp
Moore HS Rockbestos Prods Corp
Monack AJ Mycalex Corp of America
Morris JG Ault & Wiberg Div
Mosow WA Manufacturers Screw Prods
Mucher GJ Clarostat Mfg Co Inc
Munro WC Halstead Traffic Comm
Myers JT Wallace Mfg Co Wm T

— N —

Nelsen M Guardian Elec Mfg Co
Nelms RL Superior Tube Co
Nielse HV Sparks Withington Co
Nordlie L Micarta Fabricators Inc

— O —

O'Brien RJ Trav-Ler Karenola Radio & Telev Co
O'Callaghan JJ Rauland Corp
O'Connor P Miller Co J W
Olander LW Johnson Co E F
Omer CL Air Communications Inc
O'Neill RE Imperial Molded Prods Corp
Osborne Maj WE Harvey Machine Co
Osterland E Ballantine Labs Inc

— P —

Pacholke F Majestic Radio & Telev Corp
Pauly AJ Ilsco Copper Tube & Prods Inc
Pearce CE Precision Piezo Serv
Pearson AC Harwood Co
Peters CE Benwood Linze Co
Petersen J Tech Art Plastics Co Inc
Peterson H Lepel Labs
Pierce FL Eureka Vacuum Cleaner Co
Planck RM Radio Mfg Engineers Inc
Pollack Dr D Templetone Radio Mfg Co
Ports EG Federal Telephone & Radio Co
Potter WF Potter Co
Powers JW Selectar Mfg Corp
Pratt LC Eastern Air Devices
Pray GE Airplane & Marine Inst Inc
Prince MA Metaplast Co

— Q —

Quackenbush C American Phenolic Corp
Quirk AL Harvey Radio Labs Inc

— R —

Rall CA Bodine Electric Co
Rattray A Lafayette Radio Corp
Reed CM Haydon Mfg Co Inc
Reeves HE Reeves Sound Labs
Reich RA Ohio Nut & Bolt Co
Reichel WA Eclipse-Pioneer Div Bendix Aviation Corp
Reinhardt RC Atlas Sound Corp
Replogle DE Electronic Mechanics Inc
Reynolds WH American Inst Co
Rhoads JA Air Associates Inc
Rice LA Electrical Prods Supply Co
Richards LJ Dow Chemical Co
Richmond WE Standard Piezo Co
Ricks JB Gen Telev & Radio Corp
Rinehardt H Sperti Inc
Rittenhouse A Magnetic Windings Co
Robb JS Radio Condenser Co
Robbin L Mallory & Co P R
Rollefson KE Muter Co
Roche WP Central Screw Co
Rose CK Royal Engineering Co
Rosenbaum J Espey Mfg Co Inc
Rubenstein AL Hudson American Corp
Rubenstein HW Centralab Div
Rudd WE Induction Heating Corp
Rusher G Oxford-Tartak Radio Corp
Russell V Crescent Industries Inc
Ruth E Erco Radio Labs Inc
Ruth E Aero Communications Inc

— S —

Sack SL Transmitter Equip Mfg Co Inc
Saliba GJ Presto Recording Corp
Samuelson RE Echophone Radio Co
Samuelson RE Hallicrafters Co
Saunders A Zophar Mills Inc
Schaefer E Hareo Steel Constr Co Inc
Schellenger NC Chicago Tel Supply
Schmeling AM Lavoie Laboratories
Schneider EF Stille-Young Corp
Schneider EV Alliance Mfg Co
Schnell WJ Electrical Research Labs Inc
Schnoll N Industrial Instruments Inc
Schum WR Cuver Dual Signal Systems
Schum WR Electra Voice Corp
Schutz FC Ace Mfg Corp
Schwartz BA Delco Radio Div
Schwennesen D Chicago Trans Corp
Seabury RW Radio Frequency Labs
Setchell BT Setchell Carlson Inc
Shapiro LC Pilot Radio Corp
Shaw CE Western Lithograph Co
Shidler A Scientific Radio Prods Co
Shimer RB Kenyon Transformer Co Inc
Silva AE Noblitt Sparks Inc
Smalley NB Comm Meas Lab
Smith JP Daven Co
Smith P Midwest Radio Corp
Snow JA Radex Corp
Snyder EI REA Magnet Wire Co
Snyder G Snyder Mfg Co
Sobel AD Air King Prods Co Inc
Soward R Supreme Instr Corp
Sparling CE Sperry Gyroscope Co
Spencer PL Raytheon Mfg Co
Stallman AC Stallman of Itahaca
Stanmyre EJ Meissner Mfg Co
Steiger BF United Electronics Co
Sternad AF Gardiner Metal Co
Stevens FJ American Lava Corp
Stickney FS Instrument Specialties Co
Stillman GW Radio Studios Inc
Stoffel LL Ohio Chemical Co
Strobel F Mangold Radio Parts & Stpg
Strunk KG Breeze Corps Inc
Stuhrman AP Wilcox Electric Co
Stupakoff SA Stupakoff Ceramic & Mfg Co
Sullivan M Sullivan Varnish Co
Swanson JA Standard Radio Parts Co
Sylvester FF Richardson Allen Corp
Sylvone AA Comm Radio Sound Corp

— T —

Taylor CE Megard Corp
Tennyson MA Sola Elec Co
Thomas LS Blake Radio Equip Co
Thunen GW Electrical Prod Corp
Tish FP Pheoll Mfg Co
Townsend CS Bendix Radio Div

RADIO DESIGNERS' ITEMS

(CONTINUED FROM PAGE 57)

wide range of ambient temperatures. The switch breaks at 200% of its rated load at 10 to 100 seconds, yet it will hold for one hour at 115% of rated load under an ambient temperature of 77° F. However, these characteristics are altered only

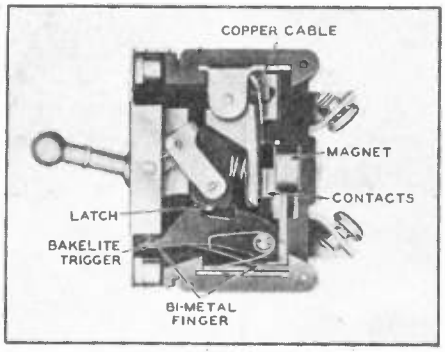


FIG. 7. TEMPERATURE-REGULATED SWITCH

slightly between −65° and +180° F. due to the use of a compensating bi-metal finger indicated in Fig. 7. Rating is 5 to 50 amperes at 32 volts AC or DC, although the switch can break 2,500 amperes on short-circuit. Performance is in accordance with specification AN-C-77. Dimensions are 2⅛ ins. high, ¾ ins. wide, 2 ins. deep behind panel.

Selector Switch: Of small, compact design, manufactured by Federal Telephone &

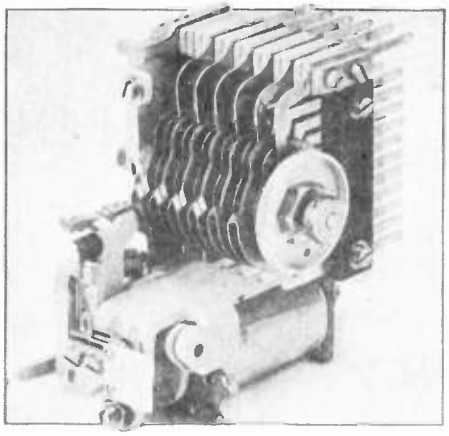


FIG. 8. SWITCH FOR REMOTE CONTROLS

Radio Corporation, Newark, is adaptable to many automatic or remote controls on police, railroad, airport, and other types of radio communications equipment. This device is shown in Fig. 8. The rotor assembly is actuated by a stepping mechanism in response to current impulses transmitted manually or by a dial. If required, the rotor will return automatically to the starting position. Many different circuit combinations are possible, with one to three 2-row levels of 22 points each, or one to six 1-row levels of 11 points each. Dimensions are 2½ by 3¼ by 3½ ins. Rated operating life is 4,000,000 revolutions at speeds up to 60 per second.

Chief Engineers, Cont.

Trickey PH Diehl Mfg Co
Trott BS Garod Radio Corp
Turney E Precision Tube Co
Tuttle FE Eastman Kodak Co

— U —

Urey GM Radiation Prods Inc

— V —

Veley HN Speer Resistor Corp
Viser JH Bluff City Distributing Co

— W —

Wagener WC Litton Engineering Labs
Wall JR Boes Co W W
Waltmead BT Bud Radio Inc
Wardell J Thermador Electrical Mfg
Warren RS Adams & Westlake Co
Webb WL Bendix Radio Div
Webster FD Bunnell & Co J H
Weinreich GF Clare & Co C P
Weinstein M Freed Radio Corp
Weise RC Barker & Williamson
Weiss WA Hickok Electrical Inst Co
Wernine HH Belden Mfg Co
Wetzel FH Electric Auto-Lite Co
Wexler C Meck Industries John
Whitney LH Grenby Mfg Co
Wickham P Gibbs & Co Thomas B
Wilborn F Schott Co Walter L
Wilkens WB Jefferson-Travis Radio Mfg
Willets HN Western Electric Co
Williams WS Schuttig & Co
Willyard L Universal Microphone Co
Winthers R Signal Electric Mfg
Wise RM Sylvania Electric Prods Inc
Wolcott CF Gilfillan Bros Inc
Wolf A Lewyt Corp
Wolfskill JM Billey Electric Co
Woodward CA Ucinite Co
Wootton W Boots Aircraft Nut Corp
Woycke LG Lear Inc
Wright JA Tungsol Lamp Works Inc

— Y —

Young FC Stromberg-Carlson Co

— Z —

Zaleski J Northern Engineering Labs
Zilliger A Molded Insulation Co
Zmuda D H R S Products
Zobrist HE Herb E Zobrist Co
Zottu PD Girdler Corp
Zurian PD Press Wireless Inc

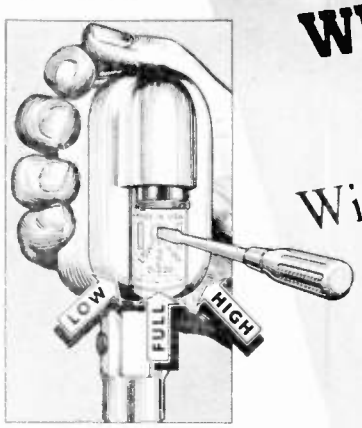
D220

The Big Name in the Book

WHEN YOU'RE TALKING MICROPHONES

Wide Range • High Fidelity • Moving-Coil

Three types of response for all purposes



The circuit combines two dynamic generators, each with a specific frequency response. Its ideal quality is produced by coupling the outputs electrically and acoustically. Total band 25 to above 10,000 cps. Broad crossover from 150 to 5,000 cps. Crossover band in the D220 has been designed to eliminate peaks in the middle frequency range.

LOW
For pickup systems requiring embellished lows and good intermediate range.
(25 to 5000 cps.).

FULL
For high fidelity requirements where smooth, flat response and broad range are necessary.
(30 to above 10,000 cps.).

HIGH
For all purposes requiring richness in the higher frequencies. Slightly rising characteristic.
(From 150 to 10,000 cps.).

D220 - Dynamic (30 - 50 ohms)
D220T - Dynamic (Available in 200 - 250 ohms, 500 ohms or High Impedance)

American MICROPHONE CO.
1915 So. Western Avenue, Los Angeles 7, California

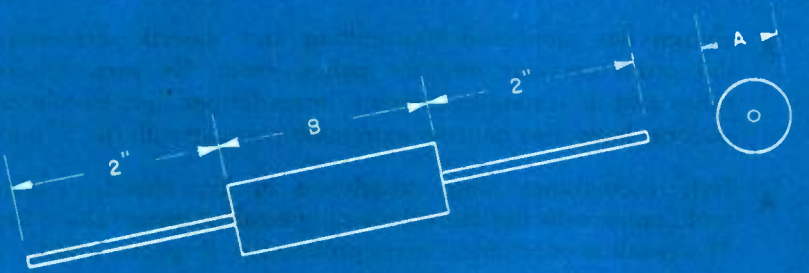
SEND FOR BULLETINS ON OTHER MODELS IN PRODUCTION

MEMO TO Purchasing Dept.

In our postwar radio sets, recommend you buy Solar Sealdtite Tubular Capacitors – they're the best we've ever tested – the only wax-molded units – superior protection against moisture.

E.M.

ENGINEERING · SPECIFY SOLAR · DEPARTMENT



ART NO.	SOLAR PART NO	CAP'Y MFD.	WKG VOLTS	DIMENSIONS "A"	DIMENSIONS "B"
9A40-1	S-0211	.001	600	3/8	1-3/16
9A40-2	S-0215	005	600	3/8	1-3/16
49A40-3	S-0221	.01	600	7/16	1-3/16
49A40-4	S-0224	.02	600	7/16	1-5/8
49A40-5	S-0230	05	600	9/16	1-5/8
49A40-6	S-0240	.1	600	9/16	2-1/8

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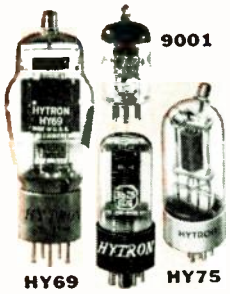
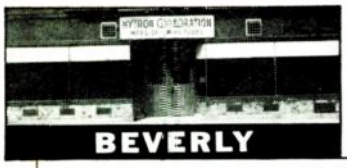
ISSUE

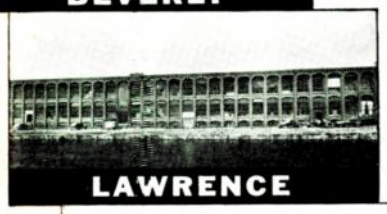
Prominent engineers consistently show their preference for Solar Capacitors. Solar pledges continued production of superior quality capacitors to merit that preference. Solar Manufacturing Corporation, 285 Madison Avenue, New York 17, N. Y.

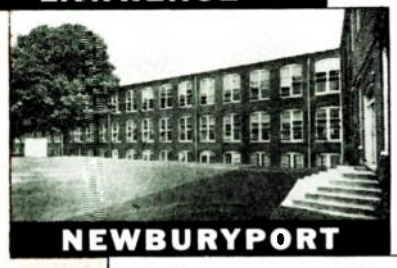
SOLAR CAPACITORS & ELIM-O-STA·TS

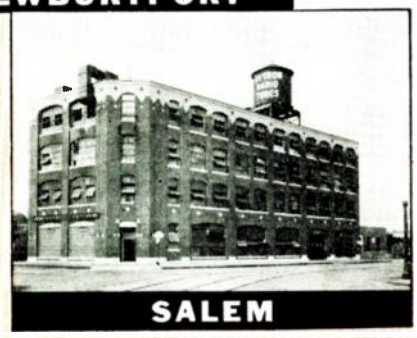
Some INTERESTING FACTS ABOUT HYTRON











★ Hytron is the oldest manufacturer in the United States specializing on radio receiving tubes. The first Hytron tube was made by hand in 1921.

★ The now standard BANTAM GT receiving tube is a Hytron origination. Hytron designed and developed over 70 of the popular GT types. These small glass receiving tubes contributed to the development of the miniature table radio and to large scale production of radio and radar equipment for the Services.

★ The tiny BANTAM JR. tubes originated by Hytron were the first subminiatures. They made possible hearing aids and pocket radio sets. Similar Hytron tubes serve in wartime electronic devices.

★ Hytron has pioneered transmitting and special purpose tubes for the radio amateur and for police radio. Its very-high-frequency tubes and its instant-heating r.f. beam tetrodes for mobile communications, have also become extremely popular with the Services.

★ Hytron combines long experience in high-speed receiving tube techniques with the know-how of special purpose tube engineering. The result is economical mass production of special tubes.

★ First of the receiving tube manufacturers to convert 100% to war production, Hytron will be just as alert in serving the post-war market.

CONSULT HYTRON regarding your needs for these tubes: receiving, ballast, hearing aid, very-high-frequency triodes and pentodes, miniatures, medium and low-power transmitting triodes, r.f. beam tetrodes (particularly instant-heating), r.f. pentodes, gaseous voltage regulators, and rectifiers.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

ARMY NAVY

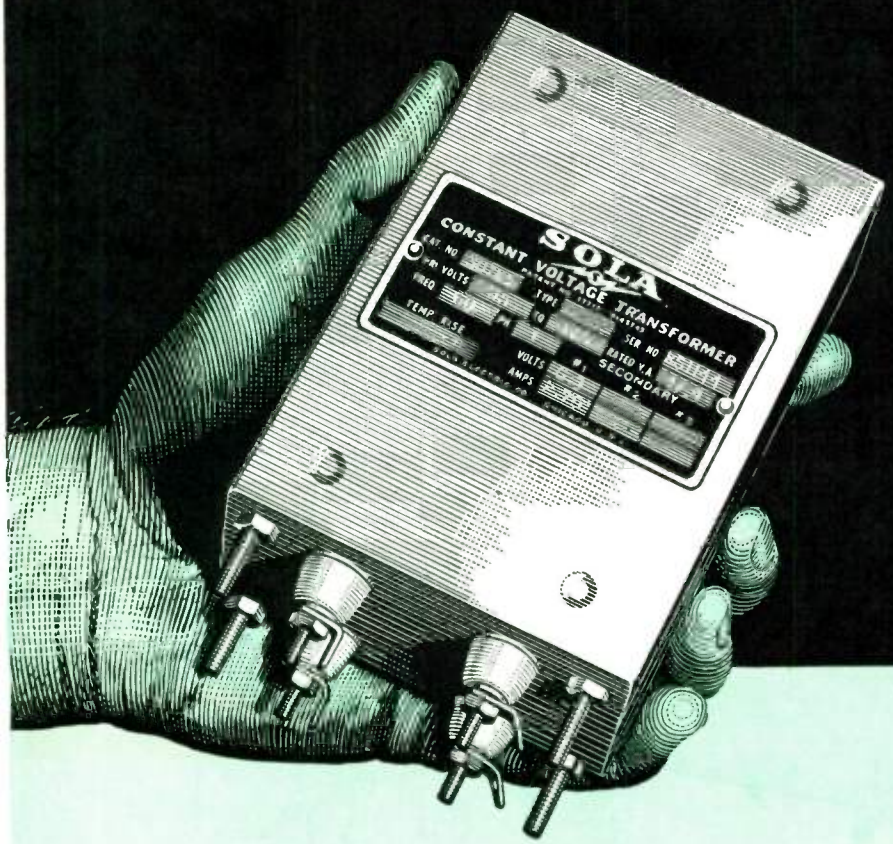
HYTRON RADIO TUBES

BUY ANOTHER WAR BOND

This SOLA CONSTANT VOLTAGE TRANSFORMER

has an important postwar future in

YOUR



HEATING CONTROLS • REFRIGERATION CONTROLS • TELEVISION SETS • F-M RADIO • VACUUM TUBE VOLTMETERS • ELECTRONIC GAUGING AND INSPECTION EQUIPMENT • PHOTO-METRIC INSTRUMENTS... *there are other applications of course*

Here is a SOLA Constant Voltage Transformer that should be a built-in part of your equipment—

First: because it will stabilize output voltage at your rated requirements regardless of line voltage fluctuations as great as ±12 to 15 %.

Second: because its small, compact size is ideal for chassis mounting.

Third: because of its low, economical cost.

Fourth: because of the saving that can be made through the elimination of other components.

Fifth: because a majority of anticipated service calls can be eliminated from your cost calculations.

Sixth: because the users of your product will get greater satisfaction from trouble-free service.

This particular transformer is rated at 6.3 volts, 17VA output and is designed primarily for the stabilization of vacuum tube filament and heater voltages. Other voltages and capacities for chassis mounting can be supplied on the same low cost, economical basis to meet your exact requirements.

Constant Voltage Transformers

To Manufacturers:

Complete specification details covering this new Constant Voltage Transformer will be furnished at your request.

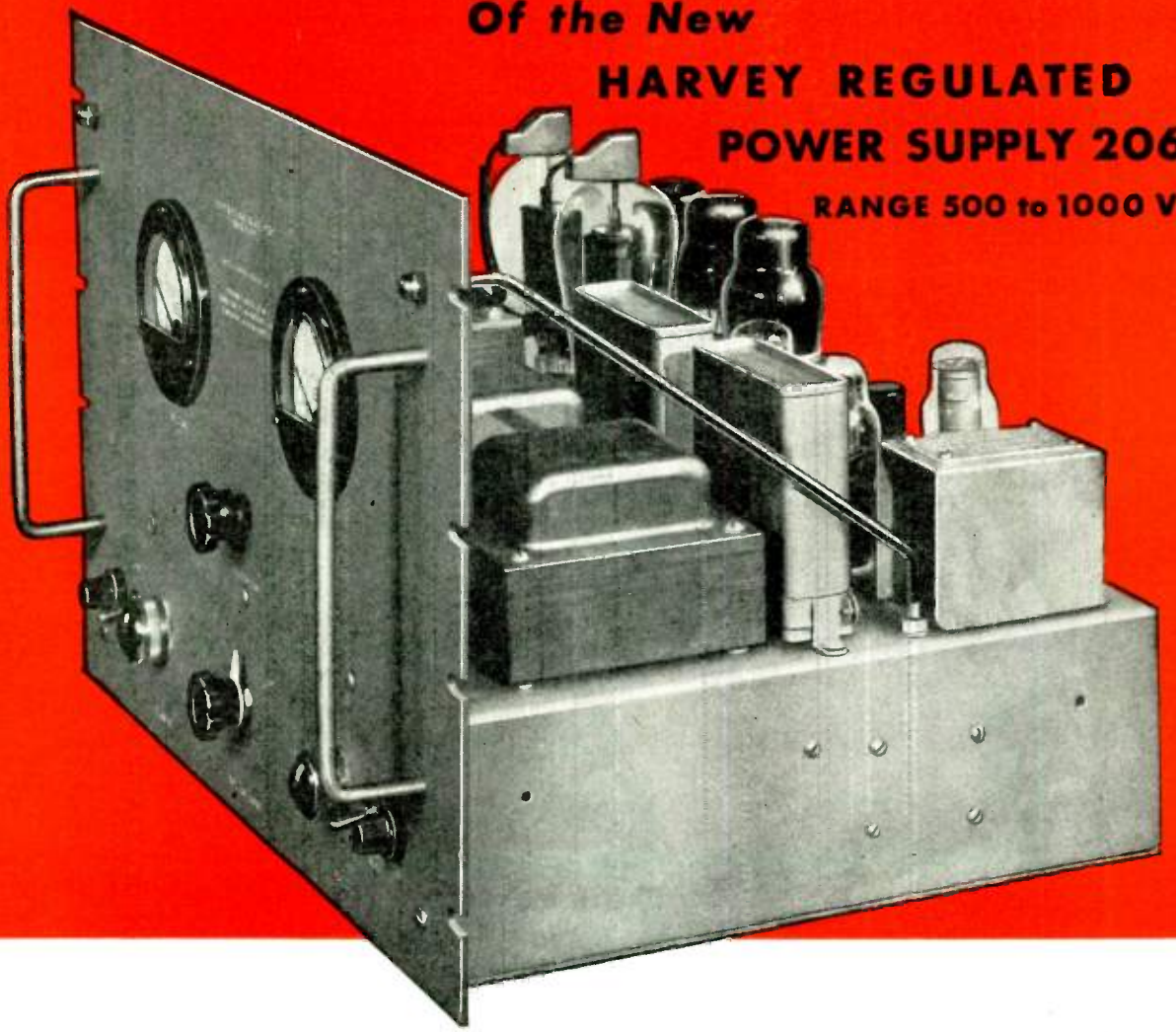
Ask for Spec. No. 5CV-103

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

FIRST OFFICIAL PICTURE

Of the New HARVEY REGULATED POWER SUPPLY 206 PA

RANGE 500 to 1000 VOLTS



Look It Over! You'll see the quality craftsmanship and compact construction of this new HARVEY 206 PA—its sound design, precision assembly and easy accessibility. Notice the gray, crackle-finish panel and the copper plated chassis.

The new Harvey 206 PA is equipped with spare fuses, a generous 6 ft. heavy duty Typex cord, two interlocks for safety, overload and time delay relays—everything to make it a thoroughly dependable, easy-to-operate source of laboratory D. C. power.

Although the picture gives you an indication of why the HARVEY 206 PA operates smoothly and efficiently, it can't show you how this precision instrument operates in two ranges—500 to 700 volts at ¼ of an ampere; 700 to 1000 volts at .2 of an ampere—with both ranges accurately regulated within one per cent. That's up to the instrument and us. We'd like nothing better than the chance to show you just what this important new development can do. Get in touch with

HARVEY
OF CAMBRIDGE

HARVEY RADIO LABORATORIES, INC.

443 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

ENGINEERING SALES

(CONTINUED FROM PAGE 8)

lis; Earl Dietrich, Cleveland. New members at large are Richard A. Hyde, 4253 Quitman St., Denver; Gail Halliday, 1526 Ivy St., Denver; Leonard D. Allen, 135 Spring St., Rochester, N. Y.; Marshall T. Ball, same address; Franklin Y. Gates, 19 W. South Temple, Salt Lake City. Total membership is now 230.

Stewart-Warner: George Johnson will handle sales promotion on the S-W radio set line, and radio distributor relations.

Motorola: Has appointed Strickland Distributing Company, Paducah, Ky., as distributor in the Kentucky territory. Under the management of I. H. Strickland, this firm will handle the complete Motorola line of FM-AM home radios and car models.

Zenith: Los Angeles distributorship of the Zenith line goes to Sues-Brown Company. This is a newly-formed partnership, of which the principals are Melvin (Pete) Sues, formerly of Leo J. Meyerberg and John G. Rapp companies, and Clarence Brown, an executive of Metro-Goldwyn-Mayer.

Bendix: Leonard C. Truesdell will be general sales manager of the newly organized home radio department of Bendix Radio, with headquarters in Baltimore. Previously he was sales manager for Crosley and national manager of the major dealer and dealer development department for Frigidaire.

Samuel Rochester, already a member of Bendix Radio, will be district manager of the middle Atlantic territory, operating from Baltimore, while Royal Vilas will be manager of the southeastern district, with headquarters in Atlanta.

RCA: David J. Finn, formerly sales manager of RCA industrial and sound equipment, has been named manager of the Chicago region, and James W. Cocke has been shifted from the Bloomington, Ind. plant to take up management of the Dallas, Atlanta region, with headquarters in Dallas.

Ohio Appliances, Inc., of Columbus, Dayton, and Cincinnati has been appointed RCA distributor for southwestern Ohio. This concern is headed by Mark

(CONCLUDED ON PAGE 70)

ENGINEERING SALES

(CONTINUED FROM PAGE 69)

Lintner, Radio & Appliance Distributors, Inc., headed by Louis K. Roth, will be RCA distributor for Connecticut and western Massachusetts. Both companies will handle FM-AM and television sets, Victor and Bluebird records, tubes, and test equipment.

Belmont: George Russell, formerly general sales manager at Sentinel, and active in radio sales for 20 years, has been appointed sales representative for Belmont, covering the southern states. He will make his headquarters in Birmingham.

Westinghouse: Has announced the appointment of Harold P. Donley as manager of the home radio receiver division. George Faurie, formerly with Delco Appliance and Frigidaire, has been named manager of advertising and sales promotion.

Concord Radio: Ed Berliant, for 9 years in charge of amateur and industrial sales for Sun Radio, New York, is now manager of Concord's branch at Atlanta, Ga. From 1941 to 1944, he was general manager of Aeronautical Radio Manufacturing Company.

Hamilton: Jack F. Crossin, formerly of Crosley and Kelvinator, has been appointed national sales director for Hamilton's line of Olympic home radios.

Sound Equipment: Recently moved from Hollywood to Glendale, Calif., has announced the appointment of Howard M. Irwin as sales and advertising manager. He will set up jobber distribution of the Company's line of high-fidelity amplifiers and audio components, precision coils, circuit tracers, and soldering irons.

Astatic: Ray T. Scottenberg, as sales manager of the jobber parts division, and William J. Doyle, in charge of sales set manufacturers, are preparing for an anticipated resumption of civilian sales of crystal and dynamic microphones, pick-ups, cartridges, and recording heads.

WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

teriously related to *electronics*, embellished with curved lines traced by dots which got nowhere. Now, it comes out that the advertising didn't get anywhere, either.

Furthermore, the people who have been reading those advertisements have also been reading about wonderful new television machines that will sell for $150, yet the very companies responsible for that publicity know that an FM-AM phonograph combination in a good cabinet, with an audio system capable of doing justice to FM broadcasting, will cost at least twice $150 after the War! And if good television sets can't be bought for $150, right from the start, most people are just going to sit tight with the idea of waiting until the prices come down. How, then, will it be possible to build an initial television audience before the pioneer broadcasters run out of what it takes to keep stations on the air when there's no advertising revenue?

Wouldn't it be a lot smarter to tell people the stark truth about the cost of television receivers, and then promise them programs that will justify the investment? They will accept somewhat meagre program fare at the beginning, and assume that it will be improved. But it's going to be tough to gain the confidence and enthusiastic support of the public when it comes out that manufacturers were only kidding about the wonders of electronics which would make it possible to sell the kind of television sets people will want at prices of $150 to $200!

3. When this publication was called *FM* RADIO-ELECTRONICS, we were frequently asked by subscribers and advertisers: "Are you going to keep this a radio magazine, or are you, too, going to spread out into the general field of electronics?"

We have hardly heard that question since the name was changed to *FM* AND TELEVISION. Perhaps that settled it. At least, the change was intended to make clear our intention to maintain this publication definitely as a radio man's magazine. "But," it may be asked, "since all the new applications of electronic tubes are based on radio principles, where is the boundary line of the radio field?"

That question is difficult to answer because it involves the misuse of the word *radio*. The second edition of Merriam's New International Dictionary defines *radio* the noun, as: *the transmission and reception of signals by means of electric waves without a connecting wire.* The adjective *radio* is defined as: *of or pertaining to, employing, or operated by radiant energy, specifically that of electric waves.*

This brings out the simple fact that anything correctly classified as *radio* must pertain to, or employ, or be operated by

(CONCLUDED ON PAGE 72)

TECHNICAL NOTES

Excerpts from New Home Study Lessons Being Prepared under the Direction of the CREI Director of Engineering Texts

CIRCUIT EQUIVALENTS

THE CREI NEWS, monthly house organ published by the Capitol Radio Engineering Institute, is now presenting an interesting series of technical articles on the subject of Circuit Equivalents.

The current article takes up actual circuit equivalents. These include such elements as speaker dividing networks, high-frequency resistors of large power dissipation for use in high-level video amplifiers, rhombic antenna termination, and finally, an example from the acoustic field, that of the rubber transmission line used in a disc recorder.

We believe you will be interested in this material and in the further examples that are to follow in succeeding issues. If so, we will be glad to place your name on our mailing list to receive copies of the CREI NEWS, free of charge. Merely write to Capitol Radio Engineering Institute and ask for your copy of the December CREI NEWS, plus other issues discussing Circuit Equivalents.

★ ★ ★

The subject of "Circuit Equivalents" is but one of many that are being constantly revised and added to CREI lessons by A. Preisman, Director of Engineering Texts, under the personal supervision of CREI President, E. H. Rietzke. CREI home study courses are of college calibre for the professional engineer and technician who recognizes CREI training as a proved program for personal advancement in the field of Radio-Electronics. Complete details of the home study courses sent on request.

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ENGINEERING INSTITUTE

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Home Study Courses in Practical Radio-Electronics Engineering for Professional Self-Improvement

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WASHINGTON 10, D. C.

Contractors to the U. S. Navy — U. S. Coast Guard — Canadian Broadcasting Corp. — Producers of Well-trained Technical Radiomen for Industry.

WHAT'S NEW THIS MONTH

electric waves (without connecting wires). It is not material whether the waves are generated by spark-coils, tubes, or high-frequency alternators, or whether they are picked up on receiving sets using coherers, vacuum tubes, or crystal detectors. Thus any device controlled by a circuit employing electric waves (through space) is *radio-operated*.

Therefore, applications of electron tubes to medical, chemical, electrical, and mechanical devices and equipment which do not involve the use of electrical waves transmitted without wires may be classified as electron tube-controlled, but they are no more related to radio than electric pyrometers, ignition systems, or other electrical equipment dependent upon the transmission of current over closed metallic circuits.

On the other hand, applying the word *electronic* to sound, television, or mechanical equipment *pertaining to, employing, or operated by electric waves* serves no useful purpose, but only creates confusion.

Therefore, when we say that this publication will be maintained as a radio man's magazine, we use the word *radio* in accordance with its established definition. Furthermore, we use the title *FM* AND TELEVISION because, as the FCC allocations hearing has made clear, the vast expansion of the radio art will be in these two fields.

By covering the engineering and commercial aspects and progress of FM and television, we shall continue to serve those who control the greatest dollar market for radio equipment, tubes, components, and materials. In the interests of this group, we are content to leave the editorial coverage of non-radio tube applications for division among the many magazines devoted to the various professions, trades, and industries which have found uses for such apparatus.

RADIO RELAY SYSTEMS

(CONTINUED FROM PAGE 30)

to suggest 20 mc. as the minimum or unit channel width for broad-band transmission of the kind here envisioned, with the expectation that more than one unit channel may be required for some kinds of experimentation and for wider-band signals such, for example, as high definition or color television.

In a radio relay system, at each station, the incoming signal is amplified and its frequency changed so that the retransmission will not interfere with the reception. Under favorable conditions, the frequency change at the next relay point can be back to the original frequency so that each channel is used every other span, and only two channels are necessary

(CONTINUED ON PAGE 73)

RADIO RELAY SYSTEMS

(CONTINUED FROM PAGE 72)

to relay a signal as far as may be desired in one direction. For the unfavorable condition where spurious, longer-distance transmission can occur, causing one station to interfere with another on the same frequency several spans removed in the chain, each channel can be reused only every third or fourth span, so that more than two channels are required for each signal carried through the system. To be sure, if such spurious transmission is avoidable and, in addition, if it were possible to use at the repeater station two antennas of such directivity that the transmitter could not fire back materially into the receiver, operating on the same frequency, one channel would suffice for relaying each signal. Under present conditions, two channels for each one-way signal transmission is a good median assumption. Since there must be transmission in both directions, we conclude that four radio channels are needed to make up a complete broad band communication circuit.

The ultimate communication load capacity which can be expected from a given microwave band is an important question. The use of extremely high frequencies and sharply directive transmission tends to reduce interference, so that frequencies can be used over and over again. If sound engineering is applied to the whole problem, the set of frequencies needed for a 100- or 200-mile circuit should be adequate for the extension of that circuit to much longer distances and, by branching, to wider areas, thereby creating a comprehensive network. Using the same frequencies simultaneously on several routes branching out of a common point is a nice problem in antenna refinement, station locations, and power levels, requiring a great deal of detail system-design coördination. In such congested cases, the use of wires and cables in solving the terminal and toll entrance problems may be necessary to conserve radio frequency space.

If the hopes we entertain for the success of the experimental system between New York and Boston are realized, the radio relay type of transmission may well become an important feature of the communications system of the future. Therefore, we believe the frequency requirements to be provided for at this time should be based on assumed minimum traffic requirements for important routes in the nationwide network. As a practical matter, 5 broad-band circuits is the smallest number that would be considered reasonable on routes likely to be developed in a 5- to 10-year period. With no provision for spares, 5 circuits would allow, for example, 3 television circuits and 2 multiplex groups of telephone circuits.

(CONCLUDED ON PAGE 74)

RADIO RELAY SYSTEMS

(CONTINUED FROM PAGE 73)

Viewed now from the development engineer's standpoint, this turns out to be a size of circuit-group which fits in well with an economical layout of radio apparatus. It is expected that a set of channels aggregating about 400 mc. wide can be passed as a solid block through one radio antenna system, so that an economical design is probable. When fully used, 400 mc. should yield 20 unit-channels each 20 mc. wide. As was worked out above, 4 channels are needed for each 2-way broad-band circuit, so these 20 channels should give 5 circuits. Thus, from both minimum traffic and development standpoints, this seems to be a conservative and practical beginning.

Since these are minimum figures, and since we are as yet quite uncertain which frequency range will prove to be best for this service, it is important to allow two such blocks, one near 2,000 mc. and another near 4,000 mc. At still higher frequencies, around 12,000 mc., provision should be made for a larger block 1,000 mc. wide, in order to give adequate room for experimentation and possible commercial development in the next 5 to 10 years.

Specifically, it is our recommendation that the following reservations of frequencies be made to care for the probable needs of multiplex telephony, television and sound programs and similar services in public telephone systems:

20 channels each 20 mc. wide, constituting a band 400 mc. wide from 1,900 to 2,300 mc.

20 channels each 20 mc. wide, constituting a band 400 mc. wide from 4,000 to 4,400 mc.

A space 1,000 mc. wide, lying between 11,500 and 12,500 mc.

It is also our suggestion that ten to fifteen per cent of the space above 13,000 mc. should be reserved to permit experimentation and to meet the future public telephone system requirements for this type of radio service.

While no specific suggestion is here made for the reservation of frequencies in the region of 6,000 to 8,000 mc., it might become necessary to go into this range, particularly if crowding by other services curtailed use of the 2,000-mc. band, or if the bands near or above 12,000 mc. proved unsuitable for relay purposes.

The bands of frequencies recommended herein are considered conservative since, with current methods, they might be severely taxed by a moderate development of network television service. While we may optimistically expect developments of the future to increase the carrying capacity of these bands, we must expect that the load will grow too.

PICTURE OF TELEVISION

(CONTINUED FROM PAGE 17)

clear pictures[1] as those of 250,000 elements unless equipment of the former type affords higher white-to-black contrast than is provided by present-standard transmitters and receivers. And the 250,000 element equipment cannot be considered to approach perfection until the images approach the standard of contrast established for motion pictures.

Perhaps this situation is partly responsible for the impression that Commissioner Jett favors the use of the present standards and frequency band until such time as television engineers are ready to make use of wider television channels at higher frequencies.

RCA-NBC, Du Mont, and Philco engineers testified in favor of the present standards and frequencies, while CBS[2] and Cowles engineers want to go immediately to wider channels somewhere above 200 mc. In fact, CBS announced the signing of a contract with Federal Telephone & Radio Corporation for a television transmitter operating on 460–476 mc., with Zenith designated as the manufacturer of suitable receivers. It was also stated at the hearing that Westinghouse has offered to build a 750-mc. transmitter for CBS.

There is not even agreement on the relative effect of ghosts or multi-path transmission and shadows at the different frequencies proposed for television. It was claimed that these effects become more pronounced as the frequency is increased. Meanwhile, certain propagation data has been declassified by the Joint Communications Board, Joint Chiefs of Staff which will shed some light on this most important problem.

This situation recalls Chairman Fly's admonition, uttered last May at the opening session of the Television Seminar in New York: "Why blow our brains out with hot air? . . . Stop talking and get back to the research laboratories and experimental stations!" That's advice that all those interested in television would like to heed. Unfortunately, almost every television engineer is tied up on radar work, and will be for some time to come. Meanwhile, until the questions of frequencies and standards are settled, everyone is treading water.

It is possible that, by the time these words appear in print, the FCC will have made its decision on frequency allocations known to the industry. Whatever the outcome, the engineers will probably find ways to make good on the claims and assertions which have been made by the front office. They usually do!

[1] See "Relation of Contrast to Width of Television Band" by Madison Cawein, *FM* AND TELEVISION, November, 1944.

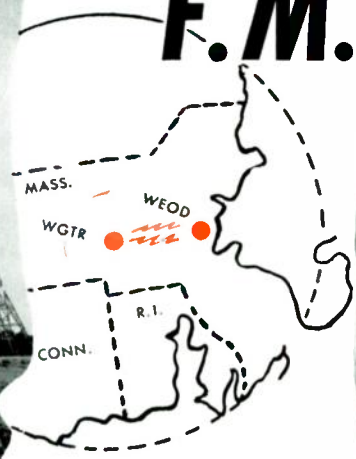
[2] See "The CBS Report on Television Standards" by Paul W. Kesten, and "Discussion of the CBS Television Report," *FM* AND TELEVISION, May, 1944.

REL

PAXTON

FIRST WITH F.M. RELAY!

(S.T.L.)



BOSTON

F. M. relay operation...offered by others as a postwar possibility...is already an REL accomplishment of proven reliability.

● For five years, the first studio-to-transmitter F. M. relay ever to be installed has been in continuous practical operation by the Yankee Network *without wire connections* between studio and transmitter. Programs originating in Station WEOD, located atop the Buckminster Hotel, Boston, are relayed to Station WGTR 50 kw, also an REL installation in Paxton 43 miles distant, over two hill-ranges and beyond line of sight.

Yes, REL has in back of its organization five years of practical operation—in F. M. relaying, a field generally regarded as one for future development. REL has again established a scientific precedent . . . and continues to energetically and successfully lead the field in radio pioneering!

REL equipment in this installation consists of 250 w., S-T link transmitter operating on 156.75 mc.

Sales Representatives

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2040 Grand River Ave., W.
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MID WEST
REL Equipment Sales, Inc.
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N. B. Neeley
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PIONEER MANUFACTURERS OF FM TRANSMITTERS EMPLOYING ARMSTRONG PHASE-SHIFT MODULATION

RADIO ENGINEERING LABS., INC.

Long Island City, N.Y.

RUMFORD PRESS
CONCORD N H

WRH

Link FM *Preferred*

In WAR as in PEACE

Link was the first major manufacturer of Armstrong licensed FM emergency radio communication equipment commercially acceptable for police, fire, forestry, railway, public utility, government and other emergency services.

1st AWARD

The Connecticut Statewide FM police radio communication system, which is 100% Link, was the Signal Corps proving ground that led to universal adoption of FM by the Allied Armed Forces.

FM combat equipment by Link includes multiple channel armored car and tank installations, Navy C.B. advance base equipments, special purpose communication units for the Navy and Radio Link networks for the Signal Corps.

2nd AWARD

These and a host of other developments, many of which remain classified, are proof positive that Link is *Preferred.*

We feel that our customers fully understand these statements. By their splendid cooperation they ensured to our Armed Forces an unhampered flow of vital FM communication equipment and they share with us the high honor of receiving the Army-Navy E three times.

3rd AWARD

As the demands of war decrease, there will be more and more Link FM equipment available for the emergency services and in peace as in war, Link will be *Preferred.*

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ENGINEER • MANUFACTURER

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PREFERRED *FM* RADIO COMMUNICATION EQUIPMENT

EMPLOYING ARMSTRONG PHASE SHIFT MODULATION