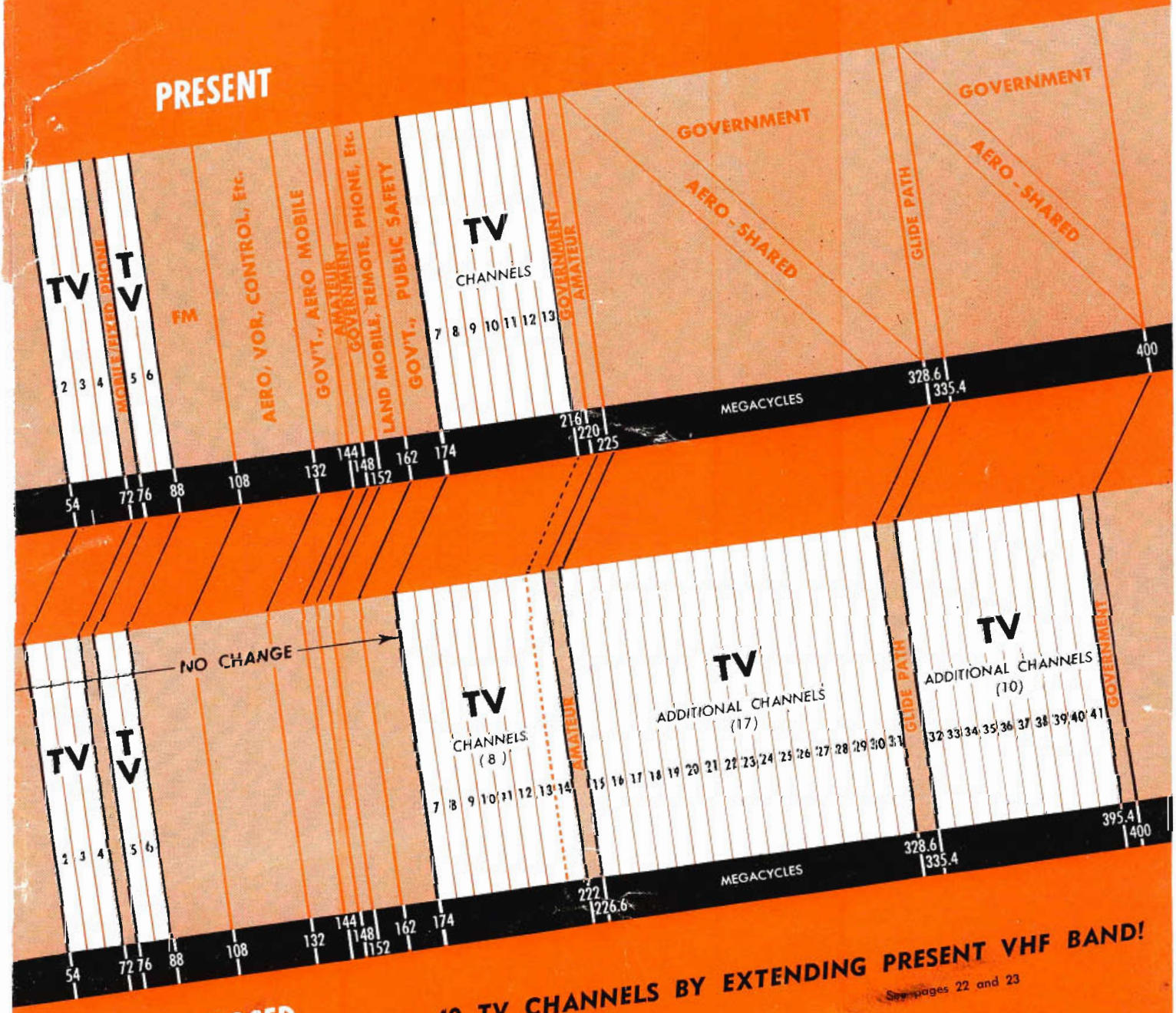
# TELE-TECH

Formerly ELECTRONIC INDUSTRIES

**TELEVISION • TELECOMMUNICATIONS • RADIO**




**40 TV CHANNELS BY EXTENDING PRESENT VHF BAND!**

See pages 22 and 23

***War Mobilization of Radio-TV Mfrs.—II***

***25 KW VHF Power Triode***

***Navy Records Color Video***

**August • 1950**

CALDWELL-CLEMENTS, INC.

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# The *New* Adlake "MIGHTY MIDGET" (Relay 1140)


**Every ADLAKE Relay gives you these "plus" features:**

- **HERMETICALLY SEALED**
  (dust, dirt, moisture, oxidation and temperature changes can't interfere with operation)
- **SILENT and CHATTERLESS**
- **REQUIRES NO MAINTENANCE**
- **ABSOLUTELY SAFE**

**Now protected with metal-enclosed contact**

**For dependability** under all operating conditions, Adlake's "Mighty Midget" Relay is now available with a metal-enclosed contact. This new improvement in the "Mighty Midget" eliminates entirely the possibility of failure due to cracked and broken switches.

Although small enough to fit into one hand, the No. 1140 Relay makes or breaks 30 amps. easily, with low operating current. Like all Adlake Relays, it requires no maintenance. Its mercury-to-mercury contact prevents burning, pitting and sticking. It is absolutely safe . . . hermetically sealed . . . and cushioned against impact and vibration.

Some of the many uses of this versatile and dependable relay are: flasher installation, power circuits, motor and heater controls and traffic signals.

**Write today** for full information on this new "Mighty Midget" Relay. The Adams & Westlake Company, 1117 N. Michigan, Elkhart, Indiana.

Adlake TRADE MARK

**THE**

# Adams & Westlake

**COMPANY**

Established 1857 ELKHART, INDIANA New York • Chicago

Manufacturers of Hermetically Sealed Mercury Relays for Timing, Load and Control Circuits

# TELE-TECH

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*Edited for the 15,000 top influential engineers in the Tele-communications industry, TELE-TECH each month brings clearly written, compact, and authoritative articles and summaries of the latest technological developments to the busy executive. Aside from its engineering articles dealing with manufacture and operation of new communications equipment, TELE-TECH is widely recognized for comprehensive analyses and statistical surveys of trends in the industry. Its timely reports and interpretations of governmental activity with regard to regulation, purchasing, research, and development are sought by the leaders in the many engineering fields listed below*

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## AUGUST, 1950




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Publishers also of RADIO & TELEVISION RETAILING

# TELE-TECH

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Formerly ELECTRONIC INDUSTRIES





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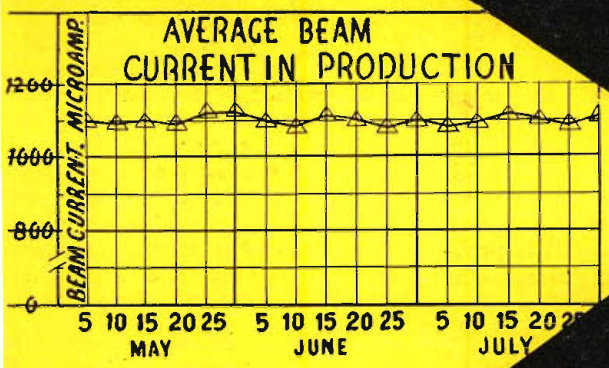



Thorough Inspection is your Protection

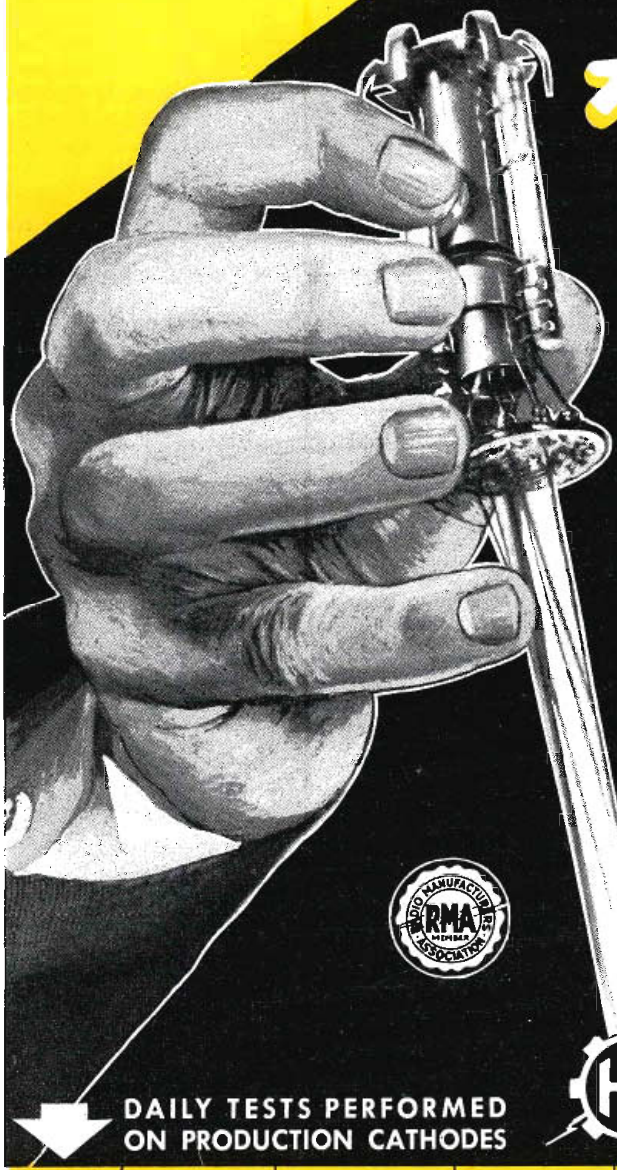
# Attention...

## ENGINEERS • MANUFACTURERS PURCHASING AGENTS

Haydu Brothers' inspection system is your guarantee of perfect tubes, with no rejects due to failure to meet electrical specifications!

In Haydu electron gun manufacture, *nothing* is left to chance which can be measured or tested! Metal parts are metallurgically checked. Chemicals used are analyzed in our own laboratory. Sub-assembly tests are made at important stages throughout manufacture of the gun, assisted by the best optical and electrical equipment, to ensure spotting and rejecting of the slightest flaw!

This Haydu quality-control system of multiple materials- and production-checks, PLUS an all-inclusive final inspection, ensure the strict uniformity and superior quality of every Haydu electron gun. For sample units and specifications on these fine guns, please write:



DAILY TESTS PERFORMED ON PRODUCTION CATHODES

## HAYDU BROTHERS

Plainfield, New Jersey

| Date | Cathode | Coating Mg.—Sq. Cm. | Thickness, Inches | Grid-Cathode Space, Inches | Static Emission Milliamps | Beam Current Microamps | Cut Off Bias, Volts |
|---|---|---|---|---|---|---|---|
| 7-10-50 | Lot 32750 | 8.04 | 0.0018 | 0.0065 | 9.2 | 1080 | 50.1 |
| 7-11-50 | Lot 32751 | 7.96 | 0.0020 | 0.0071 | 9.8 | 1110 | 48.2 |

# TELE-TIPS

**INDUCTION RADIO** may be introduced into New York's tunnels. It is understood that the Port of New York Authority is considering such radio traffic control. Operating on 550 KC the scheme is for motorists to keep car radios tuned to this frequency for traffic instructions. Before the war the lower percentage of cars radio-equipped reduced the scheme's effectiveness. But now with the majority of cars today having radio sets it should be very successful. The George Washington Bridge has been thus "wired for sound" for many years. Another plan is to install radio along the Pennsylvania Turnpike. In effect, the roads then become tunnels of signals which radiate from wires along the roadside in the same way that train radio operates. It is probable that the FCC will be asked to ease the radiation limits for equipment of this kind so that its use will not be too circumscribed.



**WHY 10-YEAR COLOR DELAY?** Edison's fundamental electronic discovery lay unused from 1883 to 1907. Dr. deForest's audion, invented in 1907, played no major role for 10 or 12 years. And Dr. A. N. Goldsmith's 1940 invention of the principle behind present RCA color-tube did not blossom into operation until 1950. In the last case, it was the problem of developing circuits to achieve 6-MC operation. And these circuits, though accountable for the delay, undoubtedly comprise as great a contribution to color-TV as the color-tube itself.

**BIGGER'N MOVIES** — Quoting Tele-Tech's figures (April issue, p. 6), "The total investment to date in the television industry," said Richard Hodgson, TV technical director Paramount Pictures, "is estimated at $3,500,000,000 including stations, receivers, transmitting facilities and manufacturing plants—with the rate-of-investment curve steadily upward. This compares with a capital investment figure for the Film Industry in this country of $2,880,000,000. Already, therefore, the four-year-old Television Industry's importance in the national economy is greater than the long-established Film Industry!"

**"MOVIES FOR TV"** — Realizing how large a part motion-picture film plays in TV, one of Tele-Tech's editors, John H. Battison, has written a book as above titled, to be published by Macmillan in the Fall. Dealing with film fundamentals, the book takes the reader through equipment for making and using films on TV, video recording, sound recording, etc., to the newsreel and preparation of commercials on film. It is the first book to cover this field. In addition to being a television engineer, Battison has produced films for TV and teaches two courses in the subject at New York University.

**TV REGIMENTATION** by local ordinance can be the thin end of the wedge for government control. Wooster, Ohio, in the guise of protecting homes from lightning damage via TV antennas, has legalized compulsory TV receiver installation inspection—for a fee! If this is allowed to stand, the next step may logically be licensing of receivers. RTMA and NAB should look into this!

**SOUND ADVICE**—General Roger B. Colton, new president of Federal Telecommunications Laboratories, Nutley, N. J., is above all a practical man. Friends say that after looking over plans for any new device he invariably comes up with the terse comment: "Well, it looks good. But now let's build a couple and get the cockroaches out of it!"


# CLEVELAND

**COSMALITE* and CLEVELITE***

**LAMINATED PHENOLIC TUBES**

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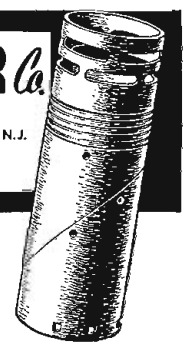

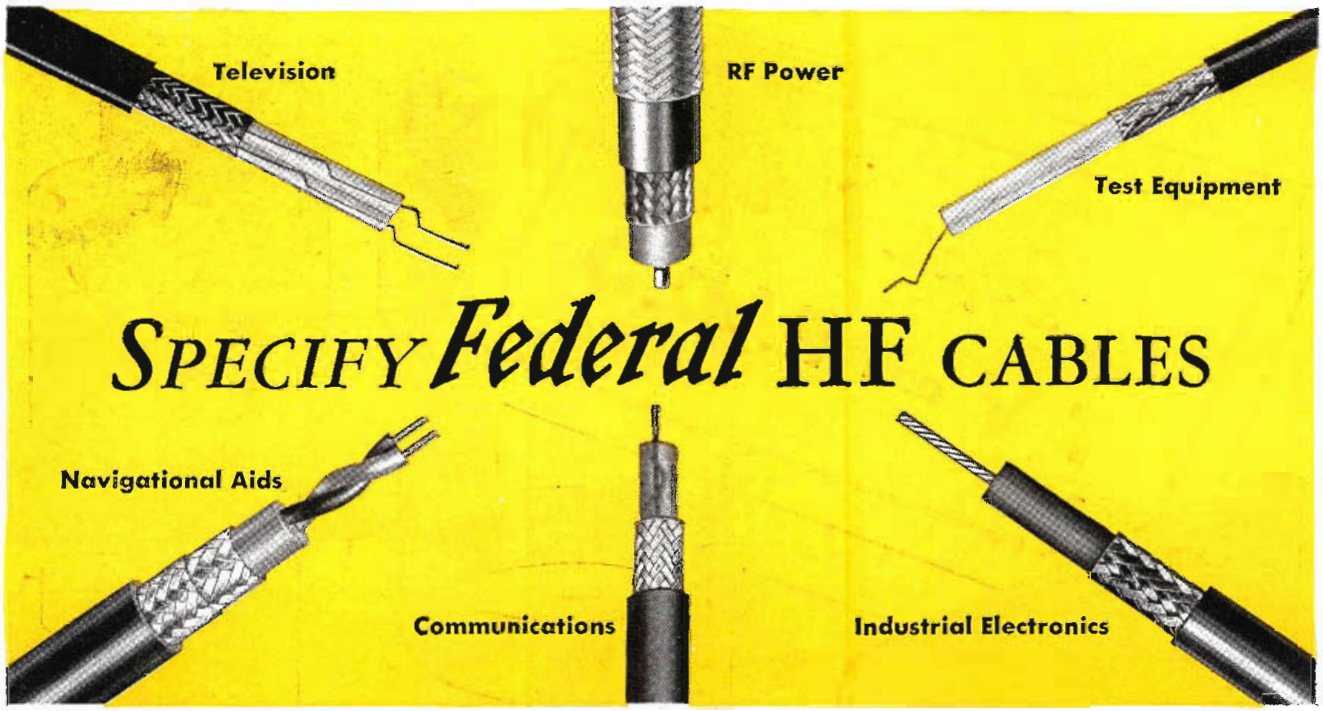


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## to get the cable that is *Precisely Right* for your application

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- **America's most complete selection of solid dielectric cable types.**
- **Quality and performance proved by years of outstanding operation.**
- **Competitively priced . . . prompt delivery—most types available for shipment from stock.**

There is no need to compromise when you specify Federal cable. Federal is your assurance of obtaining precisely the cable you require—whether it is one of the scores of Army-Navy approved types or one of the exclusive Federal-developed special purpose cables.

Nor is there any compromise with quality and dependability when you insist on Federal. Millions of feet of Federal cable, serving in countless applications, are continuing proof of Federal's superiority.

### *Does Your New Design Require Unusual Cable Characteristics?*

These three types are typical of the special purpose cables developed by Federal to meet specific requirements and manufactured exclusively by Federal:

| Federal No. | TYPE | Characteristic Impedance — Ohms | Capacitance mmf/foot |
|---|---|---|---|
| KT-107 | Shielded, balanced, twisted pair (Twinax) | 72 | 22 |
| K-109 | Ultra-low-capacitance coaxial cable | 160 | 8.3 |
| K-113 | Low impedance coaxial cable | 34 | 39 |

**For data on other Federal special types, as well as specifications on Federal's complete line of JAN-Approved cables, write today for your free copy of Federal's Cable Data Booklet. Address Department D-366**

**Federal Telephone and Radio Corporation**

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*In Canada:* Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
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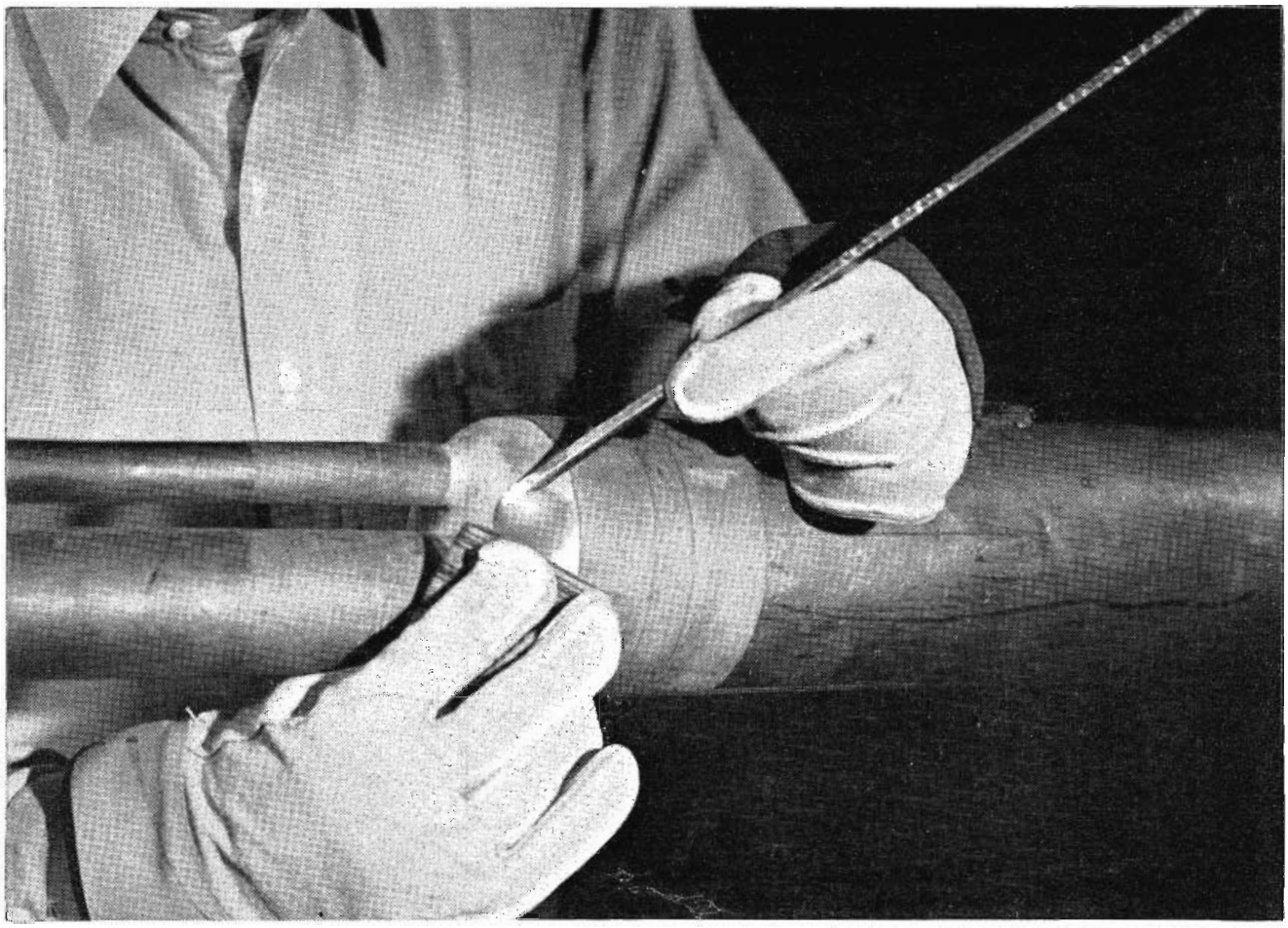


# *He seals out trouble...*

**TO KEEP THE COST OF YOUR TELEPHONE SERVICE DOWN**

To make cable joints tight and strong, splicers formerly used lots of solder. Then, Bell Telephone Laboratories developed a new technique for making better joints with much less solder. This saves one million pounds of solder a year — helps keep the price of your telephone service low.

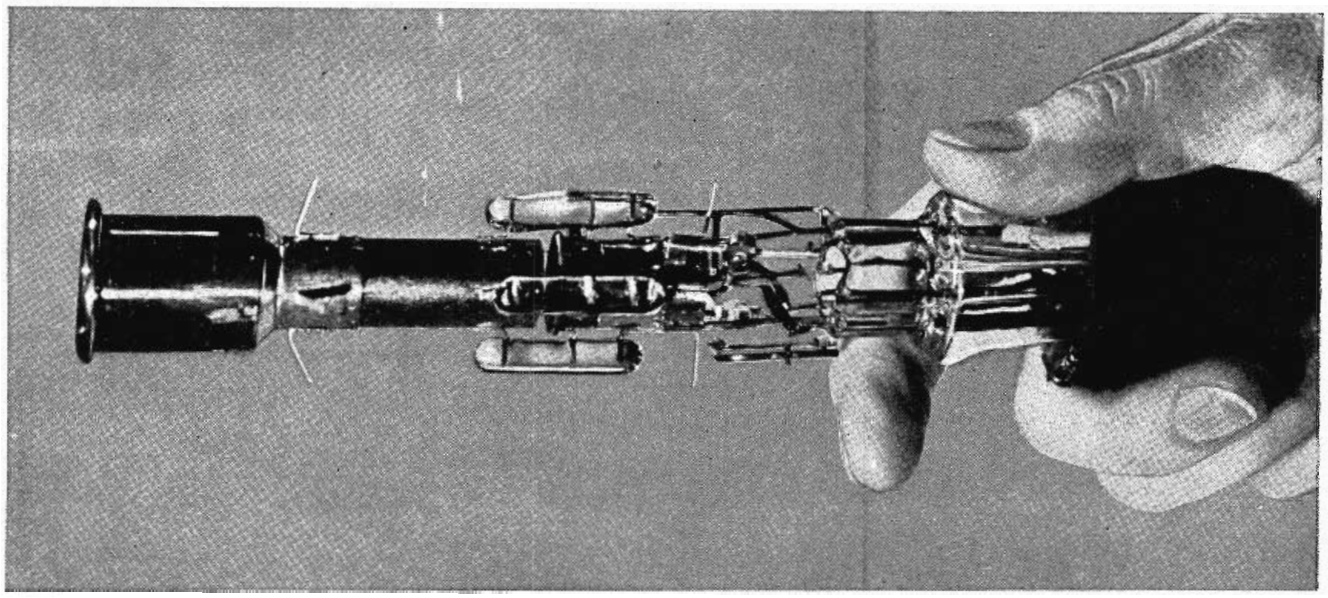
Two kinds of solder are now used. One makes the splice strong; the other seals it. First, the splicer builds up a joint with a solder of lead and tin, which flows easily under his wiping cloth. To seal the joint, he applies a light coating of low-melting-point solder, composed of lead, tin and bismuth. On contact with the still hot joint, it flows into and seals every pore.

Cable-sealing solder is only one of 30 low-melting-point alloys which Bell metallurgists have developed for special uses — in fuse wires, for example, and in the solder connecting hair-like wires to piezoelectric crystals for electric wave filters.

Continuing research with a substance seemingly as commonplace as solder demonstrates again how Bell scientists help keep your telephone service the world's best.

## BELL TELEPHONE LABORATORIES

• WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST



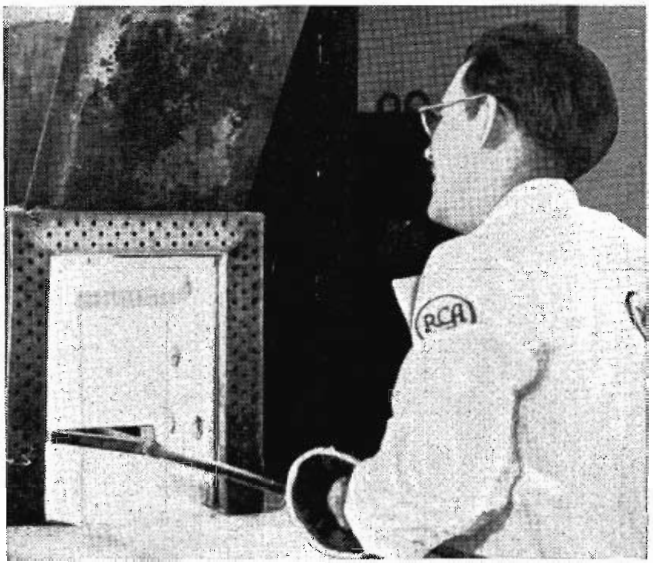
**Electron gun** *which generates the pencil-like beam or "brush," of electrons that paints the television picture on the kinescope's luminescent face.*

# Wonderful peacetime "gun" shoots electrons

**How a pencil-thin electron stream "paints" television pictures on TV screens**

**No. 7 in a series outlining high points in television history**

*Photos from the historical collection of RCA*




**After this white-hot block** *of luminescent material is taken from the furnace, it will be spread on the face of a kinescope to form the screen for television pictures.*

● Though television now is familiar to millions, few know what makes pictures on the screens of home receivers. And little wonder! This, to most laymen, is a highly complex operation.

Many factors are involved, but in home receivers the kinescope tube—developed by Dr. V. K. Zworykin of RCA Laboratories—is undoubtedly most important. The face of this tube is the receiver's "screen." On it, an amazing electron gun paints pictures in motion.

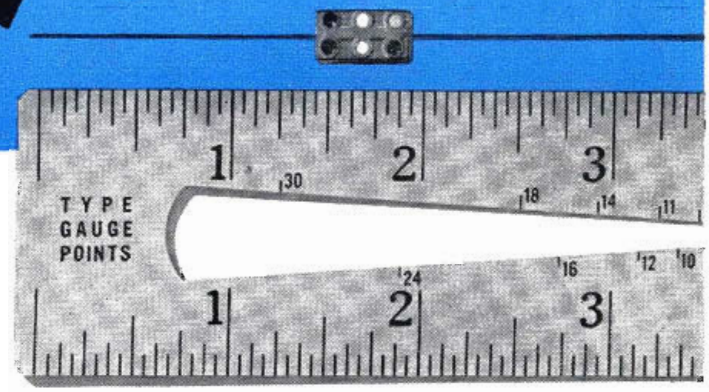
Inserted inside the kinescope—in a vacuum 10 times more perfect than you'll find in any standard radio tube—this electron gun is machined and assembled with watchmaker precision . . . to 1/1000th of an inch. Such care is necessary to assure that the electron stream, emitted by an electrically heated surface, is under perfect control—compressed into a tiny beam, in perfect synchronization with the electron beam in a distant television camera.

In obedience to a signal originating in the camera controls—then telecast and received in your home—this electron beam moves back and forth across the luminescent screen of the kinescope . . . to paint areas of light and shade. In turn, your eye automatically "combines" these areas, and sees a picture!

One of the miracles of all this is that, although the electron beam moves across the face of the kinescope 525 times in a *thirtieth of a second*—not a single mechanical moving part is involved! Thus there is no chance, in a kinescope, of any mechanical failure.

**Radio Corporation of America**
*WORLD LEADER IN RADIO—FIRST IN TELEVISION*

# tiny BUT TOUGH

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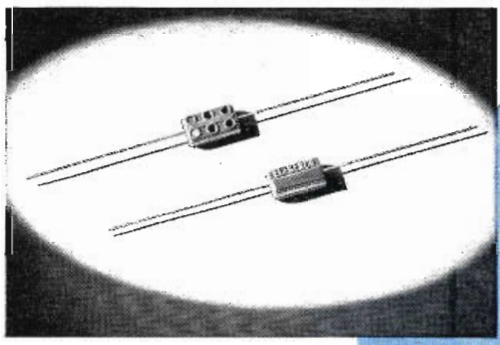
### Built to Stand Up Under Severe Stress and Strain

Fixed mica El-Menco condensers are tiny but tough. They give sustained superior performance under adverse conditions. Pretested at *double* their working voltage, El-Menco capacitors prove their ruggedness *before* leaving the factory.

They are tested for dielectric strength, insulation resistance and capacity value.

When you want peak performance put them in your product. You can depend on El-Menco to stand up under critical operating conditions and extremes of temperature and climate.

*Always Specify El-Menco — The Capacitor That's Tiny But Tough.*



**CM-15**

**THE ELECTRO MOTIVE MFG. CO., Inc.**
**WILLIMANTIC CONNECTICUT**

Actual Size 9/32" x 1/2" x 3/16".
For Television, Radio and other Electronic Appliances.
2 mmf. —420 mmf. cap. at 500v DCw.
2 mmf. —525 mmf. cap. at 300v DCw.
Temp. Co-efficient ± 50 parts per million per degree C for most capacity values.
6-dot color coded.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**MOLDED MICA El-Menco MICA TRIMMER CAPACITORS**

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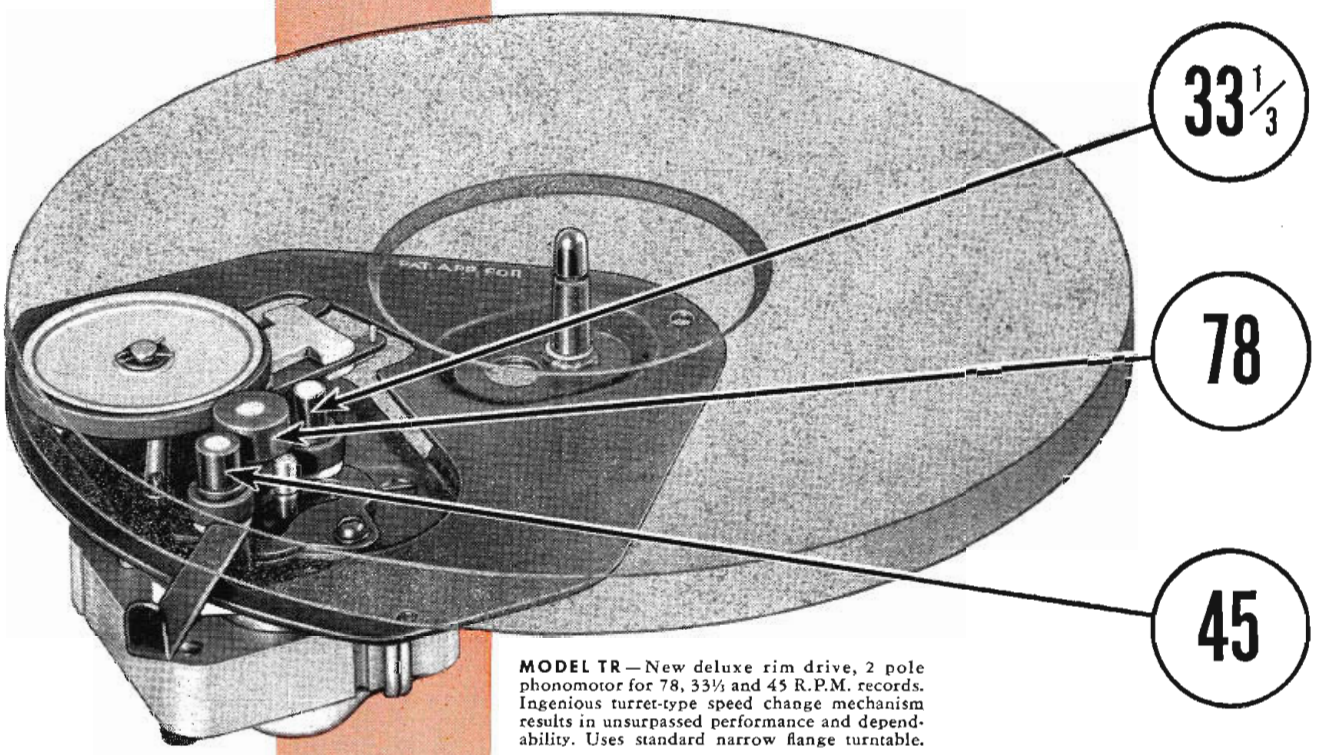
# YOU ASKED FOR IT...

# *here it is!*




**MODEL TR**—New deluxe rim drive, 2 pole phonomotor for 78, 33⅓ and 45 R.P.M. records. Ingenious turret-type speed change mechanism results in unsurpassed performance and dependability. Uses standard narrow flange turntable.

## General Industries' *New* Deluxe
# 3-SPEED PHONOMOTOR

Now . . . in answer to the tremendous demand for a manual version of the popular GI turret model 3-speed record changer motor, General Industries presents the *new* Model TR. Truly the last word in compact 3-speed phonomotors, the Model TR is designed for use in the finest phonographs and radio-combinations.

In addition to the Model TR, General Industries will continue to offer the ever-popular Model TS, 3-speed neoprene belt-driven model for both manual and record-changer use.

Today, as always, General Industries leads the field with the *only* complete line of phonomotors for every record-playing requirement. Write, wire or phone for the latest General Industries catalog containing specifications and description of the full GI *Smooth Power* lineup.

**The GENERAL INDUSTRIES Co.**

**DEPARTMENT L • ELYRIA, OHIO**

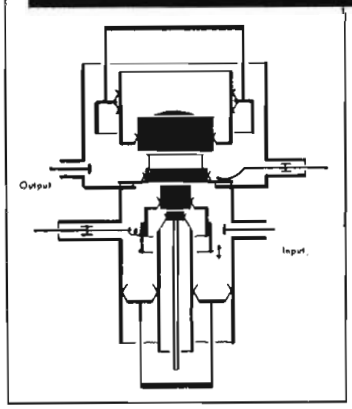
# The new Eimac 4X150G will . .

**DELIVER 20 KW AS A PULSED AMPLIFIER OR OSCILLATOR TO OVER 1200 Mc.**

**GIVE A POWER-GAIN OF 10 AT 1200 Mc.**

**PROVIDE 100 WATTS CW POWER AT 750 Mc. WITH A POWER GAIN OF 8.**




**These illustrations show an example of the simplicity made possible by the 4X150G. The cavity is for a broad-band 1200 Mc. power amplifier for a pulse application. The block diagram indicates the tube line-up of the IPA, tripler, and final PA stages. More detailed data on the 4X150G are available. Please make requests on your company letterhead.**

The 4X150G has been specifically designed to make feasible relatively high power at UHF. It is excellent as an amplifier, oscillator or frequency multiplier in either pulse or cw service. Good efficiency is obtained over a wide range of plate voltages to over 1500 Mc.

Power-gains of 10 are easily obtainable at 1200 Mc. when pulsed, and peak pulsed outputs of 20 kw per tube are possible without extending the tube beyond its maximum ratings.

At lower frequencies, for instance around 750 Mc., the 4X150G operating as a cw amplifier will provide 100 watts output with but 12½ watts of grid-drive . . . a power-gain of 8, with complete stability.

These examples are only indicative of the tube's potentialities. More comprehensive data are contained in a new data sheet, available upon request.

**EITEL-McCULLOUGH, INC.**
**San Bruno, California**

Export Agents: Frazar & Hansen,
301 Clay St., San Francisco, California

Follow the Leaders to Eimac TUBES The Power for R-F

**The 4X150G is another Eimac-developed contribution to electronic progress.**


258


Wherever these famous airliners fly, a trusted group of friendly guides goes with them, in the form of Sylvania Radio Tubes.

For, the dependability, long life, and splendid performance of Sylvania Tubes have won them top preference with radio and electronics engineers throughout this country, as well as abroad.

Sylvania's ruggedized tubes are typical examples of the alert engineering which is responsible for the increasing demand for all Sylvania quality products.

### What is your problem?

Let Sylvania radio research and advanced engineering work for you. If you have problems—as widely varied as the designing of more compact sets, and the overcoming of shock and vibration—put them up to Sylvania. Address your letters to Radio Tube Division, Dept. **R-2408** Emporium, Pa.

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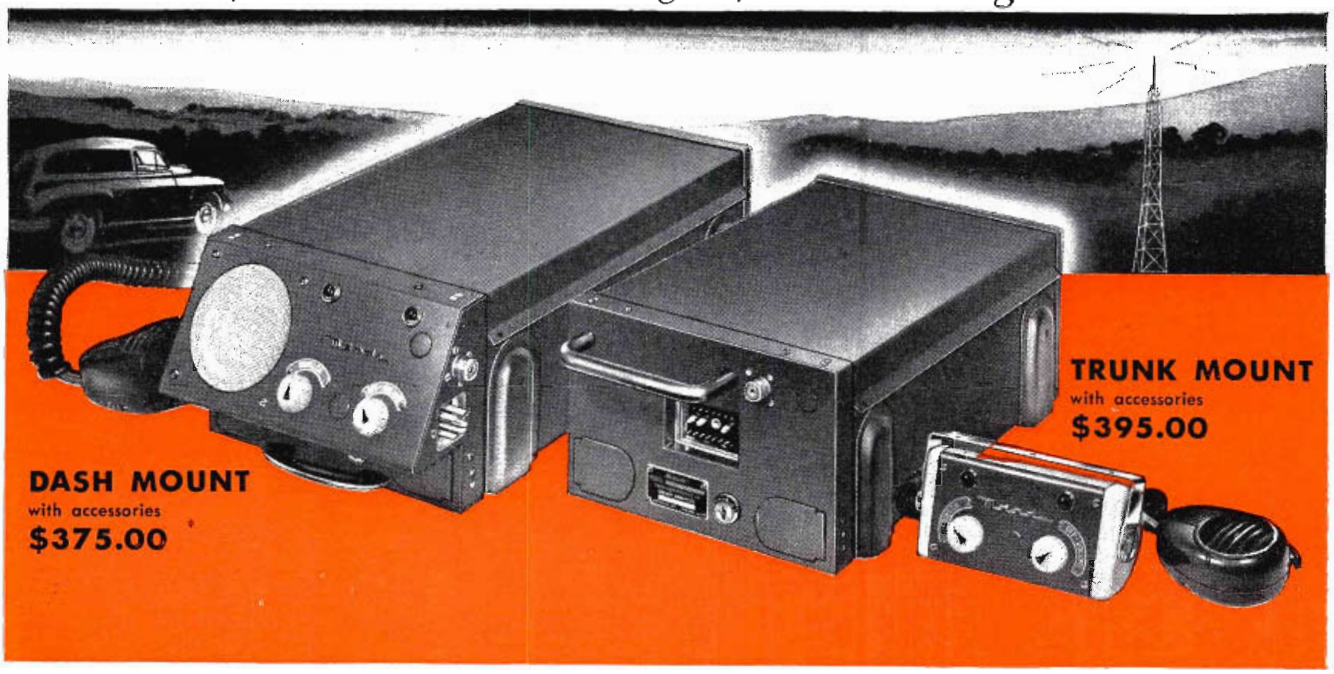
Only Motorola SENSICON can give you *these lasting Values*




## New UNI-CHANNEL SENSICON DISPATCHER—PUTS YOU AHEAD TODAY AND PROTECTS YOU (AGAINST OBSOLESCENCE) BEYOND TOMORROW!

QUICK INSTALLATION
In any of several mounting positions, the complete, permanent installation requires only four screws.

COMPLETE "SHAKE-DOWN" TESTED
——by Motorola's engineering laboratory, the unit undergoes exhaustive tests to meet extreme conditions of service. (Tests made against temperature, humidity, and shock.)

ANTI-DUST HOUSING, with heavy duty construction throughout. Here is truly the all-purpose 2-way radio for every type of mobile application—offering the owner the benefits of advanced design, complete reliability, enduring economy, and freedom from obsolescence.

ENGINEERED for true adjacent channel operation. Available for operation in the 25-50 mc. band and 152-174 mc. band. R.F. power output: 10-12 watts.

Motorola

*plug in antenna and power and you're on the air!*

*Only two quick, simple connections* and you're on the air with a complete 2-way mobile or fixed-station set-up—wherever 6 volt DC or 117 volt AC primary power source is available.

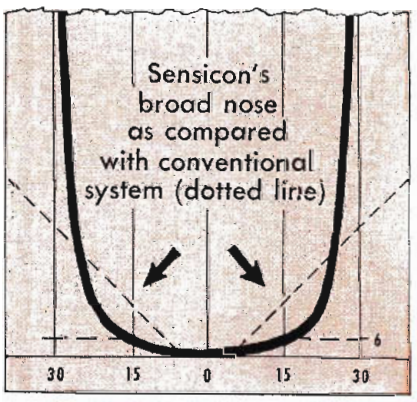
Uni-Channel fits into minimum space in the passenger compartment or trunk of any vehicle. Besides its ease of installation, it is *accessible!* Metering, P.A. tuning, and antenna alignment are done through covered ports in the front panel with the drawer in place. Turn key, pull drawer only one inch to release top cover, and the entire chassis can be lifted out, or, space permitting, pull the drawer-chassis straight out.

The unique and revolutionary Sensicon receiver design with the broad nose and steep skirt characteristic, offers the most practicable solution to adjacent channel operation plus protection against obsolescence for many years to come. It provides full modulation acceptance of ±15 Kc. at 6db. down and full adjacent channel rejection at the skirts.

THE NEW UNI-CHANNEL SENSICON DISPATCHER incorporates all of these Motorola inventions and developments:

- The Sensicon Circuit
- Statomic Oscillotor
- Differential Squelch
- Permakay-10 Wave Filter
- Capacitance Discriminator
- Instantaneous Deviation Control
- Thermally Balanced Crystal Oven

Seven outstanding features combined in one compact chassis to provide finer communication than ever before offered in this price class.




**FM 2-WAY RADIO**

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IT'S ALWAYS BEST TO BUY 2-WAY RADIO FROM MOTOROLA—THE SPECIALISTS IN MOBILE RADIO FOR 20 YEARS. THE WORLD LEADERS IN FM 2-WAY MOBILE COMMUNICATIONS SYSTEMS.


UNDERWRITER APPROVED

★Flame Resistant

★Fungus Resistant

★In Standard R-T.M.A. Color Codes

# HOOK-UP WIRES FOR TV-FM-AM

## AMPLIFIERS and COMPONENTS

**EXTRUDED PLASTIC INSULATED WIRES WITH RAYON, GLASS OR COTTON BRAID**

For complete information on these new Lenz Hook-Up Wires and other Lenz wire and cable products, write Lenz Wire engineers. Specialists, since 1904, in wires and cables for the communications field, they will be glad to submit samples and consult with you on your wire and cable problems.

**LENZ**
**ELECTRIC MANUFACTURING CO.**
1751 No. Western Ave., Chicago 47, Ill.

IN BUSINESS SINCE **1904**

HOOK-UP WIRES • MICROPHONE CABLES • MULTIPLE CONDUCTOR CABLES • SPECIAL HARNESSES • SHIELDED BRAID CABLES

# THE INSIDE STORY:

## WHY SPRAGUE MOLDED TUBULARS OUTPERFORM ALL OTHERS!

Molded paper tubulars may look alike from the outside. But there's a whale of a difference inside—the part that really counts in the performance of your products.

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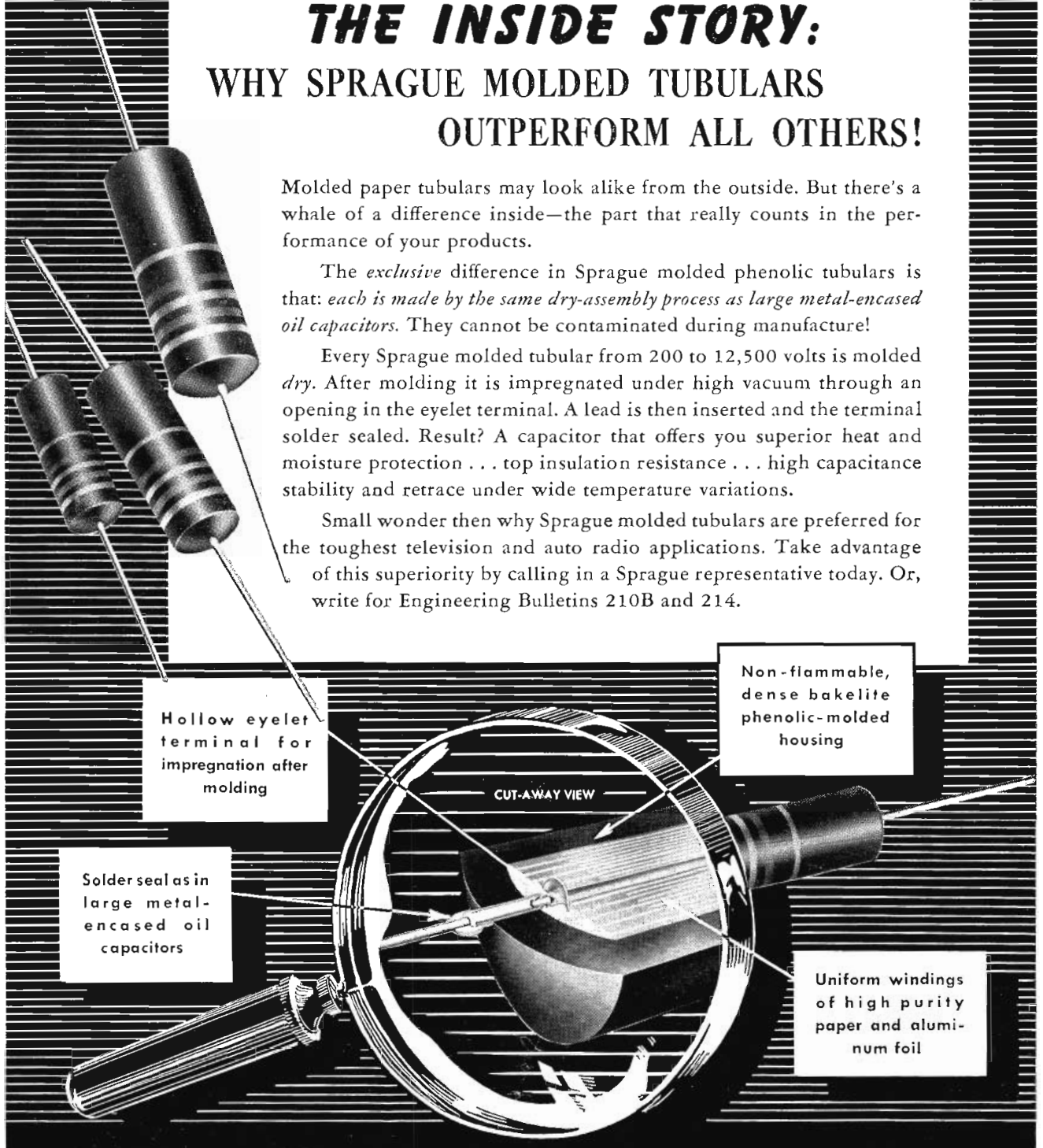
Every Sprague molded tubular from 200 to 12,500 volts is molded *dry.* After molding it is impregnated under high vacuum through an opening in the eyelet terminal. A lead is then inserted and the terminal solder sealed. Result? A capacitor that offers you superior heat and moisture protection . . . top insulation resistance . . . high capacitance stability and retrace under wide temperature variations.

Small wonder then why Sprague molded tubulars are preferred for the toughest television and auto radio applications. Take advantage of this superiority by calling in a Sprague representative today. Or, write for Engineering Bulletins 210B and 214.




**SPRAGUE®**

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

**SPRAGUE ELECTRIC COMPANY**
North Adams, Massachusetts

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

# MILITARY, 20-25%; CIVILIAN, 75-80%

## One-Fifth to One-Quarter of Total Radio-TV Factory Facilities Immediately Needed for Military Production

## Priority Percentages May Run Higher on Shortage Lines

## Vigorous Civilian TV-Radio Output Deemed Desirable, to Insure Healthy National Economy and General Morale

As we go to press, the situation in Korea presents many grave unknowns.

Rearmament on even a minor scale, with its tremendous demands for radio apparatus, is bound to involve acute shortages in raw materials, parts, components, tubes and equipment.

Outright conversion of the radio-TV industry back to full war production is not yet up for consideration. But Washington officials are already studying plans by which radio factories will be called upon to assign, by priority, 20% to 25% of their facilities to military output of short lines.

The remaining 75% to 80% of facilities could then be continued in civilian and commercial manufacture of TV and radio, with all its benefits to our national economy and public morale.

★ ★ ★

Resistors, capacitors and tubes seem to be the controlling shortage factors in the parts group, but informed observers estimate that if these particular industries would allocate 20% of their plants to military output, the Korean campaign would be well taken care of. Percentages for other groups differ. Direct military demands on assemblers and speaker manufacturers would be almost zero. But war outputs of specialty items, including certain cathode-ray tubes, might run up to even 50%. End-equipment makers would render their best services by sub-contracting and spreading of work.

Behind the immediate problem of meeting the needs of the Korean War (with $5 billions earmarked for armament and equipment, — 10% of it radio-electronic, or about $500,000,000 for our industry), our military and industry planners are also working on a general speed-up of radio-electronic output (coupled with a factory-building program using Government funds) to continue over the next few years while international situations continue tense.

★ ★ ★

The manufacturers and engineers will thus be doing their part; distributors and dealers can help by promptly absorbing current production, taking on normal inventories, and facilitating movement of sets and supplies to the public. For in this way, through the great agency of TV-radio (itself measured in billions), a vigorous national economy can be promoted and high-spirited national morale can be maintained.

# The RADARSCOPE

*Revealing at a Glance*

## THE PENTAGON

**FIRST TO BE MOBILIZED**—The Korean military situation had produced so many imponderables at the press-time of this issue of TELE-TECH (the first half of July) that its impact was most difficult to forecast. But the leadership of the Department of Defense and the Armed Services in Washington in informal views to TELE-TECH's Washington correspondent were wholeheartedly agreed that the radio-electronics manufacturing industry was not only well geared to assume its vital role of supplying the all-important electronic-radio-radar weapons for the Korean emergency but also in event of a broader war situation would be one of the first industries to be mobilized for an all-out basis. Such latter, not now contemplated would delay development and production of black-and-white television transmitters and receivers and would certainly doom the projected growth of color television.

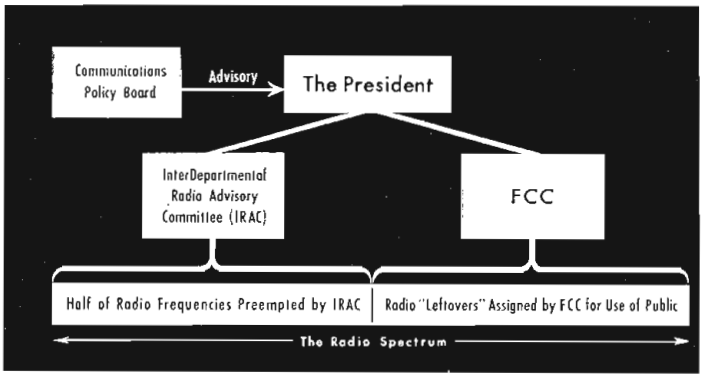
## TV's FUTURE

**AT CROSSROADS** now is the whole future development of TV. The critical turning-point will come before this year-end. For if TV's needed expansion is banished to the little-known UHF regions above 500 MC, difficulties with transmitters, tubes, receivers and down-leads may make development slow. But if space adjoining Channel 13 can be cleared for a relatively continuous TV band, up to say Channel 41 (see front cover), present TV design practices in both receiver and transmitters can be extended, TV operation will be better, and a nationwide TV system could come quickly.

## PRESIDENT'S POLICY BOARD

**UNDER THE RADIO LAW** "first pick" of all radio frequencies required by the Government, is given to the President. Carrying his terrific personal burden, the President turns this technical radio responsibility over to a committee of members drawn from each of the Government departments—IRAC. This Interdepartment Radio Advisory Committee has already gobbled half the radio spectrum, leaving the remaining frequencies to the FCC for assignment to all public and commercial uses. So acute has become this aggression of IRAC, that the President has now appointed a still higher-ranking Communications Policy Board to umpire the demands of IRAC and FCC, as between government and public. This top-side Policy Board will report to the President during October and could reshape TV's whole future by asking IRAC to relinquish frequencies that stand in way of extending the TV band practically continuously to Channel 41. (See pages 22 and 23).

**Place of the President's new Communications Policy Board in Washington radio set-up. See item above; also page 23**




## INTERNATIONAL

**TELEVISION FOR JAPAN**, Western Germany, the Philippines, Turkey and Indonesia, has been proposed by Senator K. Mundt of South Dakota. Technical plans for these installations as presented by the consulting engineers doing the groundwork, call for blanketing each country with TV stations about 50 to 75 miles apart. Direct, off-the-air pickup would relay programs from one end of the country to the other without need for coaxial cables, or other air links. TV would thus be a stupendous addition to the Voice of America in bringing American ideals to these areas. It would, of course, also open up tremendous new markets for American manufacturers of receivers. Probably aided by Government loans, which would remain in this country, to pay for the equipment, the plan would increase the debt owed to America by the world, and be another step in the inflation spiral!

## SUBSCRIPTION TV

PAID BROADCASTING such as Phonevision, "pig-squeal" FM, etc. which can be received only by special groups, are questioned in principle by FCC members in private conversations. They point out that the Radio Law specifies that broadcasts using public channels shall be available to everyone. Phonevision for example, they point out, would be limited to telephone subscribers. Practical answer by Phonevision adherents is that if a TV station carries full program of regular "free" broadcast hours, as required by FCC, its additional "paid" periods cannot in reason be objected to. In Chicago, where Phonevision test in 300 homes this Fall is now being prepared, already more than 50,000 families have applied for privilege of participating.

## NAVIGATION

**RADAR TAKES TO THE GREAT LAKES** on 61 freighters of the Pittsburgh Steamship Company. The final installation of nine vessels not previously equipped with radar completes the protection of one of the largest Great Lakes fleets. Hazards of weather and floating debris in this large inland ocean render use of radar highly desirable for both schedule keeping and safety. The 61 radar installations use equipment manufactured by GE, RCA, Raytheon, and Sperry.

## AUDIO

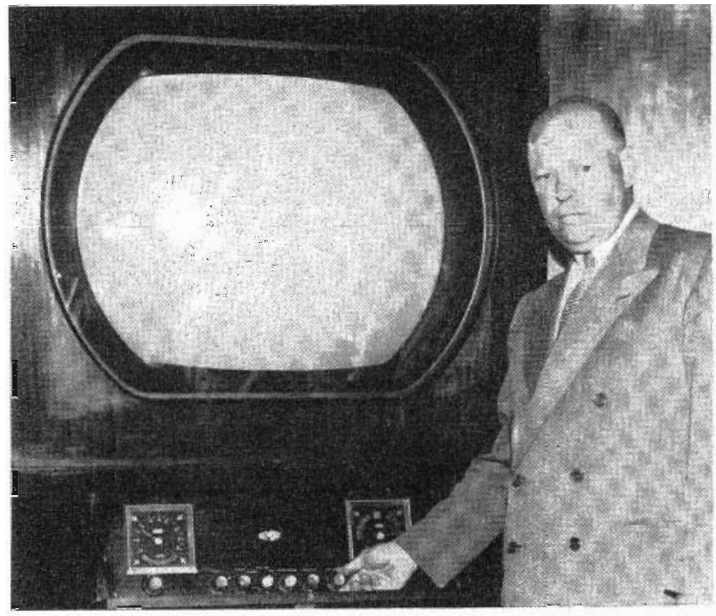
**HIGH-QUALITY**—Comparison of the features in high-quality loudspeakers now being marketed reveals that the idea of having one cone to cover the entire audio range has been pretty well abandoned. Present designs split the spectrum into anywhere from two to four segments and assign a driver unit for each segment. A wide variety of accompanying cross-over networks (mechanical or electrical frequency selective devices which enable one driver to take over control of the audio power from another) are proposed for these speakers but their general design features are varied, being rather simple in some cases and extremely complex in others. While the price of such loudspeakers generally precludes the possibility of their inclusion as a component in home instruments, the trend, nevertheless, is important and appears to be in the right direction, since ultimately many of the better features will be reflected to the benefit of the average consumer.

## TV TUBES

**RECTANGULAR** picture tubes are expected to dominate most lines of new receiver models by the end of this year. The rectangulars, of course, save space and reduce dimensions of cabinets (which cabinets account for 20% of the cost of average sets). In an effort to make comparisons with round tubes, rectangular tubes are still measured in terms of the picture diagonal. Attempts to bring about a future practice of sensibly rating sets in terms of picture width, are meeting with objections from sales managers who do not relish back-tracking in the case of, say, pictures now known as "16-inch", to the more conservative 14 inches or less—which is the real width of such a picture as the home viewer sees it. And there progress toward a desirable reform, in the public's interest, stands blocked.

## SET RADIATION

**INTERFERENCE IS THE KEYSTONE** of the FCC-industry discussions leading to the establishment of adequate standards to assure a workable TV allocations plan. Receiver radiation, already a problem on VHF, becomes doubly important at UHF. While for VHF an RF stage is effective in reducing radiation, RF stages at UHF are difficult to design, and do little to isolate the local oscillator. The NTSC has to make the best compromise between a high IF to reduce image response and associated troubles, and the fact that, at present, IF's in the VHF range of the order of 120 MC. are not simple to design or manufacture. It seems that the allocations plan must depend on the IF to keep receiver radiation off local channels. But a much more important aspect is safety of life. The radiation from FM sets in Crawfordsville, Ind., causes interference with the VOR at Lafayette, Ind. In fact the FCC is reported to be going to court on this case to establish exactly what powers it has under the Communications Act. Although loath to do it, FCC may be compelled to regulate receivers, and it is not inconceivable that Part 15 of the Rules may contain legislation controlling receiver radiation.



Dr. Allen B. Du Mont with his new biggest television tube, the 30-in. giant in the Du Mont "Club 30". The new tube, to be in production this Fall, gives a 536-square-inch direct-view picture

## CIRCUITS

**RE-INVENTION VS. RECORDS**—Permanent records of now unclassified developments in book form (often expanded into many volumes) are continuing to appear during recent years. We can assume that this information will prevent a recurrence of the practice of reinventing circuits and even systems whenever an emergency requires that a development program be carried out at an accelerated rate. Glancing through these books will show the unintentional but almost complete disregard to the placement of credit to the prewar originators of most of the special, clever, means-to-an-end circuit expedients found useful. The reason for this is clear—in many projects, the past art was inadequately described and the war emergency did not require worrying about patent coverage. One moral is this—useful circuits may be well protected by patents, but full credit to their originators best comes from an adequate description in the current technical magazines. The many abstracting services then will see to it that attention is called to those developments and their authors.

# War Mobilization of

## How military communication materiel requirements can be made to reflect the

*By COL. W. H. TETLEY, USAF,*
*Air Force Director, Electronics Div.*
*Munitions Board, Washington, D. C.*

IN our search for the appropriate planning factors to insure thorough support of a war plan, we are concerned not only with the position of an industry in the economy, but also with the industry's internal structure. The mere ability to support the industry as a whole is insufficient to guarantee that the end items will be available in the types and quantities necessary to support a war effort. The structure of the industry must be analyzed to insure that all its members are properly stressed.

Three general factors govern the degree with which the mobilization needs are satisfied, the economic potential of the nation, the productivity of the industry, or the scope of the military requirements. It seems logical that the military requirements will be properly adjusted to fall within the capabilities of our overall economy. When this is done, the onus is on industry to produce in the most efficient manner possible. Manufacturers may find themselves squarely in the middle with exacting requirements on one hand and a limited economy on the other. Thus, it is important that the structure of the industry itself, as well as its position with respect to other industries, be matters of serious concern for the logistics planner.

When dealing with the position of the radio-TV industry in the family of war industries it can be considered as an integrated activity which absorbs goods and services from the economy and produces in turn specified end items for the maintenance of the domestic economy and the war effort. The industry is presented with a specific bill of goods which it must produce, and, in turn, it submits its own bill of goods to the overall economy.

Other industries likewise make their demands on the economy based, in turn, on the demands made on them for products. The balancing of requirements in the right proportions to support different war plans is an important function of the three armed services. There still remains the laborious task of translating the various requirement patterns into raw materials and producer goods. The problem of balancing the supporting inputs to the many industries producing for the war effort rests with National Security Resources Board. The importance of computing industries' requirements quickly and accurately with changing trends requires that a method for predicting the repercussions wrought by sudden changes be developed.

### Input-Output System

*The article entitled "War Mobilization of Radio-TV Manufacturers," appearing in the June issue of TELE-TECH, showed the tremendous importance of preparedness planning and of stockpiling. This accompanying article, in reviewing the principles of the Leontief Input-Output system, provides a more quantitative analysis for gauging the large production volumes, plant expansions and conversions needed in the event of a National Emergency.*

### Intra-relationships

Just as the overall economy can be divided in to industrial sectors to aid in the study of its structure, so can the individual industries. A method known as the Leontief Input-Output method has been adopted by the Bureau of Labor Statistics for analysis of the economy; consequently, it seems logical to scrutinize this method with a view to adopting it to the analysis of a single industry.

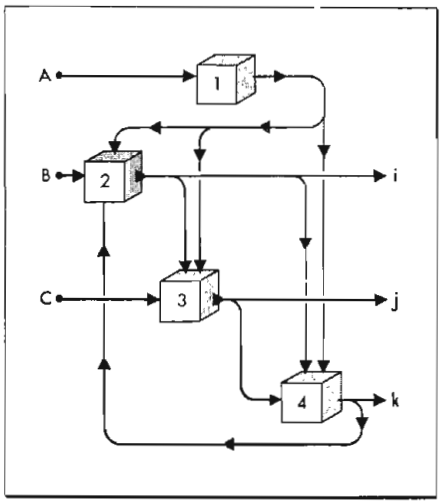
Referring to Fig. 1, let us assume that the industry is divided into four segments as shown by the four boxes. The size of the present radio-TV industry would require far greater subdivision than this, but four sectors will illustrate the procedure to be followed.

The industry absorbs goods and services, A, B, C, from the economy and produces end products, i, j, k, to satisfy a specific bill of goods. It can be seen that activity 1 must produce goods for activities 2, 3, and 4, and that activity 4 produces goods for 2 in addition to satisfying its share of the bill of goods. Any change in the amount of k imposed by a change in the bill of goods will have repercussions in sectors 1, 2, 3, 4, as well as affecting industry's demand on the economy.

Assume now, that the activity in box 2 consists of all the manufacturers of cathode ray and television tubes. Further, that the activity in box 1 consists of all manufacturers making the special glass used in these tubes. Both groups of manufacturers require manpower, raw materials, and utilities from the economy. The tube people, in addition, however, require glass from the activity in box 1.

Recently, the tube activity produced almost $102,000,000 worth of tubes during a given time period. The glass activity in turn furnished to the tube people some $25,500,000 worth of glass. Thus, for every unit

Fig. 1: Elementary division of Radio-TV Industry showing intra and inter-relationships



# Radio-TV Manufacturers—II

## *amounts of raw material, plant facility, and production required*

of its output, activity 2 absorbed 0.24 of a unit of activity 1's output. The quantity 0.25 is known as the technical input coefficient and is designated in this case by $a_{21}$ (i.e., the proportion of 1's output absorbed per unit of 2's output). $a_{21}$ when multiplied by the total output of activity 2 gives the total amount of type glass required by the tube sector during a specific time period. Under the heading "Linear Programming" there is a discussion of time lags associated with these coefficients. It is often necessary for sector 1 to produce the glass many months before it is reflected as finished tubes in 2's output.

TIME PERIOD

Table I

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Y_1$ | 0.24 | 0.22 | 0.21 | 0.23 | 0.20 | 0.15 | 0.10 | 0.15 | 0.20 | 0.25 | 0.20 | 0.15 | 0 |
| $Y_2$ | 0.00 | 0.00 | 0.00 | 0.18 | 0.19 | 0.20 | 0.20 | 0.2 | 0.3 | 0.4 | 0.5 | 0.5 | 0 |
| $Y_3$ | 0.00 | 0.00 | 0.00 | 0.10 | 0.15 | 0.20 | 0.25 | 0.29 | 0.35 | 0.35 | 0.35 | 0.35 | 0 |
| $Y_4$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.15 | 0.17 | 0.19 | 0.22 | 0.23 | 0.23 | 0 |

Table I (above) and Table II (below) list values for requirements (Y) and outputs (X) for scheduled deliveries of air-sea rescue sets as set forth in numerical problem

Table II

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $X_1$ | .316 | .440 | .476 | .518 | .542 | 0.513 | 0.574 | 0.632 | 0.625 | 0.250 | 0.200 | 0.150 | 0 |
| $X_2$ | | | | .213 | .290 | 0.257 | 0.263 | 0.273 | 0.377 | 0.477 | 0.500 | 0.500 | 0 |
| $X_3$ | | | | | .167 | 0.225 | 0.278 | 0.323 | 0.388 | 0.388 | 0.388 | 0.350 | 0 |
| $X_4$ | | | | | | 0.10 | 0.150 | 0.170 | 0.190 | 0.220 | 0.230 | 0.230 | 0 |

### The Leontief Method

The input-output technic has been developed to a high degree by Prof. Wassily Leontief of the Littauer School of Public Administration, Harvard University. The application of linear planning (a generalization of the Leontief method) to logistics has been developed by Marshall K. Wood and George G. Dantzig of the Office of the Air Force Comptroller. While this analysis indicates a powerful mathematical method, it must be implemented by the accession and maintenance of comprehensive tables of interrelated coefficients; as well as the construction and programming of large-scale electronic computers.

In the simplest case the input-output theory envisions an activity or system of activities producing from certain goods and services (input), other goods and services (output).

Let us consider the example of a system of activities engaged in the manufacture of the potted electronic-sub-assembly of the air-sea rescue set. For the sake of the example, this system is isolated from the remainder of the industry except for producer goods[1], component parts, and electron tubes. It will be assumed that the producer has on hand skilled labor, plant, and facility (capital assets). The manufacturers of the component parts and of electron tubes will also require producer goods.

The monetary value of the total producer goods created during a specific interval of time can be represented by $X_1$. This amount is split four ways: an amount, $x_{21}$ of it is used by the component parts people, $x_{31}$ is used by the electron tube people, $x_{41}$ is used by the set producer himself, and $Y_1$ is diverted and used outside the system for other purposes. We can say then:

$$(I)\quad X_1 - x_{21} - x_{31} - x_{41} = Y_1$$

Likewise, if $X_2$ is the dollar value per unit time of the total component parts produced, $x_{12}$ and $x_{42}$ are the amounts absorbed by the raw materials people and the set people, respectively. The amount $Y_2$ is then the balance to be used elsewhere. Thus, we can say also:

$$(Ia)\quad X_2 - x_{12} - x_{32} - x_{42} = Y_2$$

Similar equations can be set up for $X_3$, representing electron tubes, and $X_4$, representing the set assemblies. This gives us a system of four simultaneous equations containing twenty quantities.

In order for such a system to be determinate, only four out of the quantities can be unknowns. Consequently, if we wish to calculate $X_1$, $X_2$, $X_3$, $X_4$, the respective outputs of the various agencies contributing to the manufacture of air-sea rescue sets, we must know all the remaining quantities. This brings us to the interdependence coefficients (Leontief calls them technical input coefficients). Accordingly, let $a_{21}$ represent the value of producer goods (activity 1) absorbed by the component parts people (activity 2) per unit of component parts output.

Thus $a_{21} = (x_{21})/(X_2)$, and it is termed the technical input coefficient of product 1 with respect to activity 2. This gives us the following new information in the form of 12 additional equations:

$$(II)\quad x_{21} = a_{21}X_2,\ x_{31} = a_{31}X_3,\ x_{41} = a_{41}X_4,\ \text{etc.}$$

Substituting these relationships into the original set of equations we obtain for $Y_1$ (raw materials), $Y_2$ (component parts), $Y_3$ (electron tubes) and $Y_4$ (air-sea rescue sets):

$$(III)\quad \begin{aligned} X_1 - a_{21}X_2 - a_{31}X_3 - a_{41}X_4 &= Y_1 \\ -a_{12}X_1 + X_2 - a_{32}X_3 - a_{42}X_4 &= Y_2 \\ -a_{13}X_1 - a_{23}X_2 + X_3 - a_{43}X_4 &= Y_3 \\ -a_{14}X_1 - a_{24}X_2 - a_{34}X_3 + X_4 &= Y_4 \end{aligned}$$

If we possess tables of the various input coefficients and can estimate our external requirements of raw materials, component parts, electron tubes, and rescue sets, we can readily calculate the amount each activity or sector of the industry must produce to satisfy the complete bill of goods.

Examination of the relationships between activities reveals that many of the coefficients will be zero; i.e., the raw materials, component parts, and electron tube people have no requirement for rescue sets; neither do the raw materials people use component parts or electron tubes.

Let us assume that our external requirements for a unit period are as follows:

$Y_1$ = stockpile of raw materials
= 0.1 million dollars/month

$Y_2$ = replacement component parts = 0.2 million dollars/month
$Y_3$ = replacement tubes = 0.25 million dollars/month
$Y_4$ = sets expended in training/storage

Let us further assume that a census of the industry reveals the following technical coefficients:

$a_{21} = 0.5$, $a_{31} = .5$, $a_{41} = 0.166$, $a_{42} = 0.333$, $a_{43} = 0.166$

As a result we obtain:

$$\begin{aligned} X_1 - 0.5X_2 - 0.5X_3 - 0.166X_4 &= 0.1 \\ 0 \quad X_2 - 0 - 0.333X_4 &= 0.2 \\ 0 \quad 0 \quad X_3 - 0.166X_4 &= 0.25 \\ 0 \quad 0 \quad 0 \quad X_4 &= 0.15 \end{aligned}$$

Giving us: $X_1 = 0.3875$, $X_2 = 0.250$, $X_3 = 0.275$, $X_4 = 0.150$. These are the amounts each sector must produce to support the rescue set program plus the stockpiling and replacement needs.

Admittedly, the problem just discussed was a trivial one. The number of unknowns, $X_i$'s, was four and the agencies absorbing producer goods, component parts, and electron tubes was restricted.

A more general statement of the Leontief theory is necessary when we consider the problem of industrial expansion and linear programming. In the general case the industry will be divided into m sectors or groups of activities, the net outputs of which will be represented by $X_1, X_2, X_3, \ldots X_m$.

We may now write the general form of equations (III):

$$\begin{aligned} & X_1 - a_{21}X_2 - a_{31}X_3 - \ldots - a_{m1}X_m = Y_1 \\ & -a_{12}X_1 + X_2 - a_{32}X_3 - \ldots - a_{m2}X_m = Y_2 \\ (\text{III}) \quad & -a_{13}X_1 - a_{23}X_2 + X_3 - \ldots - a_{m3}X_m = Y_3 \\ & \cdots\cdots\cdots\cdots \\ & -a_{1m}X_1 - a_{2m}X_2 - a_{3m}X_3 - \ldots + X_m = Y_m \end{aligned}$$

Knowing the coefficients and the $Y_i$'s ($Y_1\ Y_2 \ldots Y_m$ = the specified bill of goods) we can compute the $X_i$'s of the separate sectors of the industry. It is unlikely that the radio-television industry can support the war requirements without expansion; consequently, the static model represented by (III) must be augmented by a dynamic model.

The capital goods of the electronic industry fall into many classes which must be grouped into sectors and treated as activities in the dynamic model. Skilled labor, special machinery, test equipment, structures, and stocks of producer goods, must all be considered. Thus, the activity producing resistor moulding

(*Continued on page* 62)

## Condon Committee Urges Single Color-TV Standard

The United States Senate's "Advisory Committee on Color-TV," set up a year ago by Senator Johnson of Colorado, reported to the Senate July 10 that color television may be safety authorized now, but that only one system should be adopted. Unsatisfactory experience with multiple standards in England was cited, where owners' investments in receivers for the superseded systems were eventually wiped out.

Headed by Dr. Edward U. Condon, Bureau of Standards chief, the committee asserted:

1. Color TV can be handled within the bandwidths now assigned to black-and-white.
2. Three systems—Radio Corp. of America, Columbia Broadcasting System, and Color Television, Inc., are available in the 6-ms bandwidth.
3. Because of wide differences in engineering details, the three systems are "mutually exclusive—one and only one must be chosen for general licensing."

While the Condon "committee of experts" avoided recommending any choice of the three systems, their report commented frankly on characteristics observed with each.

The CBS system, the report summarized, is not compatible; gives poorer resolution than black-white; displays flicker brightness five to ten times inferior, compared with black-white; shows color fidelity that is at present superior to other systems, although this advantage is lost when electronic methods are substituted, and provides for converting existing 12-inch receivers and smaller.

The RCA system is compatible; shows resolution equal to present black-white (finest details in gray, larger in color); has flicker brightness equalling black-white; at present shows uneven color balance in large areas and "color crosstalk" in small areas; channel-utilization effectiveness is highest of all; but involves inability to convert existing sets to color, except at substantion cost.

## Technical Notes on Extending Present VHF TV Band

THE question of how to expand TV becomes more pressing every day. Thus far all attention has been focussed on utilization of the UHF channels. However, if TV allocations could be extended in the VHF band many advantages would result. Among these advantages would be close positioning of TV channels, reduction of manufacturing costs due to easier construction, and better propagation characteristics.

Two major UHF allocation plans have been suggested by the FCC and Allen B. DuMont.

The FCC plan proposes 42 UHF channels plus 12 existing VHF channels. Balance of the UHF spectrum to be used for experimental work. DuMont proposes 48 UHF channels, plus the 12 existing VHF channels, the balance of UHF to be used for educational and community services on a first-come basis.

An alternative plan which would provide a total of 28 more channels for TV is outlined in the following paragraphs. It would entail certain frequency shifts, but these would not be extensive, and the benefits produced would much more than outweigh the minor disturbances. The plan envisages movement of most of the little used government services in the band 216 MC to the UHF band and extension of TV into this area thus vacated.

If the spectrum space from 216 MC to 328.6 MC were allotted to TV it would provide 18 more channels, plus 4.6 MC which could be assigned to the amateurs in lieu of the present band 220 to 225 MC — this could be moved to 222 MC to 226.6 MC.

The Government band 216 to 220 MC is used for telemetering, government, and aircraft phone work (fixed and mobile). The band 328.6 to 335.4 MC is used for essential aero glide path equipment and could not be touched. 335.4 to 400 MC is now used for government, civil air stations, and contract developmental stations. 10 TV channels could be placed here leaving 4.6 MC available for government and other use. This would provide a total of 28 additional channels and a grand total of 40 channels—14 short of the proposed FCC plan utilizing the UHF in addition to the VHF band.

Based on FCC's figures of 3200 TV stations provided by 600 VHF, 1600 UHF and 1000 community stations obtained from 48 channels, about 2,000 stations could probably be allocated; this would be many more than will be on the air

# A Continuous Band of 40 Channels For Television!

## President's Policy Board Is Urged to Have IRAC Release Little-Used Government Frequencies so FCC Can Assign TV a Continuous Extension Up to 395.4 MC

*Compared with various UHF Proposals—*

## TELE-TECH'S Plan Would Give Public Better TV Reception, Larger Service Areas, Cheaper and More Efficient Receivers, More Effective Transmitters, 2000 TV Stations!

A Letter to the President's Communications Policy Board—

Dr. Lee A. DuBridge, University of Southern California, Pasadena
Dr. W. L. Everitt, University of Illinois, Urbana
Dr. James R. Killian, Mass. Institute of Technology, Cambridge
David H. O'Brien, ex-VP Graybar, ex War Assets Administrator
Dr. Irving L. Stewart, ex FCC Commissioner, W. Va. University, Morgantown

Gentlemen:

Your Board in the next 60 days can accomplish untold benefits for the public and television. You —and you alone— can clear the way for an adequate continuous thoroughfare for this great new TV service to the American people.

This means that television should be granted a practically continuous tuning band extending upward from channel 13 through channel 41 as shown by accompanying chart. (See front cover)

Such a continuous TV band will mean better TV reception for the public, wider areas of good reception for each station, cheaper and more efficient receiving sets, and more economical transmitters delivering adequate signals with less power — as compared with present proposals to ban TV to the little-known UHF region. The 40 channels we propose will provide for approximately 2000 TV stations, surely enough to take care of all foreseeable requirements for years to come.

Nothing stands in the way of this desirable solution of the television problem except a few minor Government installations on channels preempted by IRAC, but little used. Such Government installations could be readily transferred to the UHF, for which they are best adapted. (Already IRAC has earmarked one half of the entire radio spectrum leaving to FCC and the general public only the remaining half. Actually the Government in peacetime needs only a tenth of the spectrum for experimentation and practice. For in case of war, the whole spectrum automatically goes over to Government control).

In your coming report to the President of the United States which at his direction your Board is now drafting, we urge that you recommend that by Presidential Order IRAC be instructed to release those little-used or unused channels which stand in the way of a practically-continuous TV band from Channel 7 to Channel 41, — thus authorizing FCC to allocate these channels for TV use.

This would be a priceless vital move in the public interest, to help Television fulfil its now-evident role as the most tremendous service rendered by radio to present and future millions of American families.

Television's future stands now at the crossroads! You can steer it away from UHF unknowns, and into channels where it will have greatest immediate development and usefulness.

*Editors* TELE-TECH

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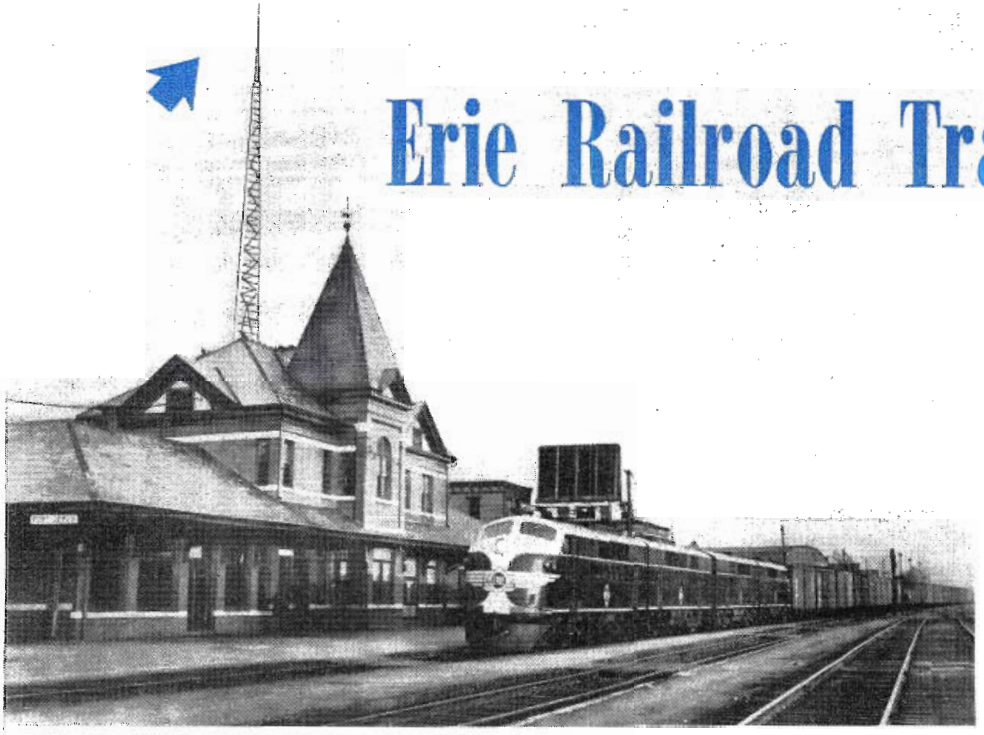
in the foreseeable future.

If these frequencies were released by the military and government services a corresponding, or even greater, number of frequencies could be relinquished by the TV industry in the UHF bands above 500 MC where the definite line of sight properties of UHF would not be the same deterrent to government services as for TV broadcasting.

Among the problems facing both allocations engineers, and manufacturers' receiver design engineers, are those of adequate image suppression and oscillator radiation. Operation on the UHF increases these problems since RF stages are much less efficient in suppressing radiation from local oscillators, and at UHF many parts of the receiver which formerly were "dead" become efficient resonators. Although 41 MC was standardized recently as the i-f for TV receivers, discussion is continuing among the groups responsible for allocations and i-f standards concerning the advisability of moving to an i-f in the region of 120 MC. This is another problem which can be laid to the use of UHF.

# Erie Railroad Traffic Control

By JOHN H. BATTISON
*Associate Editor*



***Radio maintains contact with trains over 1000 miles of track through many types of terrain; speeds handling***

THE Erie Railroad four-way train radiotelephone communications system is unique in that it was developed especially to suit the route requirement needs. It is the first, and largest, comprehensive main line system in the world, covering 884 miles or more than 85 per cent of the territory between New York and Chicago. It gives excellent results in providing dependable service between Chicago and New York and has effectively increased safety and efficiency.

Fig. 1. Freight train conductor in caboose communicating with engineer in diesel loco over a mile away at head end of train.

In order to understand the problems involved it is necessary to describe the present Erie Railroad system. It extends for 999 miles from Chicago, through Huntington, Ind., Marion, Akron and Youngstown, O., Meadville and Corry, Pa., Jamestown, Salamanca, Hornell, Corning, Elmira, Binghamton and Port Jervis, N. Y., to Jersey City, with ferries to New York City, and lighterage service throughout the entire harbor area. Principal branches extend to Scranton, Pa., Rochester and Buffalo, N. Y., and Cleveland and Cincinnati, O.

Forming a 50-foot railroad right of way, the Erie winds out of Jersey City for a thousand miles to the west. It proceeds through topography which is typical of northeastern and many western railroads, and operates through intervening land elevations and high structures in industrial areas. The mountainous and rolling country extends for more than 700 miles to Marion, Ohio. West of Marion, through Indiana and part of Illinois, the terrain is flat prairieland.

The problem was to provide, throughout such terrain, continuous radiotelephone communication in accomplishing the following:

1. *Between Locomotive and Caboose*: Many train delays are caused by "hot-boxes" (overheated journals). With radio, the crew can bring the train to a normal stop at a location where it can be started later without trouble.

2. *Between Trains and Fixed Stations*: On each division, averaging 100 miles, a dispatcher directs the movements of his trains by means of a special wire telephone circuit which extends over his entire territory. All important way stations and signal towers are connected to the dispatcher's circuit. It is in effect a long party line over which the dispatcher can selectively call any one of his offices to give orders or to obtain information.

3. *Train-to-Train*: When trains pass each other, crew members observe each other's train and engine and caboose crews exchange information indicating "all clear" or any trouble noticed.

Only the receivers are normally connected to the line. Any station operator can listen in or report trains by using a push-to-talk switch.

4. *Station-to-Station*: Ice and snow often pile up on telephone wires causing them to snap. Many hours are spent while broken wires are located. During this time trains must be stopped or restricted to give crews time to act in any emergency. Radio "patches" eliminate or reduce this form of trouble.

## Tests in 1945-46

In 1945 and 1946, Erie conducted tests of inductive carrier and both AM and FM space radio requirements along sections of the right of way. It was concluded that there were further needs from the standpoint of maintenance with respect to size, weight and interchangeability of equipment. Also, it was obvious that special equipment and circuits were needed to meet remote control requirements in main line operations.

Space radio was deemed preferable to the inductive system because of lower power requirements and independence from continuous lines in close proximity to the tracks. FM was selected because of its freedom from static and noise from electrical equipment on trains.

In February, 1947, arrangements were made with the Farnsworth Television and Radio Corp. to con-

# Operations Aided by VHF-FM

duct a prolonged test (1) to determine the most practicable type of train communication; (2) to design the equipment required.

Seven base stations were set up between Marion and Kent, Ohio (115 miles) and a freight diesel-electric locomotive and caboose were radio equipped. More than a year of experimentation followed in which the Erie main line system was developed.

In July, 1948, the newly-developed system was placed in service over three divisions from Marion to Salamanca, N. Y., involving a main line coverage of 360 miles. Equipment included nine freight diesel locomotives, seven passenger diesels and 15 cabooses. In locomotives, the cabs at each end were individually radio equipped for greater safety. A total of 47 mobile stations and 15 base stations were equipped.

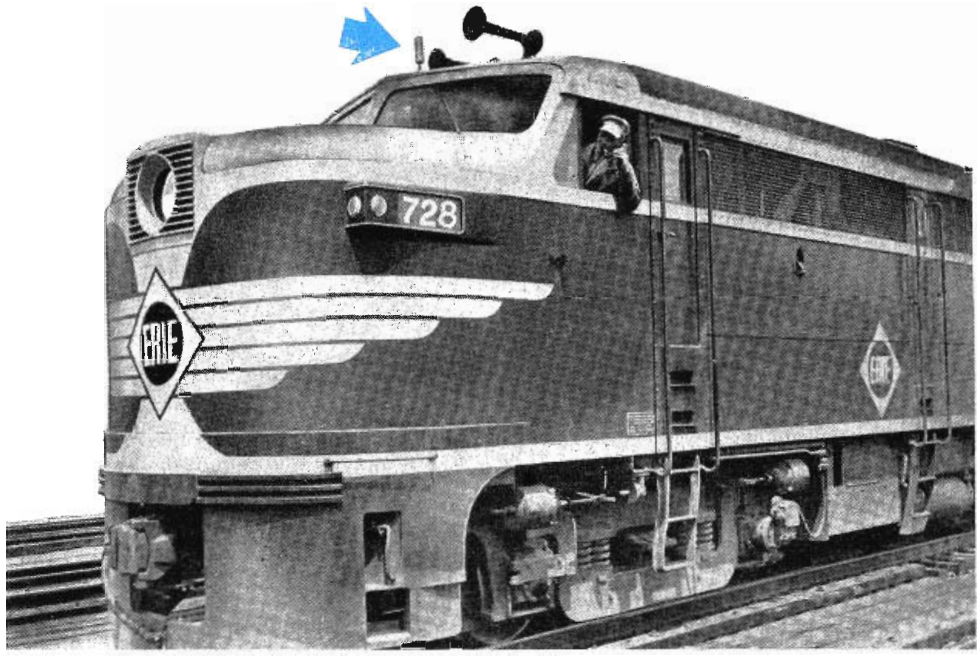



Fig. 2. Erie diesel, VHF antenna indicated by blue arrow. This folded quarter-wave antenna and the colinear antenna indicated by blue arrow on Port Jervis tower, at left, possess substantially similar characteristics and are interchangeable standard equipment.

## Base Station Operation

The base stations operate with a radiated power of 15 to 20 watts at 160.05 megacycles. They are located along the right of way to facilitate maintenance and provide progressively continuous communication between trains and the nearest base station control office and also between adjacent base stations. The rolling topography in that area permits a spacing of 13 to 32 miles between stations.

The most efficient site for a base station seldom coincides with the 24-hour wayside office from which it must be controlled. Therefore, several of the stations are remotely-controlled by wire from a 24-hour office. Others, at distances from 18 to 28 miles, are inductively coupled to existing wayside wires.

Mobile stations use both channels of the dual frequency equipment, with Band "A" at 160.05 mc. and Band "B" at 159.09 mc. "A" is used normally (1) between the head and rear of trains and for Walkie-Talkies; (2) between train and nearest wayside station; (3) between trains within range, and (4) between adjacent base stations.

The base station control office hears all rush communications within its range and takes prompt action with the train dispatcher in emergencies and in other circumstances. When desirable, the dispatcher can be connected at any one of the base station control offices to communicate directly within the range of that station. Also if wire communications are interrupted a radio link may be inserted to restore the dispatcher's circuit.

If band "A" is in use and another train has an emergency call the conductor interrupts momentarily with an emergency request to his diesel to switch to Band "B". Both then switch to "B". By returning their handsets to the hook, the cab and caboose radio stations are automatically restored to band "A".

The typical locally-controlled wayside station is equipped with a wall rack holding the light-weight, low-powered transmitter, the receiver, power and control units. On the desk is the control console enclosing the loud speaker. Where the radio station is remote from the control office, the rack-mounted units are housed in a small concrete or steel house at the foot of the antenna mast.

The control unit uses a 0.3 volt 60 cycle tone to operate the remote equipment. When the press-to-talk button is pressed this voltage passes through a low pass filter and is amplified, rectified and energizes a relay. When the transmitter is on the air a 90 volt dc simplex circuit in the control phone line operates an indicator at the control point. Replacing the handset automatically shuts off the transmitter and restores the frequency selector to "A" band if "B" band has been used.

Because all units are of plug-in type, they are easily replaced. All main line diesel locomotives and cabooses operate through Marion, O., or Hornell, N. Y., where all radio

Fig. 3. Despatcher at way station. Control console houses speaker, radio equipment is mounted on wall.

## ERIE (Continued)

equipment is inspected regularly.

Station units are serviced and maintained by the division telephone maintainer. When failures occur at base stations, he replaces the unit with a spare and ships the defective equipment to the radio shops where an FCC-licensed radio technician makes all transmitter adjustments.

Early in 1949 the Erie extended the main line radio system to the east from Salamanca. The route covers four divisions to the rail terminal on the Hudson River at Jersey City. This project increased the main line radio coverage by 524 miles, and added 14 radioized four-unit freight diesels, seven single unit passenger diesels, and 20 cabooses, a total of 55 mobile stations. Twenty-three additional diesel passenger and freight switchers in the New York commuter service and on the Buffalo and Rochester divisions are in process of radio installation.

Thirty-eight base stations provide continuous communication between trains and wayside stations over a total of 884 miles of track between Marion, O., and Jersey City.

East of Salamanca the terrain was more rugged than that of the Western District. Extensive radio exploration was necessary to determine the most efficient sites for the base stations. Tentative locations were selected following an intensive study of U. S. topographic maps covering the area involved.

The final sites were determined with the aid of a maintenance-type radio-equipped exploration truck, fitted with a 40-foot aluminum extension ladder. The upper section of the ladder was fitted with a sliding aluminum pipe having a fixed-station antenna attached to the top end. When elevated at a tentative base station site, a height of approximately 63 feet was obtained. As trains approached the radio range during the tests, contact was established and an engineer aboard the diesel held the depress-to-talk button. The variation in signal strength was read and plotted from a vacuum tube voltmeter connected to the receiver in the truck. The diesel reported as it passed each mile post, determined if it had been

(*Continued on page 45*)

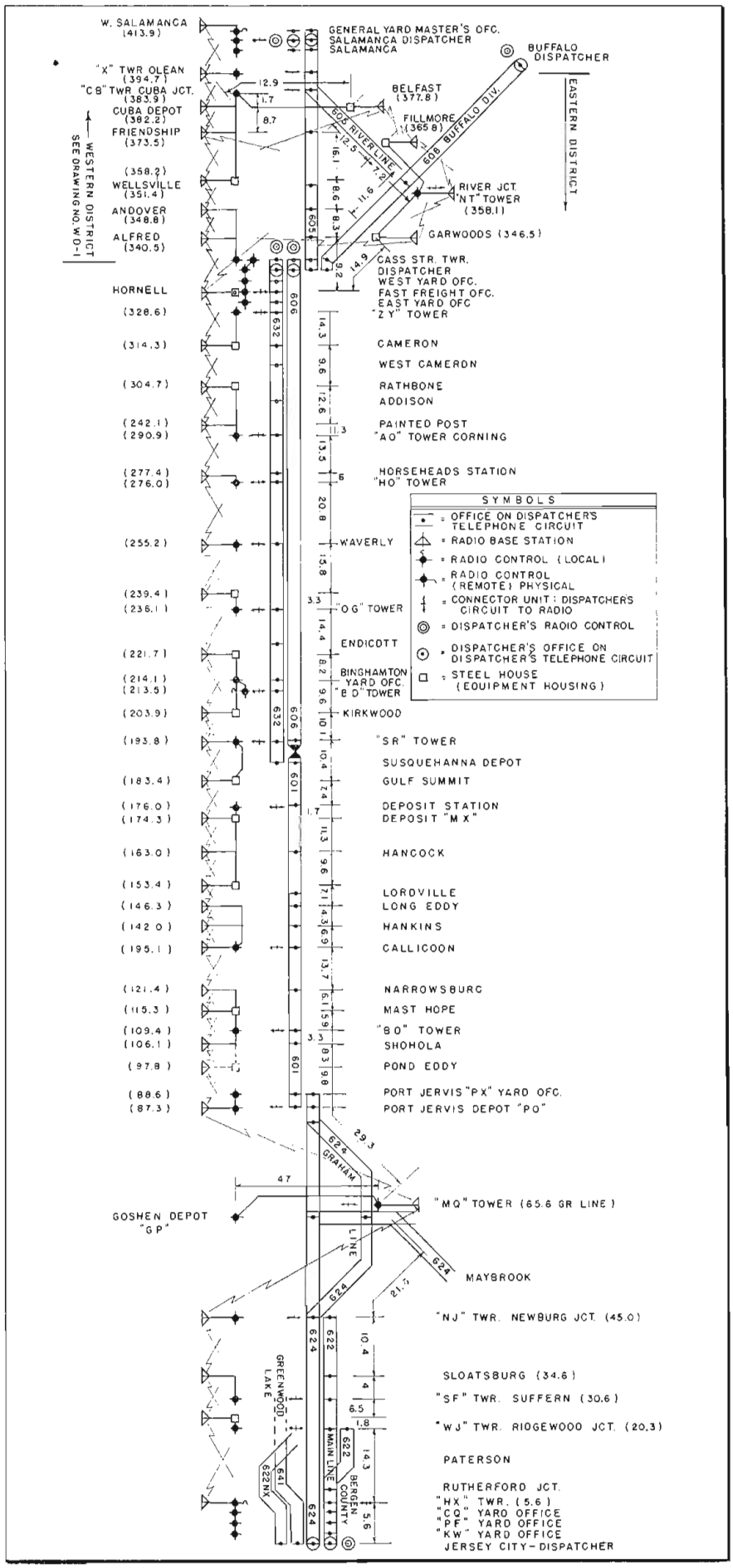



**Fig. 4: Despatcher's circuit of route from Jersey City to Buffalo. Trains are in range of at least one station at all parts of the track, two in some**

# Page from an Engineer's Notebook

## TRANSMISSION LINE SECTIONS AS CIRCUIT ELEMENTS

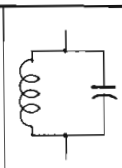
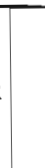
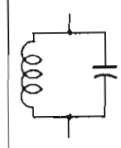
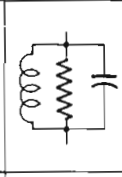
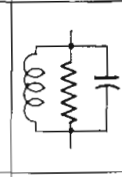
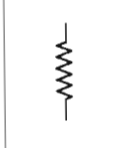
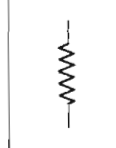
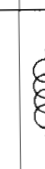
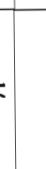
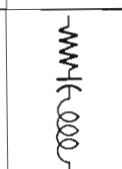
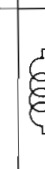
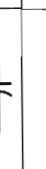
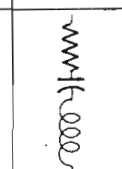
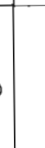
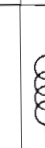
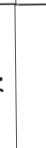
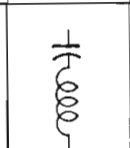
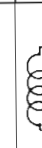
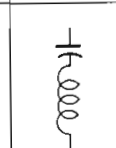
### Number 8

AS is commonly known, lengths of transmission line are sometimes used at microwave frequencies to substitute for ordinary circuit components, inductances, capacitances, transformers, etc. At frequencies where the required lengths have practical or convenient values, the efficiency of such lines as circuit elements is quite high. Specific portions of low loss line will serve as reactances if terminated in a short circuit or an open circuit. For example the effective reactance of a shorted line less than ¼ wavelength will be inductive. Between ¼ and ½ wavelength it will be capacitive. Open circuited lines give other effects. The transition between one type of impedance to another as the termination and lengths vary, is indicated in the Table below. The representations in this Table refer to lines having negligible losses.

It will be noted that low loss lines not terminated with their characteristic impedances may act as series or parallel combinations of elements, that is—resonant circuits. If line losses are low (and radiation is low) Q values of several hundred to several thousand may be found with such resonant circuits. Depending on length, either series or shunt resonance circuits may be obtained.

These characteristics are duplicated when multiples of a half wavelength are connected in tandem. The application of odd-length transmission lines must be approached with caution however since the effects noted are due to the presence of reflections. When the operating frequency of a circuit having line elements change so that its length is no longer equal to an integral number of quarter wavelengths, the type of impedance that results from such a line can also be noted from the chart.

**EQUIVALENT CIRCUITS FOR FRACTIONAL WAVELENGTH SECTIONS**

| TERMINATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| INFINITE RESIST. (OPEN) |  |  |  |  |  |  |  |  |
| RESISTANCE GREATER THAN LINE IMPEDANCE |  |  |  |  |  |  |  |  |
| RESISTANCE EQUAL TO LINE IMPEDANCE |  |  |  |  |  |  |  |  |
| RESISTANCE LESS THAN LINE IMPEDANCE |  |  |  |  |  |  |  |  |
| RESISTANCE EQUAL TO ZERO (SHORTED) |  |  |  |  |  |  |  |  |
| LENGTH OF LINE | $\frac{\lambda}{8}$ | $\frac{\lambda}{4}$ | $\frac{3\lambda}{8}$ | $\frac{\lambda}{2}$ | $\frac{5\lambda}{8}$ | $\frac{3\lambda}{4}$ | $\frac{7\lambda}{8}$ | $\lambda$ |

# New 25 KW VHF

*By A. J. MORTIMER and W. C. SCHMITT,*

*Federal Telephone and Radio Corp. 100 Kingsland Road, Clifton, N. J.*

**Operating in the 88 to 108 MC range, power TV and FM broadcasting, and in**

ENGINEERING a 25 KW triode for frequencies between 88 and 108 MC presents many problems in both tube and circuit design. This article discusses the development of the F-5512 power triode and its associated test circuits. The design satisfies the demands of communications, research and industrial services for a high power triode for use in the VHF range in such applications as high power TV broadcasting, and in cyclotron or synchroton oscillators.

A power triode for operation at frequencies above 50 MC requires different design concepts from those utilized in tubes for low frequency applications. The effect of transit is a basic limitation. If the time taken by an electron to traverse the filament-grid space is not in the order of 1/10 the period of the applied signal, or less, the result will be reduced efficiency and back bombardment of the filament, thereby shortening tube life. In a triode, transit time is directly proportional to filament-grid spacing as shown by the formula:

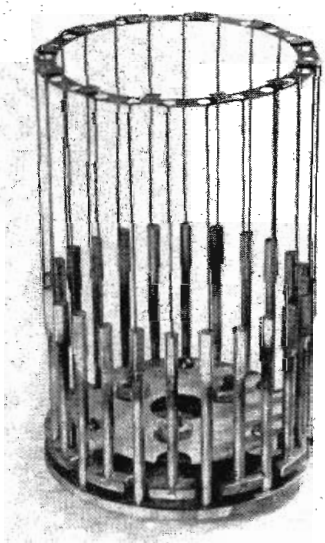
$$t = \frac{5 \times 10^{-8}}{(E_c + E_b/\mu)} S$$

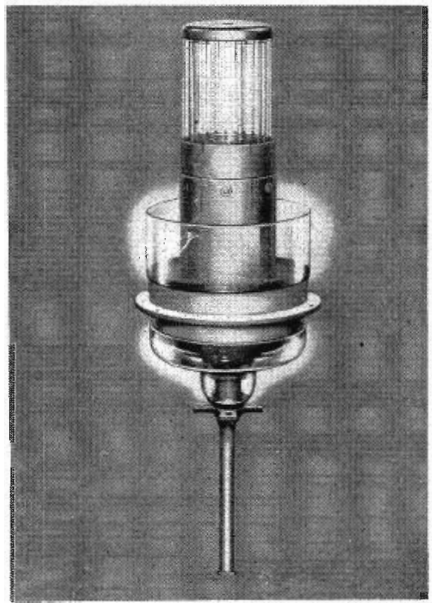
where S = filament-grid distance in centimeters, $E_c$ = grid voltage, $E_b$ = anode voltage, and $\mu$ = amplification factor. The relatively close filament-grid spacing used in the F-5512 therefore is necessary to satisfy this basic requirement of transit time.

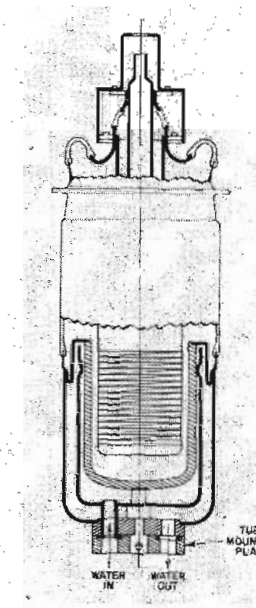
Active elements within the tube must be limited to a maximum length of approximately 1/16 wave length to avoid appreciable variations of r-f voltage along the tube elements. By using large diameter grid and filament cylinders, this criterion is met without difficulty. The coaxial circuit parameters are also approximately established within the tube to present the minimum amount of electrical discontinuity in the r-f system.

In a coaxial system the interelectrode capacitances become the lumped contestants across the high impedance end of the RF system. Because of their associated high admittances and localized heating effects they must be minimized. In addition, strict tolerances must be maintained to assure interchangeability of tubes. The input and output capacitances are held as low as practicable with the lower limits being imposed by the electrode spacings required to obtain suitably high perveance, overcome transit time limitations, and to provide suf-

Fig. 1: (Left) Filament assembly Fig. 2: (Center) Filament and Grid Assembly Fig. 3: (Right) Cross-sectional view of high power triode F-5512







# Power Triode

## *tube finds applications in high cyclotron or synchroton oscillators*

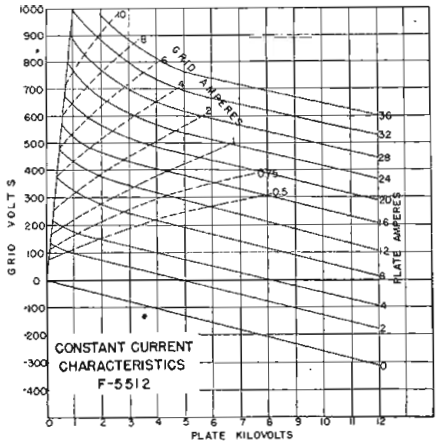



**Fig. 4: Constant current curves of F-5512**

ficient area for heat dissipation. Effective shielding provided in the grid design gives a very low value of plate-filament capacitance and consequently the tube will operate in grounded grid circuits without neutralization. Stability with stage gains in excess of 5 tc 1 is obtained in this application.

The inductance of all leads must be held as low as possible as it contributes substantially to the total circuit inductance and the interelectrode capacitance charging currents must be carried through these leads. To this end, large diameter grid and filament cylinders are used and a re-entrant type anode has been incorporated which substantially reduces the length of these leads and hence their inductance.

Due to the impracticability of using lumped capacitance and inductance at the operating frequency, these tubes are designed for normal operation in a coaxial type circuit, being contributory as a line termination. The integral water jacket, grid ring, and coaxial filament connections are all provided to enable the tube to be built in and used as a portion of the tank circuit. The utilization of a filament bypass condenser built integral with the coaxial filament terminals adds to the simplification of circuitry. Due to the relatively high circulating currents at the maximum operating frequency, all external grid, plate, and filament connections are silver plated to provide good r-f conductivity.

### Cathode Structure

The cathode is a thoriated tungsten filament with the high emission efficiency and low operating temperature inherent in this type as compared with pure tungsten. The lower filament operating temperature, approximately 2000°K as compared to 2575°K for pure tungsten, allows all internal parts of the tube to run cooler resulting in improved life and less danger of element warpage or distortion. In addition, the evaporation of tungsten at this temperature is negligible, resulting in longer filament life. The cathode is capable of supplying peak emission in excess of 200 amperes, and a sufficiently high perveance is provided to give normal operating efficiencies at a low plate voltage.

As shown in Fig. 1, the filament is a self-supported structure constructed as an independent unit, carburized, and then mounted on the tube stem. The absence of any internal springs, hangers, or filament center support rod, allows the filament to expand uniformly when heated, thereby reducing the danger of distortion. This structure, and the small diameter filament support rods used, minimizes end losses and results in a minimum temperature gradient along the filament.

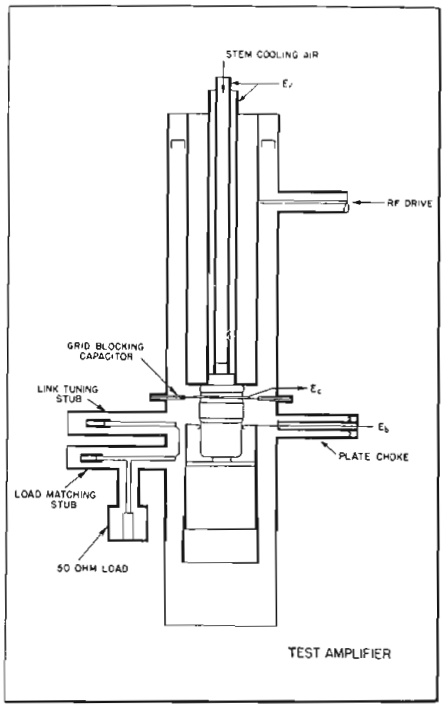
The filament current is conducted from the external connections to the heavy molybdenum support plates through two coaxial copper cylinders with kovar cups brazed at suitable points to allow for glass sealing. The use of high temperature brazing alloys is carried throughout the construction and allows internal parts to be heated sufficiently for complete degassing during exhaust. All brazing operations are accomplished either by induction heating, or radiation heating, in a hydrogen atmosphere to assure cleanliness of all parts. The copper inner filament conductor is brought out to a rolled-over lip, as shown in Fig. 2, for use as the exhaust tubulation. Upon completion of exhaust, the vacuum is held with a metal pinch-off by sealing the tubulation under pressure supplied by a hydraulic ram.

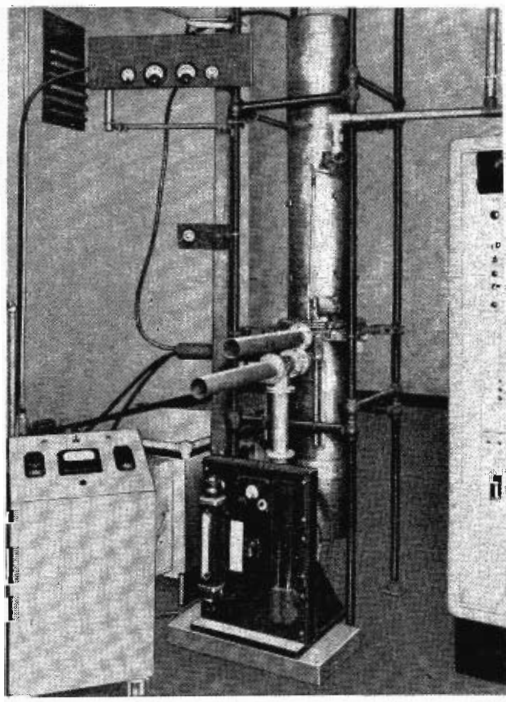
The grid is of a conventional structure with the laterals and side rods made of platinum-clad molybdenum. Use of this material with its low emission characteristic is made possible by the low operating temperature of the thoriated tungsten filament.

The grid, Fig. 2, is brought out

(*Continued on page* 58)

**Fig. 5: (Left) Cross sectional view of test amplifier used with high power triode.**
**Fig. 6: (Right) Photograph showing the test amplifier and load for the F-5512**



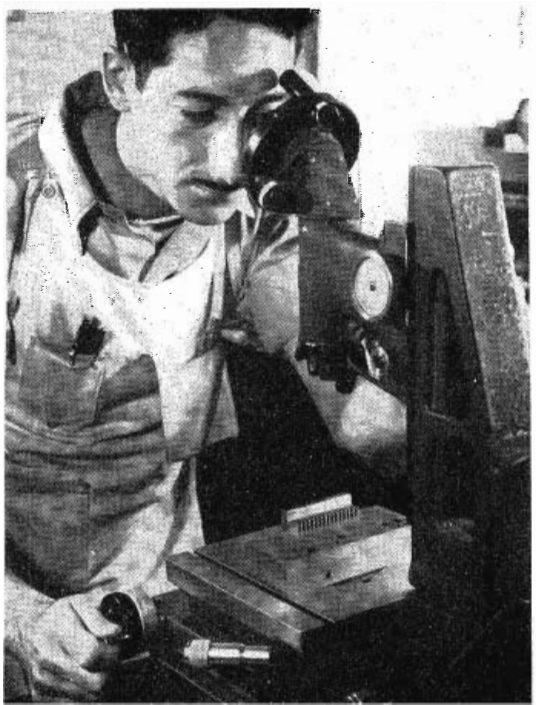

↑ View of storeroom shows a few of the many types of metals such as brass, stainless steel, phosphor bronze, nickel plated and copper coated steel employed for stampings

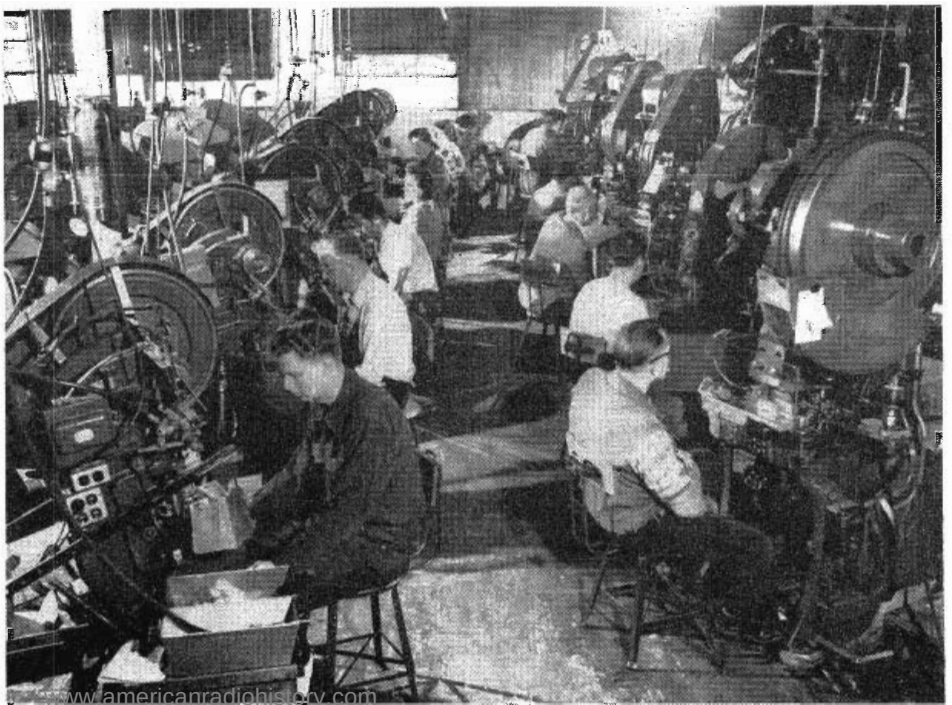
# Precision

← Dies to fit the presses that make the various stampings are manufactured on the premises. In addition, the firm designs and builds dies for other manufacturers. The die-rack shown stores about $325,000 worth of precision tools and 90% of the dies are used in the production of metal parts for TV

Toolmaker's microscope that has an accuracy to within 0.0001-in. being used to check dimensions of a die. In the manufacture of electron gun parts for television picture tubes, the aperture in first grid is 0.036-in. in diameter and must be concentric with the outside diameter of grid to within 0.001-in. Similar tolerances must be maintained on other parts produced such as the contact spring, ground plate, center terminal and cover for volume ↓ controls; contact, center shield, and shield base for miniature tube sockets

Volume production is achieved through battery of 40 presses ranging from 5 to 57 tons in capacity. Almost all are equipped with automatic feeds. Typical product is volume control cover—made in 16 stage ↓ progressive die at 50 to 55 per minute





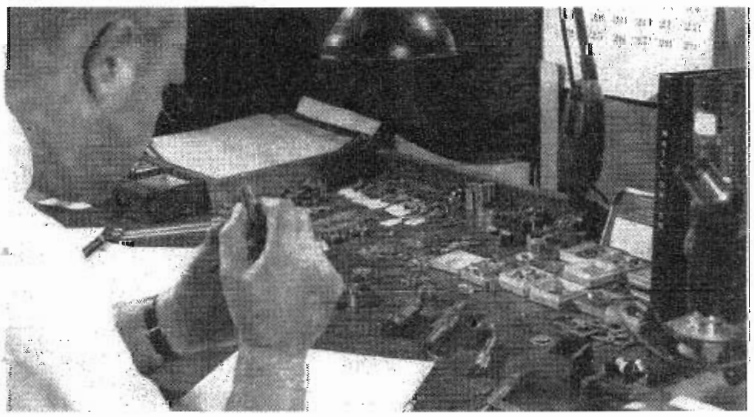
↑ New type anode for electron guns has a lock seam and is formed from flat stock rather than tubing on multi-slide machines. This process has cut costs by more than 60%. Subsequent to punching and forming, gun parts are deburred in large tumbling machine

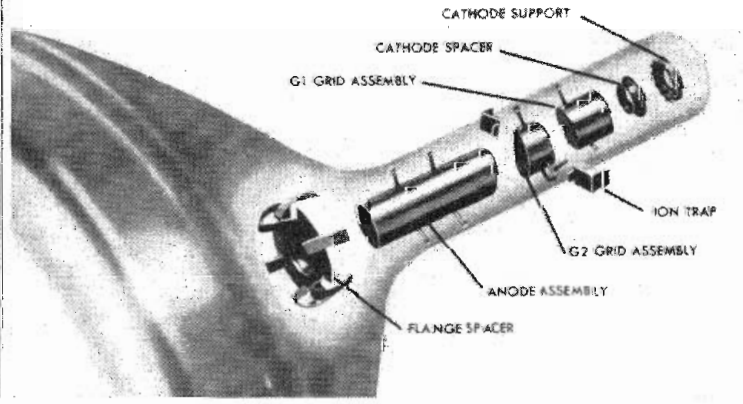
↑ View of operating stations in welding department where tiny supports and grid connectors are welded onto grid and anode assemblies. Supports on grids must be accurate to within 1°. All jigs and fixtures employed are manufactured in the plant

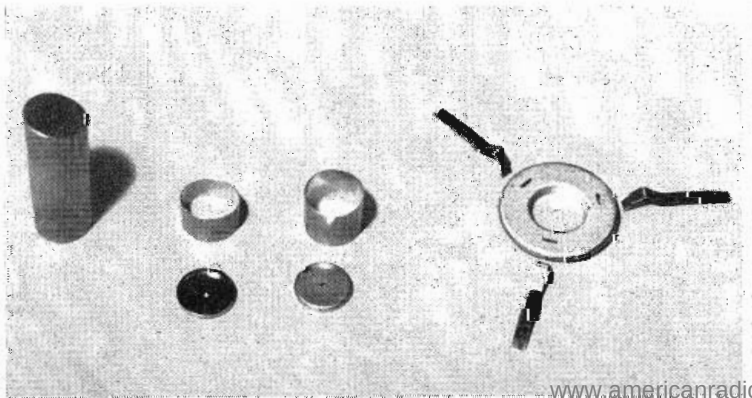
# Metal Parts for Radio-TV

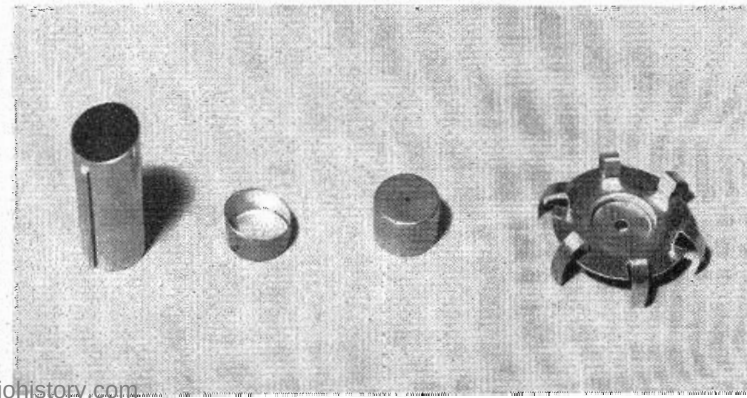
**In the year of 1948 one million, in 1949 three million, TV receivers were produced and over six million are scheduled for 1950. Few, however, realize the tremendous effects these production increases have on the output requirements of the component manufacturers and their sub-contractors. Shown here are some scenes in the John Volkert Metal Stampings Inc. plant in Queens Village, L. I., N. Y. which last year produced more than 138 million small metal stampings for use in electron guns, volume controls, and miniature tube sockets.**

(Upper left) Samples of each machine's production are taken frequently and measured to assure finished products being within tolerance specifications. Such continual checking maintains rejection percentage to less than 2%. (Upper right) Exploded view of the neck of a cathode ray tube showing location of the various small metal parts used in the electron gun assembly. (Below) Photos illustrating how the costs of gun assemblies have been reduced by redesigning four major components. In the old design, at left, the anode and grids were previously made from stainless steel tubing with lens cups welded into place. Now they are all made in one piece from flat stock as shown at right. Also, the flanged spacer is now made as one piece instead of four. The lock seam on the new anode assembly, formed by the multi-slide machine, is visible in the photo.







# Design Considerations

## *Attention to coil design details makes low-cost*

*By* ***BERNARD B. BYCER,*** *2402 North Natrona St., Philadelphia, Pa.*

SINCE scanning coils are costly components in both direct viewing and projection television the need for efficient units to reduce energy requirements and to eliminate expensive associated circuitry is quite apparent. Fundamentally, a deflection yoke is composed of two sets of coils whose axes are at right angles to each other and to the axis of the picture tube. The method of winding and the arrangements of the coils with an iron core determine to a large degree the magnetic field distribution. The field pattern of such a coil should produce a distortionless pattern that extends to the edge of the tube face and the initial focus of the electron beam should be preserved.

### Magnetic Deflection Elements

In reviewing the design and constructional features of the various types of scanning coils consider the elements involved in a magnetic deflection system: The basic arrangement of the focusing coil, deflection yoke and CR tube is shown in Fig. 1. The length of the deflection yoke is determined by the tube neck diameter. If the deflection yoke is too long the electron beam will be cut off at the neck aperture before it reaches the tube face screen. On the tube face, the corners of the raster will be rounded off and in extreme cases a circle results. The largest scanning coil, therefore, that may be used with a given tube is one that will allow the electron beam to just graze the inside glass wall when it is deflected at the required scanning angle. To this end the following formulae are presented, with Fig. 2 representing conditions for small scanning angles and Fig. 3 the conditions for wide scanning angles. It is assumed that the electron beam has zero cross-section, that the inner radius of the tube does not taper, that the scanning field acts over a length of $l$ (includes all fringe fields) and that there is no interaction between the scanning coil and the focusing coil. Solving for m from equations shown in Fig. 3:

$$m = (l/2) - (r_s^2/2l) \quad \ldots\ldots\ldots\ldots (1)$$

$$\Delta x = r_s^2/2l) \quad \ldots\ldots\ldots\ldots (2)$$

The difference in radii centers for horizontal and vertical coils

$$\frac{\Delta l_H}{2} \tan^2\frac{\theta_H}{4} = \frac{l_v}{2}\tan^2\frac{\theta_v}{2} \quad \ldots\ldots\ldots (3)$$

$$l = m + o'P_1; \text{ but } o'P_2 = o'P_1 \quad (\text{isosceles triangle})$$

$$l = \frac{r_s}{\tan\frac{\theta}{2}} + \frac{r_s}{\sin\frac{\theta}{2}} \quad \ldots\ldots\ldots\ldots (4)$$

$$l = \frac{r_s}{\tan\frac{\theta}{2}}\left(1 + \frac{1}{\cos\frac{\theta}{2}}\right) \quad \ldots\ldots\ldots (5)$$

Letting $r_s = r_a$ and using the value of m for $l/2$ in Fig. 2,

$$\epsilon = \frac{r_a}{\tan\theta/2} - \frac{l}{2}\left[1 - \tan^2\theta/4\right] \ldots (6)$$

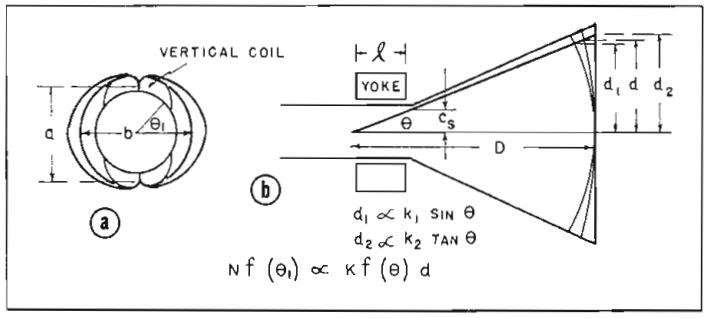
$$= \frac{r_a}{\tan\theta/2} - l\left[\frac{\cos\theta/2}{1+\cos\theta/2}\right] \ldots\ldots (7)$$

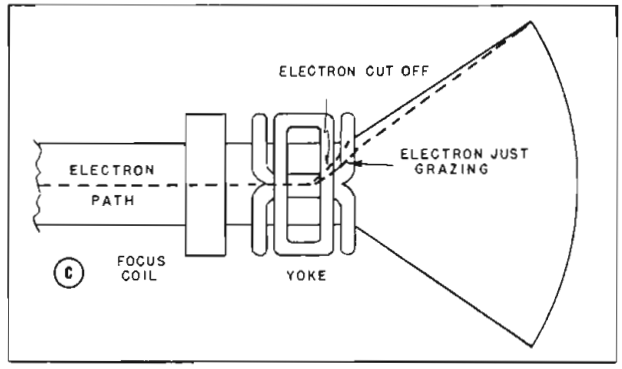
Eq. 7 permits the design of the physical dimensions of a deflection yoke in terms of the neck aperture, yoke length, scanning angle, $\theta$ and $l$. $\epsilon$ determines how far back the effective length is with respect to the grazing point of the neck aperture. The neck aperture and scanning angle are determined by the television picture tube dimensions, while f is the formed part of scan coil and $l$ is found from the formula. Knowing all these values, the engineer can design a deflection yoke that will give maximum efficiency. As a final check a scaled tube print of a given tube is used with the deflection yoke drawn in its respective place. O′ in Fig. 3 is located by computing the value of $\Delta X$ in Eq. 2. The point O′ should coincide with the apex of the scanning angle of the tube print.

At present, the tendency is to make the tube face as flat as consistent with mechanical strength limitations which makes the distance from the center of the deflection coil to the screen smaller than the tube face radius.

In Fig. 1 an attempt is made to correlate the arrangement of wires in a scanning coil to a given magnetic field pattern that fits the tube face radius. If the scanning radius and the tube radius are equal the deflection is proportional to the sine

**Fig. 1: (left) Data for basic analysis of scanning fields for a field pattern to fit the tube-face radius. (right) Arrangement of focus coil and deflection coil on the cathode ray tube neck**



# for Scanning Yokes

***improved deflection linearity possible***

of the deflection angle. With flat face tubes, however, the deflection distance (the distance from the center of the scanning coil to the screen) is proportional to the tangent and not the sine of the deflection angle θ. Actually present television tube faces are not perfectly flat, but have a large radius of curvature lying between the two values which correspond to a sine and tangent deflection angle.

To produce the desired results the actual deflection yoke may have many variations. In the "pin wound" coil the relative turns in each group were varied to achieve this result. In the English multi-wire coil, different diameter wires are used in equal areas to get a good pattern on the television tube. Another developmental deflection yoke used a wedge which approximated a mean value between the sine and the tangent deflection angle.

To ease circuit problems all scan coils should have the largest diameter wire possible in order to keep the dc resistance very small and in turn preserve good linearity. In horizontal coils distributed capacitance should be held to a minimum to produce a faster return time and to provide less loading on the flyback high voltage source. If the distributed capacitance is very large, "fold-over" will be pronounced since the return sweep interval is slower than that of the camera sweeps.

In high impedance deflection yoke, voltage breakdown possibilities between scan coils at sharp corners require insulation sufficient to protect the power transformer and the flyback transformer. The deflection yoke and focus coil should be sufficiently separated to prevent arc-over or field interaction.

### Types of Deflection Coil Windings

| | |
|---|---|
| Formed Wound: | Scan coils wound directly in their final shape. |
| Random Wound: | Scan coils wound in a flat pancake fashion and then bent into a desired pattern. |
| Pin Wound: | Scan coils wound with alternating slots of copper and insulation achieved by using pins to space the copper. |

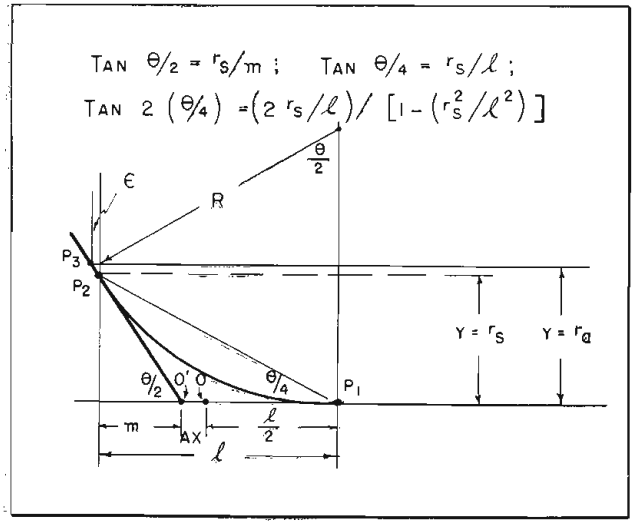
### Winding Technics

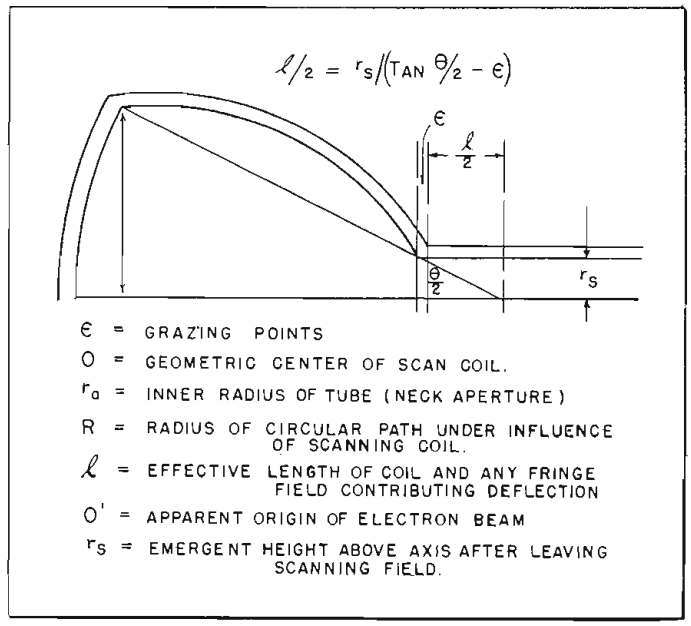
In general, there are four different types of scanning coils in use today. The coils in Fig. 4 are usually used with circular cores, but can also be used with square cores. They can be pin-wound, random wound and bent into shape, or formed wound.

Pin-winding is not used because of the relatively high cost, and form winding becomes difficult if not impossible when sets of high impedance scanning coils for small projection tubes are to be made. This latter type of coil works well in high impedance deflection yokes, but considerable difficulty is met in making a single layer coil.

For low impedance coils only the random winding technic survives. Here the shape of the field can be controlled by not only spacing the two coils, but also by the cross-sectional shape of the winding, which can be a square, a rectangular wedge, or a trapezoid. In square type yokes, the scanning coils are ideal as single layer windings of very low impedance. They can be adapted for circular cores. The type in Fig. 5 can also be wound to give high impedance and one scan field

Fig. 2: (left) Diagrams of preliminary study relations for small scanning angles and Fig. 3 (right for wide scanning angles)



## SCANNING YOKES (Continued)

consists of two solenoids. However, the coil in Fig. 6 uses one square solenoid for one scan coil and a high impedance version is usually impractical.

The coil of Fig. 4a, in extensive use in radar sets, is very economical to construct without elaborate machinery. If the spread of the coil is 0.5-in. or more, then the difference between $L_1$ and $L_2$ is great, and these unequal effective lengths are a contributing factor to picture defocusing. Here, the formed part f is equal to s which increases $\varepsilon$ considerably. The effective length of the coil ($L_2$) must be kept short.

The second set of scan coils cannot be placed inside the other pair of coils to have a common radius, and so must encircle the inner coils giving less sensitivity. In some cases, the effective length of the two sets of scan coils may be overlapped in order to get the desired performance but cross-talk may be encountered. Some coils have electrostatic shields placed between the two sets of scanning coils. Distortion of the electron beam is very noticeable because the formed part is close to the electron beam. The efficiency is very poor, so that today this coil finds very little use in television.

The circular coil, shown in Fig. 4c, at present is the most popular type used in black-and-white television. It can be easily produced in large quantities economically, and its performance is exceptional. For direct viewing tubes, where the outer dimensions are not limited, the random winding or form wound method is employed. The horizontal scanning coil is longest because line scanning requires more power. The thickness of the coil t is made equal to f and the distance between the front of the yoke to the grazing points is held to a minimum. In having the coil shaped to fit the cone of the picture tube, $\varepsilon$ can be made equal to zero. If the inner diameter of the coil is made large enough $\varepsilon$ can have a negative value. Therefore a compromise would have to be made between increasing the effective length of the coil for larger deflection sensitivity, and a decrease by placing the effective length further away from the electron beam.

In this coil, the current-carrying wires create the flux lines and the core shapes their pattern. The wires then can be placed in such a fashion so as to create the field which determines the edge of the picture. This method of reasoning can be carried a step further toward achieving geometric patterns for projection systems. In skewed projection where keystone rasters are to be produced, properly designed deflection yokes can be used to eliminate the necessity of using permanent magnets to keystone the raster.

### Circular Coil Design

In Fig. 7, a close-up of Fig. 4c, the formed and effective length must make a 90° angle. Edge A determines the straightness of the raster edge and pattern shape at the corners. The spacing of bakelite between the B edges for the line or frame coils affects pattern distortion. The outer coil (vertical) has its entire effective length covered with an iron core. In order to maintain uniform fields and good deflection sensitivity, the effective length of each wire must be equal. This is accomplished by not letting edge B start to bend before edge A does. The inner coil (horizontal) is covered with the same iron, but the effective length is longer than the vertical. It is permissible to permit edge B to bend earlier than edge A without serious harm.

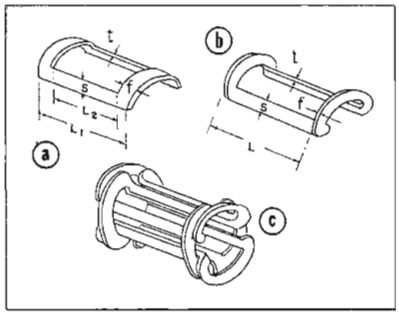
There are two ways of assembling the two sets of scan coils on the tube neck. One method is to line up the coils by having the two coils of one set meet, and this center line is 90° from the center of the other scan coils. Should the spread of the coil be slightly different, the angular degrees covered on the circumference of the tube would vary but the turns for each coil would be equal. Hence the flux density in the center would vary according to the difference of circumferential area, introducing the possibility of pattern distortion. Cross-talk would be present since the unsymmetrical assembly would make magnetic coupling by way of the iron core possible.

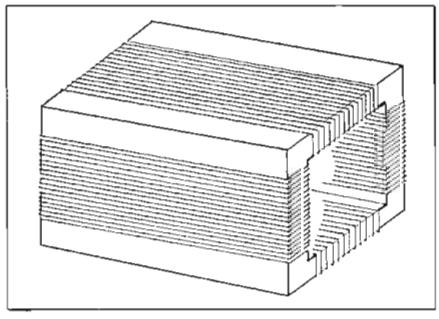
In the second method, each section of the scan coil covers the same effective angular distance. Allowance for any discrepancy is made by varying the space between each horizontal or vertical coil. With the circumferential area and the number of turns both being equal, the total flux density would appear to be uniform to the electron beam. The field is so concentrated in the center that a small variation in the center section of the scan coil is non-existent to the electron beam. In other words, if the air gap at edge B is off center, nothing occurs on the picture tube face.

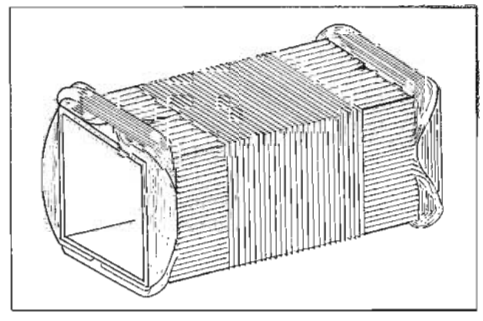
The condition of unequal spread of the coil is brought about by the eccentricity of the winding apparatus and non-uniformity of the spool of wire. It is impossible to wind a coil and have both spreads identical in form winding. Pressing into shape, when using the random winding technic, corrects for this matter.

In order to get the greatest efficiency, the stronger the field acting on the electron beam, the greater the deflection. In some cases, where sensitivity is the utmost consideration, picture quality becomes secondary. If the formed part hugs the tube neck, the deflection yoke will perform more efficiently. As an example, consider a horizontal scanning coil of 5.0 mh. If the number of turns is held constant and the formed part permitted to rise above the tube neck ⅛-in., the inductance can vary from say 4.8 mh. Here the

Fig. 4: (left) Typical scanning coil "c" with individual formed windings "a" and "b". Fig. 5: (center) Square yoke arrangement using laminated core structure. Fig. 6: (right) Early method where formed coils were set on form and iron wire winding provided magnetic core





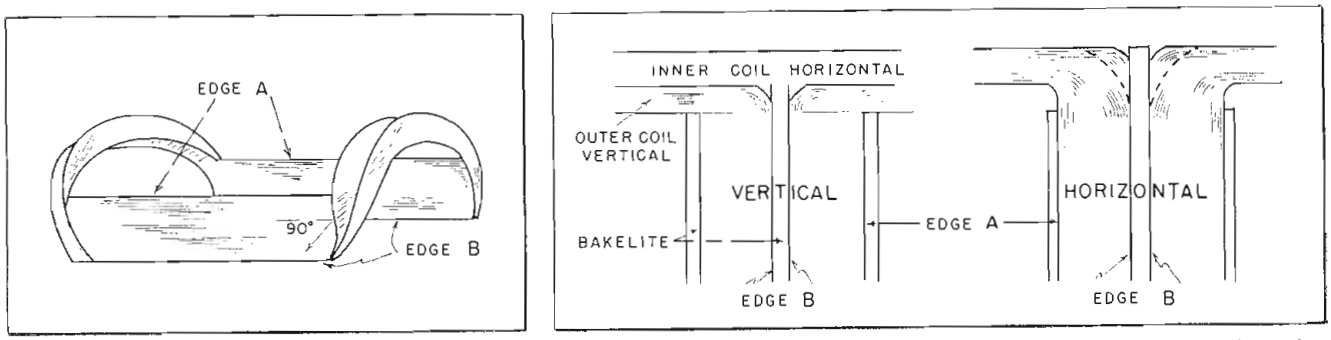



Fig. 7: (left) Close-up view of the winding shown in Fig. 4b. (right) Pattern distortion is avoided by attention to contours and overlap points

larger inductance has the greater height and requires more copper. Now if the formed part hugs the tube neck, ten more turns can be added to the smaller inductance, or twenty turns per scan field can be added, increasing the deflection sensitivity 8%. It is always better to use a longer coil with less turns than a shorter coil with more turns having the same inductance. In the shorter coil the efficiency is slightly less because the formed part has a greater volume of copper. The formed part of any scan coil is waste material in copper and an energy loss.

The square yoke with the laminated core (Fig. 5) is popular today because it is easiest yoke to construct. All that is necessary are L laminated sections or a powdered iron core of the same shape, and four rectangular solenoids. More copper is used than in the circular yoke in Fig. 4. The primary function of the copper on the outside is to serve as a return path for the current and contributes little if any to the deflection of the electron beam. The efficiency of the yoke, due to the geometric design, is poor and pattern distortion is difficult to compensate as shown in the chart below.*

*COMPARISON OF TWO YOKES

| | Square Yoke | Circular Yoke |
|---|---|---|
| Effective length of horizontal Coil | 2" | 2" |
| f | 1/16" | 1/16" |
| core length | 2" | 1¼" |
| core weight | 16 oz. | 3.5 oz. |
| core material | .014 lamination | .016 dia Wire |
| wire size | 26E | 26E |
| number of turns | 128 | 128 |
| inductance | 4.6mh | 4.6mh |
| deflection current | 200ma | 200ma |
| deflection in inches | 6 11/16" | 8 5/16" |

Since the surface of the wire for the square yoke is larger, only two layers are necessary, while for the circular core several layers of wire are needed. However such a square type yoke has an advantage. The value of $\varepsilon$ in some cases is less than for the other three styles. It can be layer wound with the wires spaced to keep the distributed capacitance down. If higher scanning frequencies are ever required, distributed capacitance may be the deciding factor in choosing a scan coil.

## Cylinder More Efficient

The deflection yoke in Fig. 6, used extensively in low impedance scanning systems a few years ago, gave good focusing throughout the picture. It always had pin cushion pattern distortion particularly in the horizontal deflection. The process of winding one square solenoid and separating the wires to pass the tube would encounter enormous difficulties on the production line. This coil works more efficiently on a cylinder rather than a square. The formed part is not very good on the 10-in. direct-viewing tube, but for small projection tubes this yoke type is difficult to construct in order to meet the physical dimensions.

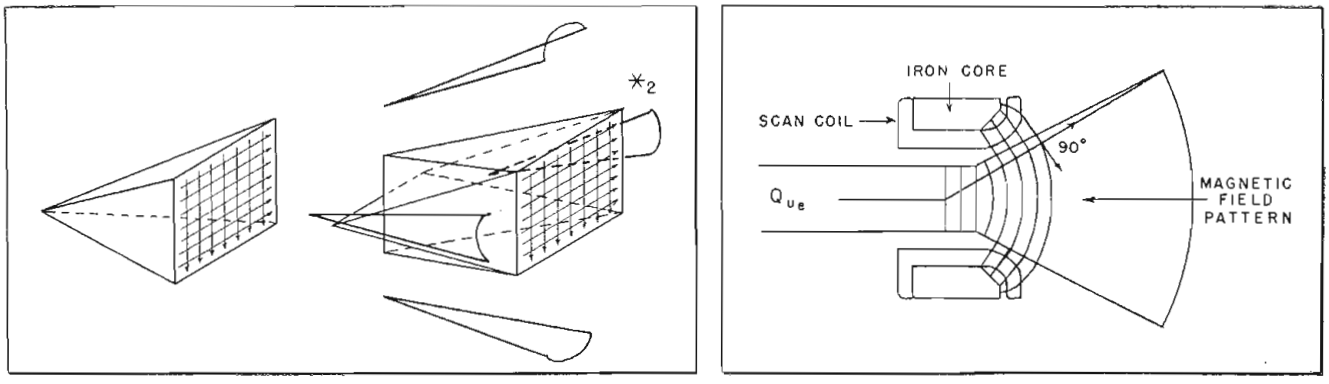
Of the four different types of scan coils shown, only the circular coil in Fig. 4c remains, and with the public demand for larger pictures, smaller cabinets, and more economical receivers, the present deflection yokes must be redesigned along new lines.

In the interest of economy the scanning coil should approximate the deflection beam path and no more. The deflection efficiency is completely determined by the coil geometry. Fig. 8 shows an electron deflection path and corresponding ideal field.

With the present trend toward wider scanning angles and shorter neck tubes, the designer has a threefold problem: the deflection yoke must be made smaller to accommodate a wider scanning angle, a stronger field is required for larger scanning angles and the deflection yoke is placed closer to the screen, cutting down the amount of travel length from the center of the yoke to the screen (decreasing sensitivity). The designer is forced to "ride" the deflection yoke up on the cone of the tube where a longer magnetic field is achieved and the shorter tube neck does not affect any space requirements. Even at present the yoke "rides" a little up on the cone, with the major por-

(*Continued on page 58*)

Fig. 8: (left) Approximate boundaries of electron paths and ideal magnetic cross-section with approximate field and corresponding winding sections at right. Fig. 9: (right) Making stray fields increase deflection by shaping their paths perpendicular throughout deflection area



# CUES for BROADCASTERS

***Practical ways of improving station operation and efficiency***

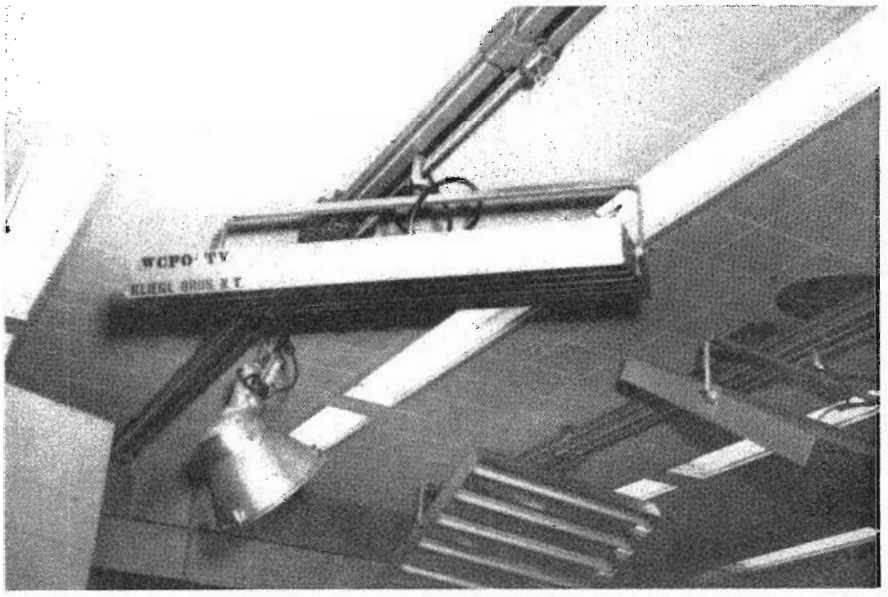
## Plate Voltage Lightning Control for Low-Power Broadcast Transmitters

*ALBERT H. CHISMARK, Chief Engineer, WTRY, Troy, New York*

THE plate voltage lightning protection method described is applicable to broadcast installations of 10 KW and under, having antenna systems which operate above dc ground. The components comprising this protective circuit consist of an r-f choke, a 32 v. dc relay controlling a set of normally closed contacts and a 45 v. battery.

These components are connected to the common point of the antenna system with the controlled relay contacts wired in series with the "plate on" control or a conveniently located interlock. When an arc occurs due to lightning, static build-up, or otherwise, a dc path is formed through the arc to ground causing the relay to energize and open the plate voltage control. As soon as the arc is extinguished, the dc path is broken and plate voltage is automatically re-applied. This system is very rapid in action with carrier interruptions scarcely noticeable. It is assumed that in transmitter installations which have the "Manual" and "Automatic" features, the equipment is set for "Automatic" operation. Auxiliary contacts on the relay can be utilized for an alarm bell or buzzer.

For complete protection, this system could be used in conjunction with any one of the other schemes which operate from RF pickup.




## Improved Television Studio Lighting

CINCINNATI'S television station WCPO solved the problem of making fast, frequent and smooth re-arrangement of the lighting effects by using TK Flex-A-Power, an electric power busway manufactured by the Trumbull Electric Mfg. Co. of Plainville, Conn.

Under this system, three TK Flex-A-Power busways, which may be likened to tracks for electric trains, are suspended in parallel runs, each fifty feet long, through the length of the studio. Trolleys, riding along and picking up power from these busways, hold the lighting fixtures, which, for complete flexibility, are mounted on universal joints. Thus, by means of a hook stick, the lights, which are of the spotlight and fluorescent types, can be rolled back and forth or pointed in any direction, as the situation demands.

Each of the three busways is made up of five 10-foot sections which are mechanically but not electrically joined. Within each of these sections are two individual, separately controlled circuits. Thus a total of 30 circuits are available in the three busways. With such a system, lighting arrangements can be pre-set for use with different types of backdrops, while separate circuit control permits all lights to be turned off except those in immediate use.

This new system replaces an old arrangement of portable stand-type spotlights, wall-mounted baby lights, and ceiling mounted Kliegl lights. It also does away with long extension cords and cables which formerly cluttered the floors.

The service furnished by TK Flex-A-Power is 100 amp., 120/240 v., single phase, three wire. TK is one member of a six-member power distribution family manufactured by the Trumbull Electric Co., Plainville, Conn., and designed to take power from the outside transformer, through the main breakers and to deliver it to individual leads.

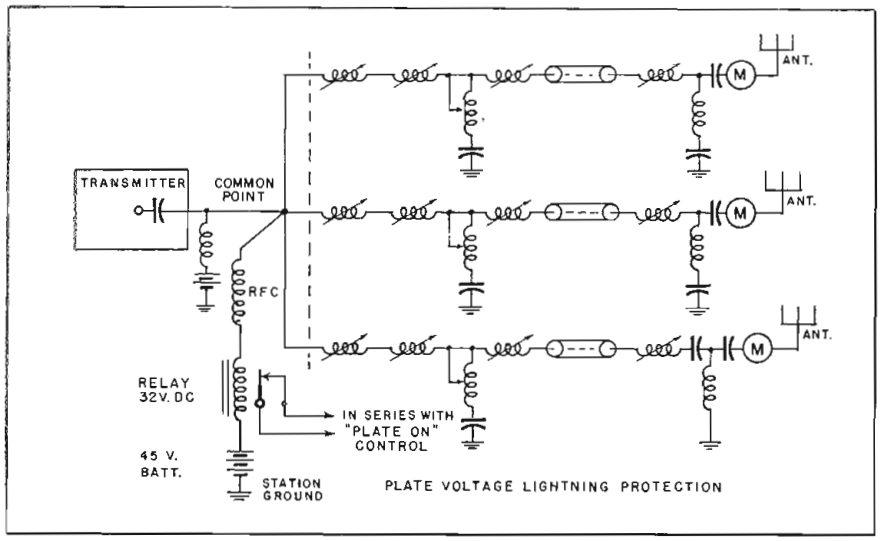
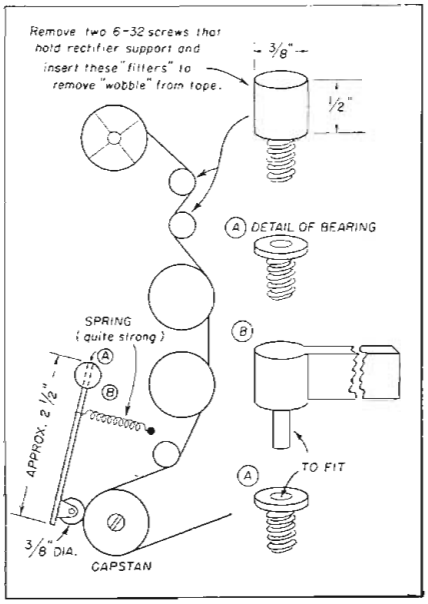


PLATE VOLTAGE LIGHTNING PROTECTION

## Soundmirror Modifications

*C. Harvey Haas, Transmitter Supervisor, KFSG-AM, KKLA-FM Los Angeles 26, Calif.*

Users of the Brush Soundmirror, BK-401 usually encounter two major problems. The first is excessive heating of the take-up motor. This excessive heat may be cured by inserting a 150 Ohm, 200 Watt




resistor in series with this motor, this decreases the current flow and at the same time reduces the pull on the tape, thereby reducing the load on the motor. This resistor value keeps the tape "just taut enough" for operation.

The second trouble encountered is slipping tape as it is pulled thru by the capstan, this may be remedied by a combination, roller and spring attachment, such as is shown in the sketch.

## Six Remotes on Single Line

*W. S. CANDLER, Fredericksburg, Va.*

THIS system affords a saving in line charges in instances where studios and transmitter are located several miles out of town, and several permanent remote points are maintained in town. It requires only one line from the metropolitan area to transmitter. The remote required is dialed on a phantom circuit on this single line. The remote lines all terminate at one central point (possibly one remote location) and any of the remote points can be dialed for broadcast from the studio. It requires a relay, magnetic rotary selector switch, a telephone dial and a battery. The batteries last for years, since the dial

### $$$ FOR YOUR IDEAS

*Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Our usual rates will be paid for material used.*

pulses are of short duration, and are generally not used more than a few times a day at the most. The voltage to operate the actuating relay is obtained from the studio consolette, and since the dial contacts are normally open, no voltage is applied to the line except when the system is being dialed. In this particular application, six remote lines were used and consequently a six position switch was installed at one remote location; the switch is of the continuously rotary type. For instance, if the last broadcast had been from remote point #3, and one wished to use point #6, it would be necessary to dial 3 times. If from #6 remote #3 was again required, #3 would be dialed.

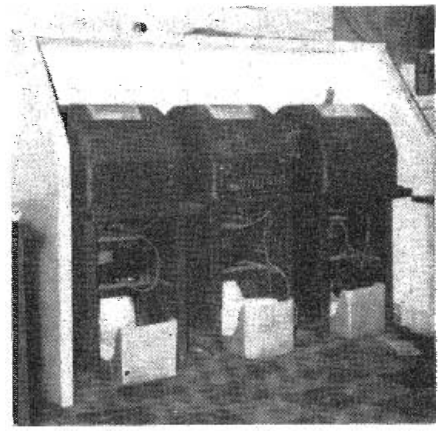
## Eliminating Teletype Clatter

*S. P. McMINN, Consultant, Fort Myers, Fla.*

EVERY broadcast station has at least one teletype machine for spot news developments and summaries, and some stations have several. In most cases they run practically constantly and add considerable clatter to already too-noisy newsrooms. In fact, teletypes are mostly relegated to the lobby, or to some more or less inaccessible location in an effort to cut down on the noise they make.

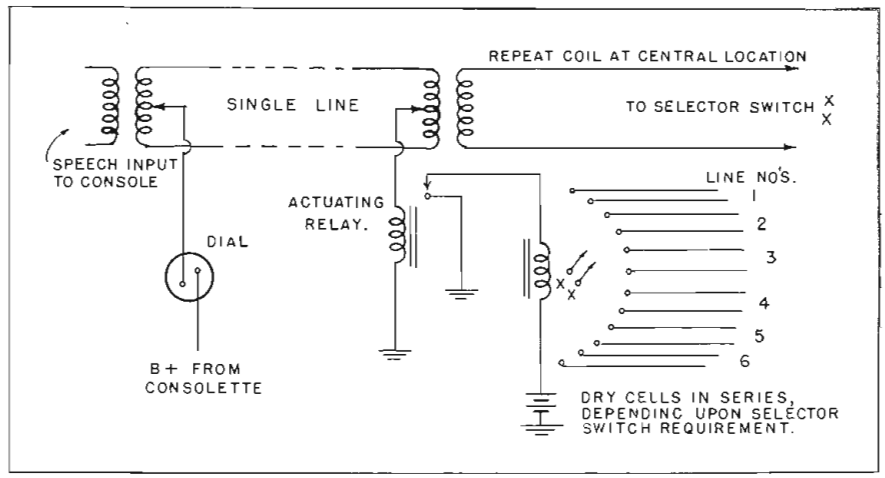
Regardless of where they are put in a station, they can be quieted to a mere whisper in a very simple manner and without sacrificing accessibility. The answer is the use of an "open-face" enclosure completely lined with sound-absorbing material, such, for example, as Armstrong's Cushiontone.

The enclosure illustrated, designed to house three machines, consists of a fairly substantial framework measuring 5 feet wide, 4½ feet high and 2½ feet deep, covered with half-inch plywood and



lined with ⅞-inch thick sound-absorbing material.

The product is supplied in 12-inch squares and 12-inch by 24-inch strips in three thicknesses. The noise reduction coefficient varies with the thickness and the manner in which the material is applied. If fastened directly to the plywood enclosure the noise reduction coefficient varies from 55 for half-inch material to 60 for ¾-inch material and 70 for ⅞-inch material. If applied over furring strips, so as to leave an air space, the noise reduction coefficient is considerably higher. In any case, enclosure of teletype machines in an open housing of the kind gives a remarkable reduction in the noise they make and still allows for necessary ventilation and accessibility.



# Video Recording

***First of anticipated problems posed by color TV in filming programs is solved by US Navy for RCA and CBS color systems***

DURING the War, the Polaroid Corp. developed a special 25mm focal length lens with an aperture of f/0.7. This lens was mounted on a Ciné Special 16mm Motion Picture Camera and successful motion pictures of PPI type radar scope images were obtained. In 1948 the Naval Photographic Center contracted with the Polaroid Corporation to build an improved 25mm f/0.7 lens. In the design of this lens, high speed was the guiding requirement and, consequently, other aberrations including "barrel distortion" were tolerated. In spite of this, a resolution of twenty lines per millimeter on the axis was achieved which is quite adequate for recording PPI type radar targets.

High Speed, lenses as a general rule, have a shallow depth of field and a short back focus distance. Before the f/0.7 lens could be mounted on a Mitchell "16" Motion Picture Camera, it was first necessary to mill out a ⅛" deep circular section around the camera aperture to permit focusing the lens. Fortunately, in radar recording, the object distances are usually 12 to 18 inches which permits focusing in the "racked out" lens position. A new lens turret to hold the f/0.7 lens and three other conventional lenses completed the interim model radar motion picture recording camera. (Fig. 2.) Successful exposures have been secured of PPI radar scope images or targets at 24 f/sec. with a "G" filter using this modified camera. A new radar recording camera designed and now being built by G. J. Badgley has a shutter opening in excess of 310° which increases the exposure time by approximately 80%.

## Recording of CBS Color

During a CBS experimental color TV broadcast in Washington tests were made of video recording in color. The program originated at Johns Hopkins Hospital, Baltimore, Maryland and was telecast to Washington over the facilities of WMAR-TV, Baltimore and WMAL-TV, Washington. Two (2) receivers were installed at the District of Columbia National Guard Armory and a Berndt-Maurer camera was set up in front of one of the color receivers. A 25 mm f/1.4 Cine-Ektar Lens and daylight type Kodachrome were used. Exposures were made at 15 f/sec. synchronous and at approximately eight and four ft./sec. using the hand crank. The results were quite promising in that the exposure at both 4 and 8 f/sec. speeds was adequate.

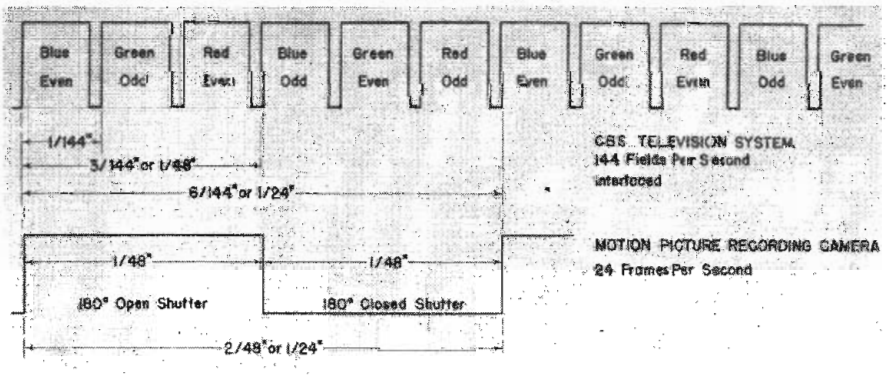
At a late test in Washington a modified black-and-white TV receiver for CBS color was available so the opportunity to try another color recording was taken. Previous exposure data indicated that by using the radar recording camera equipped with a single phase synchronous motor, and a 180° open shutter, the possibility of getting adequate exposure at 24 f/sec. was within reach. A series of tests with the f/0.7 lens mounted on the Mitchell "16" was necessary in order to reduce the "shutter bar" to a minimum. (When conventional lenses are stopped down, the shutter bar, if present, becomes more sharply defined) It was finally determined, that a shutter opening of approximately 179½° produced a barely visible shutter bar on the film at 15 f/sec. when the conventional lenses were stopped down to f/11. When the lenses were wide open, the shutter bar practically disappeared. Actually, no shutter bar was apparent when a shutter opening of 177° was tried with the f/0.7 lens on the camera. An induction motor was converted to a synch motor and a reduction gear box of 1,800 to 1,440 rpm constructed.

The Naval Research Laboratory receiver did not have sufficient light output for 24 f/sec. recording with the f/0.7 lens. Both Kodak Type A and Ansco Tungsten color films were used. In order to get greater effective emulsion speed, the Ansco film was given twice the normal time of development in the first developer. Adequate facilities were not readily available for special developments and consequently only 100 ft. of film were given this type processing. This treatment produced a better film record, but the additional work involved was not worth the expense. The Ansco ompany specially developed some Ansco Tungsten Color Film, but the effective emulsion speed was still not adequate. It was then considered that the work involved by special color processing could not be justified and it was decided to concentrate on standard color development.

## Navy Camera Used

A special Navy Type "C" 16 mm Camera equipped with the f/1.4 Ciné Ektar Lens, a 4 and 8 f/sec. gear box and synch motor was also tried with limited success. This camera is a modified Ciné Kodak Magazine Type equipped with elliptical gears designed to increase the exposure time per frame. Good color recordings were obtained at 1 f/sec. with this camera.

**Fig. 1: Color field sequences for CBS 144 fields per second system, interlaced compared with motion picture film camera using 180° shutter, camera running at 24 frames sec.**



# in COLOR

*BY W. R. FRASER AND G. J. BADGLEY,*
*US Naval Photographic Center,*
*Naval Air Station, Anacostia, Fla.*

The CBS color system lends itself particularly well to color kinephotography. The sequence of scanning is shown in the accompanying table.

| Color Frame | Time | Scan No. | Color |
|---|---|---|---|
| 1 { 3/144 | 1/144 Sec. | 1 | Blue* |
| 1 { or | 1/144 Sec. | 2 | Green† |
| 1 { 1/48 sec. | 1/144 Sec. | 3 | Red* |
| 2 { 3/144 | 1/144 Sec. | 4 | Blue† |
| 2 { or | 1/144 Sec. | 5 | Green* |
| 2 { 1/48 sec. | 1/144 Sec. | 6 | Red† |

*odd lines
†even or interlaced lines

A combination of 1-blue, 1-green and 1-red scan in 3/144 or 1/48 second makes up one complete color frame. A motion Picture Camera operated at 24 f/sec. synchronous will therefore record every other complete color frame when a 180° open shutter is employed. (See Figure 2) Double and other even multiple exposures are possible:

| Camera Speed f/sec. | Color TV Frames Recorded Per Film Frame |
|---|---|
| 24 | 1 |
| 12 | 2 |
| 6 | 4 |
| 3 | 8 |
| 1½ | 16 |

For the purpose of conducting exposure tests, a variable synch motor with the above speed markings made by the Producers Service Co. of Burbank, Calif. (Fig. 1 was used.)

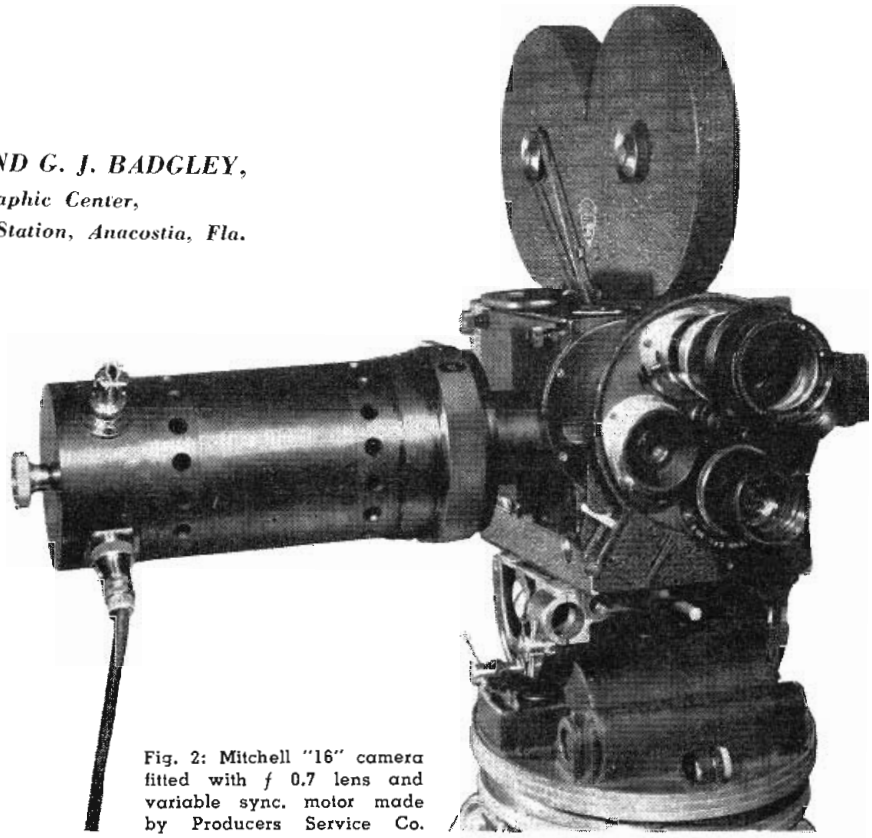


Fig. 2: Mitchell "16" camera fitted with *f* 0.7 lens and variable sync. motor made by Producers Service Co.

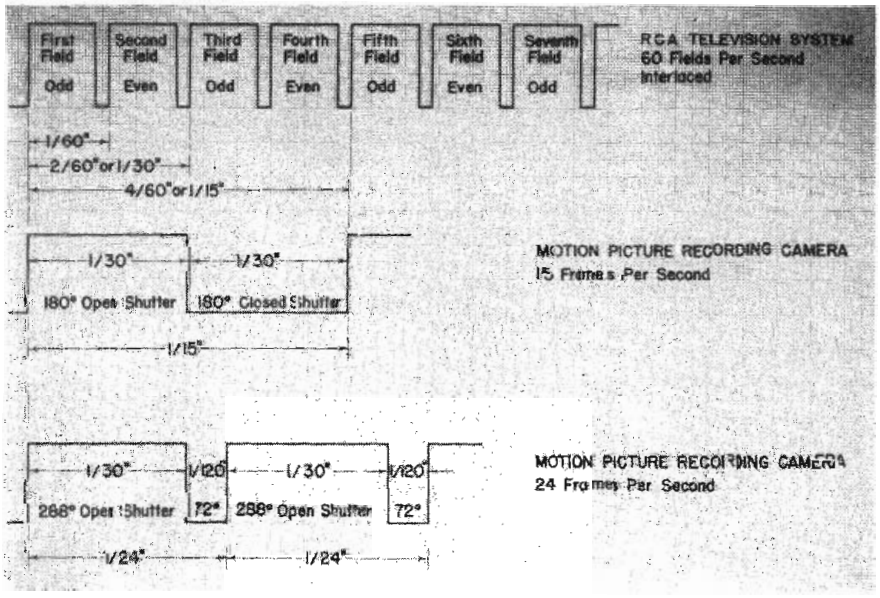
Complete successful color recordings were made from the CBS Color TV receiver at the rather unorthodox speed of 25 f/second (CBS was using 25 f/sec. during their tests). Portions of the surgical operations were recorded.

1,300 ft. of 16 mm color film was exposed as follows:

2—400 ft. rolls of Type A Kodachrome
1—400 ft. roll of Ansco Tungsten
1—100 ft. roll of Commercial Kodachrome

As the color temperature of the CBS TV tube is approximately 3800°—4000° Kelvin, C 1/4 and C 1/8 Harrison Color Filters were used to reduce the color temperature of the TV to more closely match the color temperature of the film. The quality of the color prints compared favorably with results usually obtained by direct 16 mm color cine photography. As usual, however, there was a definite division of opinion concerning the relative merits of Kodachrome and Ansco Tungsten Color Films.

Fig. 3: Color field sequence producted by RCA color syslem at 60 frames per second compared with motion picture film recording at 15 and 24 frames/sec. with 180° and 288° shutters. With the latter the closed period is only 72°, or 1/120 second.




## Recording RCA Color TV

Arrangements were made in 1949 to attempt a recording of the RCA "dot sequential" color TV system and after several unavoidable delays, the first color recording was made at the RCA Silver Spring Laboratory on 10 March 1950. This initial recording was made at 15 f/second with a 180° open shutter —the exposure time being 1/30th second. Referring to Figure 3, it is evident that the same exposure time of 1/30th second is obtained at both 15 f/sec. with a 180° open

(*Continued on page* 57)

# Short 16-in.

By L. E. SWEDLUND and
H. P. STEIER
*Tube Dept.,*
*Radio Corporation of America*
*Lancaster, Pa.*


Photograph of the 16GP4, whose shorter length makes for more compact receiver designs

TELEVISION receiver customers have shown an increasing preference for the larger kinescope sizes such as the 16AP4, but the length of these kinescopes has been too great for attractive and low-cost cabinet design. The new short length 16-in. metal-cone kinescope, 16GP4, overcomes these disadvantages.

The production of a kinescope of shorter length involved not only widening the deflection angle to reduce cone length but also the development of several new features to improve focus and image quality. These new features are closely related to the operation of the kinescope as well as to its design.

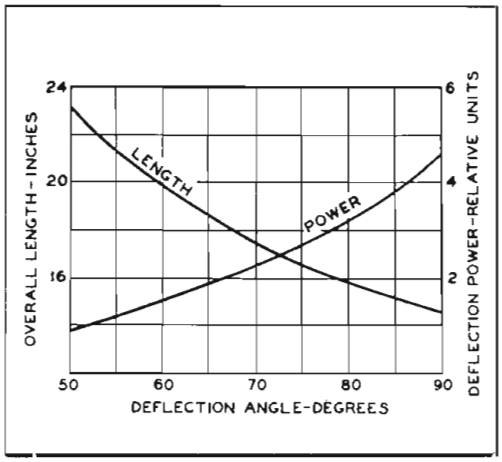
The principal means of reducing kinescope length is by increasing the deflection angle. The choice of a 50° deflection angle in the early designs provided a good balance between ease of deflection, uniformity of focus, and length in the smaller-sized kinescopes. Increasing the deflection angle, however, requires a considerable increase in deflection power, tends to produce poor edge focus, and requires more accurate alignment of components. Fig. 1 shows how overall length and deflection power vary with deflection angle for 16-in. kinescopes. These curves include the effects of a reduction in neck length as the deflection angle is increased. The fact that deflection power goes up rapidly with angle, has placed a severe limitation on the use of much more than a 50° deflection angle in the past. Fortunately, deflection-circuit development engineers have continued to make great improvements in circuit and component efficiency. The development of new deflection amplifier tubes, transformers, and circuits have made it possible to double the deflection power without increasing the demands on the B power supply. Fig. 1 shows that if the relative deflecting energy of the 16AP4, which has a 53° deflection angle, is one, then a relative deflecting energy of two corresponds to an angle of about 70°. This in turn makes the development of a 16-in. kinescope less than 18-in. in length possible.

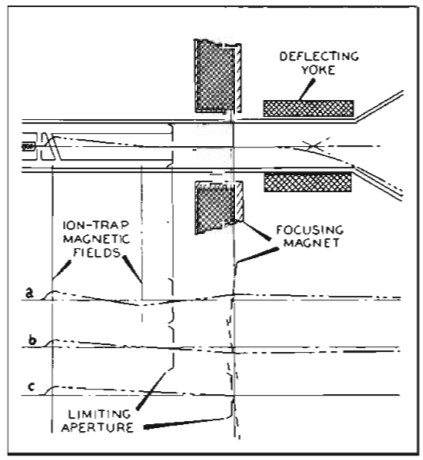
In spite of the limitations such as edge focus problems and ion trap adjustments, imposed by shorter overall length and greater deflection, it was decided that the new kinescope should also provide improved picture quality. Design changes were therefore made in the electron gun, the deflecting yoke, and the face plate to achieve this objective.

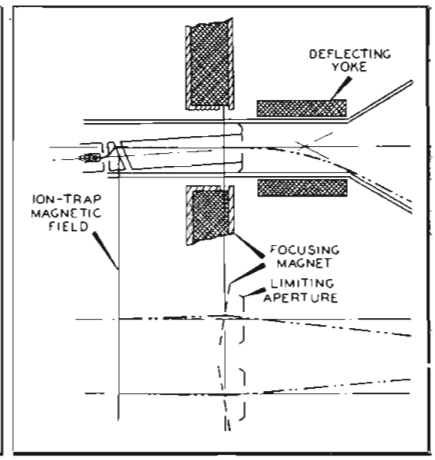
## Electron Gun Improvements

The tilted-electrostatic-lens ion-trap electron gun developed for the 10BP4 and the 16AP4 has given excellent service. One advantage of ion-trap electron guns, not general-

Fig. 1: (Left) Overall length and relative deflection power vs. deflection angle for 16 in. kinescopes. Fig. 2: (Center) Electron beam paths in double magnet, ion-trap kinescope gun. Fig. 3: (Right) Electron beam paths in new single magnet, tilted gun, ion-trap kinescope gun



# Metal-Cone Kinescope Development

***New design reduces overall length 5 in. and provides improved picture quality through changes effected to electron gun, deflecting yoke and face-plate characteristics***

ly appreciated, is that they provide a means for accurate compensation of small manufacturing variations in the gun alignment. In comparison to the bent gun ion-trap, the tilted-lens type has the advantage of coaxial electrodes which are simpler to assemble and which tend to produce less spot distortion. (The latter is smaller because the electrostatic field distortion is opposite that of the magnetic bending field.) However, the fact that the earlier tilted-lens design requires a double-ion-trap magnet for optimum performance makes it longer than desirable for a 70° deflection kinescope. In the 70° kinescope gun length can be reduced because electron optical magnification is less. The focused spot is the image of the electron crossover near grid No. 1. The electron crossover is projected on the screen by the main focusing lens located at the focusing coil. In accordance with simple geometrical optics the image size is inversely proportional to the object distance (grid to focusing coil) and proportional to the image distance (focusing coil to screen). Since the image distance (focusing coil to screen) has been reduced by increasing the deflecting angle, the object distance (grid to focusing coil) or gun length can be reduced a proportionate amount without increasing the spot size at the screen.

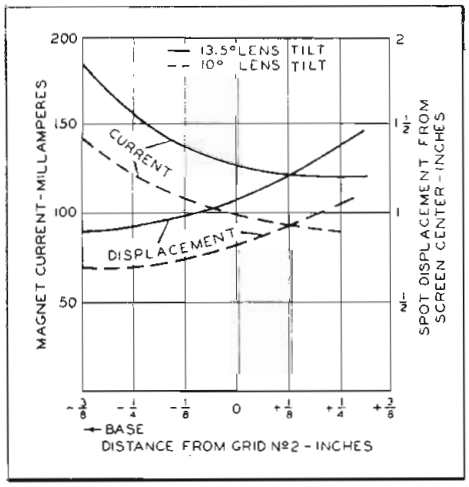
Reduction in gun length also has the important advantage of reducing the diameter of the electron beam in the focusing and deflecting fields since the beam diverges from the crossover to the focusing field. When the electron gun is shortened, there is space for only one ion-trap magnet on the neck. It has also been observed when the ion trap is being adjusted, particularly when permanent magnets and decentering or tilting the focus coil for raster centering are used, that the adjustment of the ion trap to provide maximum brightness is not necessarily the best one for uniformity of focus. Because of these considerations, the tilted-lens ion-trap electron gun was studied and redesigned to provide optimum performance with a single ion-trap magnet.

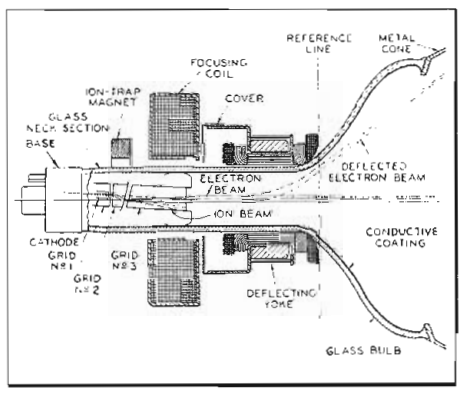
## Operation of Earlier Gun

In order to understand the changes in the new electron gun, the operation of the earlier gun will be reviewed. In Fig. 2, a schematic cross-section of this gun in a kinescope neck, the ion-trap magnet fields are applied at the positions indicated, in a direction perpendicular to the paper. Because it is very difficult to make the deflection of the electrostatic and magnetic fields equal and opposite at every point, the beam is displaced from the gun axis. The amount indicated is exaggerated for purposes of illustration. A second magnetic field of opposite polarity is used to deflect the beam back onto the gun axis. The correct adjustment of the ion-trap magnet is generally judged only by obtaining maximum picture brightness, but it happens that various combinations of ion-trap and focusing coil adjustments will also do this, although only one combination gives best performance. It is not generally possible to provide exactly the right magnetic field strengths so other conditions of adjustment are usually used.

Fig. 2a illustrates the case where both magnetic fields are too strong. The beam is centered in the limiting aperture as required to produce maximum current to the screen but is at an angle and off axis when it reaches the focusing coil. The focusing coil, therefore, must be tilted or decentered to direct the beam toward the center of the screen. This tilting, however, acts to increase the aberration of the focusing field. Because the beam also enters the deflecting field off center, the beam may strike the neck. Also, because of the curvature of the fringe field of the deflecting yoke, the opposite sides of the beam are deflected unsymmetrically to produce added deflection defocusing. This defocusing is generally not the same on both sides of the screen. Moreover, most deflecting yokes are surprisingly sensitive to this type of decentering. A readily observable effect of the beam being off-center is bowing of the sides of the raster.

Fig. 2b illustrates a more usual condition in which the second field is too weak or is not used. Here the



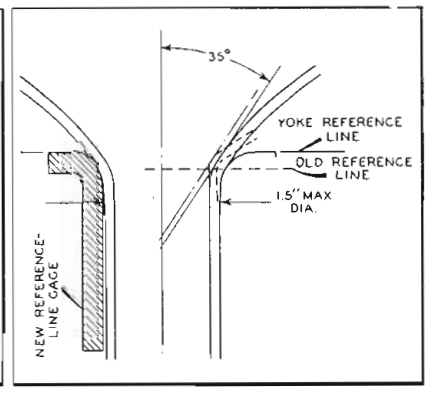




**Fig. 4: (Left) Relation between ion-trap magnet position and undeflected beam position at the screen. Fig. 5: (Center) Sectional view of 16GP4 electron gun and external components. Fig. 6: (Right) Diagram showing the increased beam clearance because of new cone contour**

## METAL-CONE KINESCOPE (Continued)

beam is again at an angle and off-axis in the focusing and deflecting fields. As before, the result is added focus distortion.

Fig. 2c shows the limiting aperture in the middle of the focusing field, a location which in the past has been assumed to be undesirable. However, this location has been found to be advantageous for it will be noted that, although the focusing coil still has to be displaced from the position for optimum alignment, the amount of displacement is small and the beam is on the gun axis before it enters the deflecting field. An additional advantage of placing the limiting aperture in the focusing coil field is that the gun structure is then relatively longer and thus can be more accurately aligned with the inside of the neck.

### New Tilted-Gun Design

The next step in improving the alignment of the electron beam with the neck is illustrated in Fig. 3. The grid end of the gun has been displaced by an amount equal to the electron beam displacement. This amounts to about 0.1-in., and depends principally on the tilt of the electrodes of the electrostatic lens. Since it is desirable to keep this displacement small, the requirements for lens tilt were reviewed. It was found possible to reduce the tilt from 13½° to 10° without risk of passing negative ions through the gun at limiting operating voltages. The amount of displacement was determined by operating the gun without focusing and deflecting fields. Grids No. 2 and No. 3 were first connected together to avoid electrostatic refraction of the beam. The axis of the gun was then located by means of the fluorescent spot on the screen. After normal voltages have been applied to the electrodes, a single-field ion-trap magnet was operated which caused the fluorescent spot to be displaced. From this displacement and the dimensions of the bulb, the gun tilt could be calculated.

Fig. 4 shows this displacement for lens tilt of 13.5° and 10° for a range of positions above and below the normal one for a single magnet of the electromagnetic type. The various currents for this magnet can be converted to equivalent permanent-magnet field strength values if desired. It is of interest to note from this diagram that when a permanent-magnet type of ion-trap magnet is chosen it should have a field strength high enough so that it can be placed between grid No. 2 and the base rather than on the other side of grid No. 2. Toward the base side of the range, the change in displacement is small, but the change in current is large. Thus, permanent-magnet strength should be chosen on the high side to cover possible variations in order to provide the least deviation from optimum beam centering. The amount of displacement for an ion-trap magnet of average position and strength is compensated by tilting the electron gun structure about the limiting aperture as a center. The variations from this amount are small and can be corrected by displacing the focusing coil a small amount. Because of the reduction in electrostatic lens tilt, a weaker ion-trap magnet than previously used provides optimum alignment. If the focusing coil has a narrow gap which is close to the deflecting coil, a 35-gauss magnet may be strong enough, but if the focusing coil has a wide air gap and large spacing to the deflecting coil, a field strength up to 55 gausses may be needed for typical operating voltages.

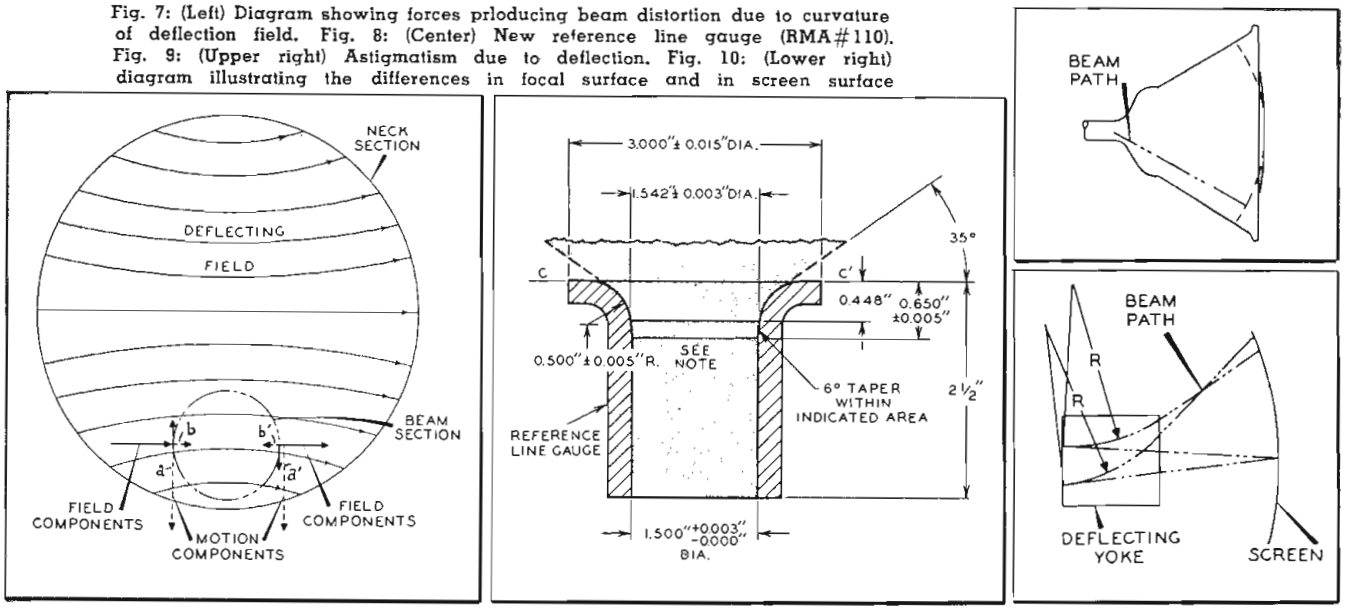
No change was made in the operating voltages of the electron gun compared to that of the 16AP4 but efficiency was improved by reducing the amount of current masked in the limiting aperture. This feature has the additional advantage of improving the tone scale in the high lights of the picture.

An advantage of the new gun, which is of incidental importance to the kinescope user but of great value to the tube manufacturer, resulted from making the electrodes of the new electron gun the same length as the old ones even though the neck is about one inch shorter. This feature makes it practical to run the 16AP4's through the exhaust machine as set up for 50° kinescopes without change and to intermix these types of kinescopes in production. Mounting the gun off-center at the bottom does not present any particular manufacturing problem because it is centered by means of preformed leads on the stem and mounting jigs as is done with the old mount.

Fig. 5 shows a schematic sectional view of the neck of the new kinescope to illustrate the relative size and position of the electron gun and its related external components.

The second major change is that concerned with deflection. The de-

**Fig. 7: (Left) Diagram showing forces prloducing beam distortion due to curvature of deflection field. Fig. 8: (Center) New reference line gauge (RMA#110). Fig. 9: (Upper right) Astigmatism due to deflection. Fig. 10: (Lower right) diagram illustrating the differences in focal surface and in screen surface**



sign of the deflection yoke was given careful consideration to keep the deflecting power at a minimum and to provide good uniformity of focus across the screen. It has already been pointed out that the beam should be well centered when it enters the deflecting-yoke field and the steps taken to center the beam in the neck have been described. To make this beam centering effective, the yoke must also be well-centered on the outside of the neck. In the past, such centering has generally been difficult because the tolerances required for the glass neck tubing make an appreciable difference between the inside diameter of the yoke and the outside diameter of the average kinescope neck. Since the kinescope is nearly always partly supported by the deflecting yoke, the weight of the tube pushes the yoke off-center on the neck. This off-center position is particularly harmful to good edge focus in wide-angle kinescopes and also indirectly acts to reduce the length of yoke which can be used because it limits the clearance of the deflected beam.

### Glass Cone Construction

Because the glass cones on metal kinescopes are made by pressing molten glass in relatively accurate molds rather than by blowing or drawing, it is possible to make them with closer tolerances than feasible for those on neck tubing. Advantage was taken of this feature by extending the glass cone so that the splice to the neck tubing was below the point where the top of the yoke contacts the glass. In order to provide good yoke centering, the inside of the top of the yoke and the bottom of the glass cone were tapered, making possible a snug fit between the yoke and the glass cone. A wedge-shaped liner may be inserted at the base end of the yoke to complete the support and centering action. Fig. 6 illustrates the cross-section of the new glass cone; the cross-section of the glass cone is shown in part as a dotted outline. The change also made possible a worthwhile increase in yoke length by providing more beam clearance at the bottom of the glass cone. With the yoke in place on the new section, the center of deflection can be about ⅛" farther away than on the old cone, thus making possible a yoke about ¼" longer. A new reference-line gage was specified to indicate the position of the yoke on the new neck section as shown in Fig. 8. The new reference line corresponds to the top edge of the windings of the yoke and is about ¼" above the old one for the same yoke position. The advantages of this new cone shape has led to its adoption on other new bulb designs.

### Raster Centering

Due to the difficulty and cost of providing dc yoke centering in receivers, is was decided that provision be made for centering the raster by means of the focusing coil. This method of centering, in effect, requires deflection at the focusing coil position. The yoke, therefore, has to be made slightly shorter than otherwise required in order to move the deflection center forward enough to compensate for focusing-coil deflection and thus maintain sufficient beam clearance in the neck. The yoke windings are 1-11/16" long, about 5/16" shorter than in the 50° yoke. It is estimated that without the new glass cone and yoke contour a reduction of ½" in yoke length would have been necessary.

The shape and distribution of the magnetic field inside the deflecting yoke has an important bearing on the uniformity of focus toward the edge of the raster. This problem can be made less critical if the electron gun is designed to produce a beam of smaller diameter in the deflecting field, but this solution would result in decreased brightness and modulation sensitivity. Although it was possible, to make some compromise in reducing beam diameter, changing the yoke winding distribution makes possible a very noticeable improvement in focus. Figs. 9 and 10 may be used to illustrate the incomplete explanations which have often been given as the reason for poor edge focus. In Fig. 9, if it is assumed that the deflecting field is uniform, the electrons in the beam will describe paths which are arcs of the same radius. Because all parts of the beam do not have the same length of path, the deflection across the beam will vary and the focus in the plane of deflection will be shortened as indicated. Fig. 10 indicates that the relatively flat screen used does not coincide with the focal surface represented by a sphere about the center of deflection. Actually these effects are not of much consequence because the beam is quite narrow and therefore has a considerable depth of focus. There is, however, an important source of distortion with reflection which is due to the curved field lines in the deflection yoke.

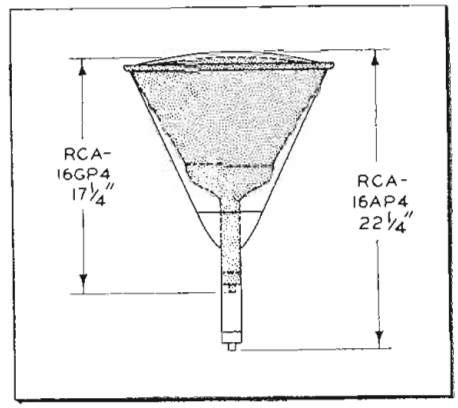



Fig. 11: Compare size of 16GP4 and 16AP4

Curved field lines are necessary to provide a rectangular raster on a relatively flat screen because the deflecting field must be weakened toward the edges. It may possibly have a shape like that shown in the sectional sketch in Fig. 7. Due to the curvature of the deflecting field, there are not only the components $a$ and $a'$ acting to deflect the beam but also components $b$ and $b'$ acting to press it together normal to the direction of deflection. The fringe fields at the ends of the yoke have a considerable effect and in a poor yoke the pinchusion field may represent the difference between a barreled field in part of the yoke and a stronger pinchusioned field in another part. It has been found that the yoke coil shape developed for 50° deflection can be improved for wide-angle deflection by making the windings wider which, in fact, requires that they overlap. It is also of interest to note that contrary to the report of other investigators, corner focus is better with a small amount of pinchusion rather than with a barrel-shape raster.

### Contrast Improvement

The third principle improvement incorporated in the short metal cone kinescope is concerned with the face-plate glass. RCA, several years ago, recognized the possibility of improving contrast in kinescope screens by the addition of a light absorption characteristic to the face glass. Dr. R. R. Law of the RCA Princeton Laboratories described this improvement in a paper, "Contrast in Kinescopes" at the IRE Convention, New York City, June 17th, 1938. Neutral gray glass embodying the principles described in Dr. Law's article had not been available commercially in a type of glass suitable for use in kinescopes faces. During the past year, how-

(*Continued on page* 59)

# Process Screen Projection

PART TWO OF TWO PARTS

## *Motion picture technics developed for television production*

*By R. A. LYNN and E. P. BERTERO*
*Staff Engineer* *Development Engineer*
*National Broadcasting Co., 30 Rockefeller Plaza, New York City*

A 3-2 system projector was tried for background purposes. As expected it was compatible with the regular studio camera; however, as was predicted, there was insufficient illumination on the screen for viewing purposes.

A typical diagram showing the sequence is shown in Fig. 3. It was predicted that pulldown would have to be extremely rapid otherwise flicker effects would be observed in various parts of the picture depending on the phasing of the shutter. Several manufacturers were approached with this problem. The Holmes Projector Company had already developed the mechanism for rapid film pull-down with a time relationship similar to that shown in Fig. 4. The principle of the 3-2 intermittent had already been established. A new shutter, shown in Fig. 6, was designed to rotate at 720 RPM.

The Holmes Company cooperated with NBC and fabricated a prototype unit containing the various features thought to be desirable for background projection work. Tests of this unit showed that the basic plans were correct.

The projector includes both carbon arc and incandescent light sources. The arc is a standard type known to the industry as the Strong Junior High Intensity Arc with a normal rating of 30 amperes at 27 volts. A rectifier is supplied to give the necessary dc. The arc can be removed and the incandescent lamp house quickly dropped in place (as is shown in the photograph) when a smaller picture is required.

### Noise Reduction

Since it is required that these projectors operate in studios containing active program microphones, particular attention was given to noise reduction. The film pull-down was designed to be as quiet as possible and the main driving motor was mounted on rubber driving via a toothed rubber drive belt.

Extremely short focal length lenses are not readily obtainable in the field of motion picture projection. However, the Bausch and Lomb Company recently made available a 20mm lens which has suitable characteristics. The throw distance required to fill the 9 x 12 ft. screen is 18 feet.

### Approval by City Departments

When equipment such as a film projector utilizing a carbon arc is used in a studio in New York City, it is quickly found that various departments have regulations which must be satisfied before the equipment may be operated. Three of these departments are: The Department of Water, Gas and Electricity; The Department of Building and Housing; and the Fire Department. Although non-combustible 16mm film is used it is necessary to exhaust the arc vapors either to the outside atmosphere, or else through a water bath. Since projector mobility is important it was decided to exhaust through water. The moving elements of the machinery are not noiseless, so it was necessary to enclose the entire apparatus in a mobile booth containing sound deadening treatment. The previously mentioned regulations dictated the type material used in the construction of the booth.

The projector with the attendant projectionist weighs approximately 550 lbs. and requires a substantial dolly to prevent beam disturbance. The first dolly used by NBC was made of angle iron with boiler plate as the platform. Transite side walls and roof, plus soundproofing, brought the overall weight up to one ton! To cut down on this weight new plans called for a wooden substructure completely covered with Transite to comply with fire regulations. Aluminum angle instead of iron will reduce the weight to 1300 lbs.

Fig. 5 shows the booth and Fig. 7 the projector within the booth. Construction is Fire Underwriter approved. This booth is 50 x 72 x 72

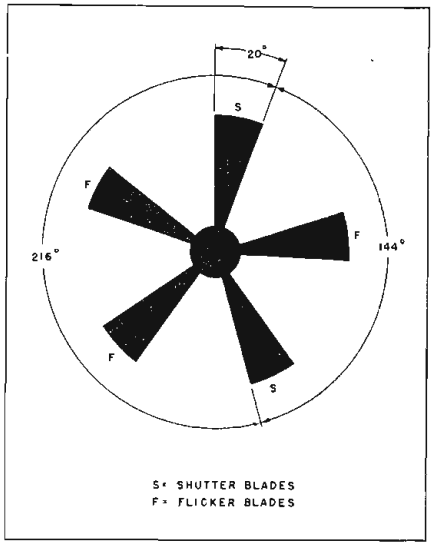



**Fig. 6. Five bladed shutter revolves at 720 RPM, uses three blades to eliminate flicker**

in. and rests on a dolly 6 in. above the floor. Soundproofing consists of 2 in. of fibre glass covered with a glass cloth retaining screen. Two projection windows have been cut in the booth, one straight ahead which is used when image reversal is not important and sufficient throw distance is available. The second window, located in the side, is used in conjunction with a mirror which is mounted as part of the projector. This mirror gives a reversed image on the screen when viewed by the projectionist. However, a correct image is viewed by the television camera from the far side of the screen.

### Exhausting Arc House Fumes

A suction blower located within the booth exhausts the arc house fumes into a receptacle holding swirling water. After emerging from the water bath the exhaust air is conducted to the outside of the booth through a muffler.

Two blowers are located within the booth, for air circulation. Also provided are a film rewind and splicer, loop holder, intercom set, working lamp for general illumination purposes, power input receptacles, rope for moving the booth, and screw jacks on the four corners of the dolly to lift the booth

off the casters thus making it completely static.

One problem was to construct this booth so that it would pass through any studio doors—which are 6 ft. 7 in. high. This necessitated low head room within the booth, and consequently for maximum comfort the projectionist should not exceed 5 ft. 10 in. in height.

For pictures from 4 x 5 ft. up to 5 x 7 ft. the arc is not required and use is made of the 1000 w incandescent lamp. When used on shows on a daily basis, their requirements can be met by assigning a lightweight type of motion picture background projector. The deletion of the arc house, rectifier and water bath permits the unit to be compact and portable. Furthermore, in those cases where a broadcast control booth with a glass window is available, the projector can be used therein eliminating the need for sound insulation.

### Two Screen Types Available

In general, two types of screens are available for background projection. The "white" screen has a light transmission of approximately 70 per cent. The "black" TransLux screens appear similar to the white in texture; however, they differ in that they are tinted to various densities with dyes. These screens exhibit light transmission factors in the range 40 per cent to 60 per cent. All screens are roughened on both sides. The side with the coarse texture faces the camera while the side with the fine texture faces the projector.

The relative merits of the white and black screens have not as yet been fully explored. Initial experience indicates that the TransLux black screen provides better contrast between highlights and shadows under conditions of spill light than the white screen.

The screens are fragile to the extent that they will tear if props, ladders, etc., are allowed to fall against them. "Flying" of the screens is recommended but few TV studios have sufficient overhead space to permit this procedure.

The 9 x 12 ft. size of screen is presently in use. There has been some indication that a size of 18 x 24 ft. would be desirable for certain large shows. This larger size would present problems such as increased illumination, increased projection distance, greater screen storage hazards and a heavier frame construction. The more recent models of still projectors running at higher than normal voltage can supply the required illumination. A more serious problem exists in increasing the illumination from a 16mm motion picture projector. A 60 ampere carbon arc would be sufficient; however, improved methods of cooling the film will have to be devised.

Motion picture background projection in its present form was first used for TV on January 13 on "One Man's Family". The motion pictures were photographed in San Francisco. One scene depicted a trip on a cable car, the other scene an automobile trip to and over the Golden Gate Bridge. As used on "One Man's Family" a section of a streetcar was fabricated for the foreground upon which the live actors stood. In the case of the road scene a section of an automobile was shown with the actors sitting facing the screen.

Slides are easily available from existing library material—or glossy prints or art drawings may be made into slides for still background projection.

In the case of motion picture background projection the footage must be chosen very carefully. The material available in most film libraries will be found to consist of broken continuity. Typical scenes last from 5 to 10 seconds whereupon the continuity is broken to portray a new angle of view. This would be unsatisfactory for background projection since the effect of realism would be lost. In the case of "One Man's Family" a specially used motion picture camera was kept going continuously for *10* minutes. When the streetcar came to a stop the camera continued photographing the halted traffic and the pedestrians crossing the street. However, care must be used to preserve the correct proportion of the background material in relation to the anticipated live foreground actors. For example, a live actor standing 5 ft. 7 in. would appear ridiculous if the motion picture background portrayed individuals who were giants.

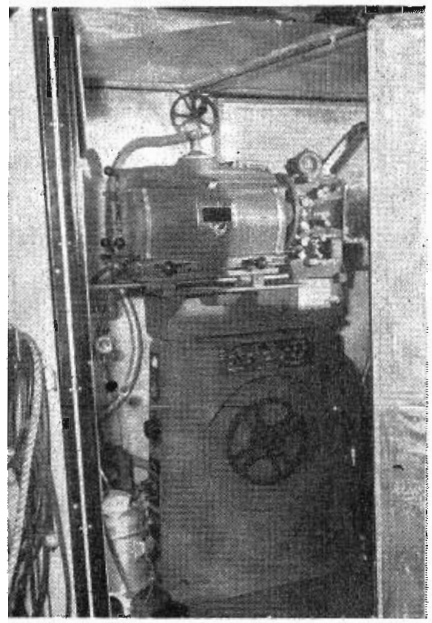


**Fig. 7. Holmes projector mounted in booth. Water type vacuum cleaner for arclamp exhaust cleansing is seen below lamphouse**

This project was carried out by NBC's Engineering Development Group under the direction and guidance of Mr. O. B. Hanson, Vice President and Chief Engineer of the National Broadcasting Company and Mr. G. M. Nixon, Manager of the Development Group.

## Erie Railroad

*(Continued from page 26)*

called, then held the "talk" switch to the next mile post. This procedure would continue until the train was definitely out of range. This was necessary since field strength may increase as changes in terrain offer more favorable transmission paths to the station site.

By plotting the results of these tests, stations were erected at locations where the 15 to 20 watt radiated signals from any two adjacent base stations overlapped sufficiently to assure an adequate signal strength of 5 microvolts in the receiver of a mobile station in the overlap area. On the mountainous Delaware division, 106 miles in length, the average base station spacing is about nine miles. On the remainder of the project east of Salamanca, the average spacing is 15 miles.

In Buffalo, N. Y., the tower of WEBR-FM, which is 410 feet above ground, is used to support the antenna. This antenna height provides coverage to Niagara Falls, the terminal area and considerable territory on the Buffalo and Southern-western divisions.

The Capehart-Farnsworth Railroad Radio-telephone System makes use of standard communication equipment together with a number of units specially developed for use on trains. As may be expected, particular attention had to be given to ensurance that the equipment was sufficiently rugged to stand up to daily heavy use coupled with continuous vibration and shocks from the passage of wheels over rail

*(Continued on page 53)*

# WASHINGTON
## News Letter

**Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau**

**SC-31 PROGRAM TO MOVE AHEAD**—One phase of the radio manufacturing industry which seems certain not to be curtailed but will be even sharply increased will be that in the supplying of aviation radio flight safety equipment. Before the Korean emergency, the Congressional economy axe which had lopped off $22 million from the funds of the Civil Aeronautics Administration during the House's consideration of the 1951 appropriations would have set back this program sharply for a year. But now the achievement of all-weather flying both for military and civilian aircraft is among the No. 1 priorities in the National Capital.

**MAKEUP OF NEW BUREAU**—The new FCC Safety and Special Radio Services Bureau which started functioning July 31 consists of an Office of the Chief under which is an Enforcement Unit; an Aviation Division which Col. White had headed; a Marine Division which handles all ship radio-electronic and radar matters and is being headed by William N. Krebs, FCC marine radio chief; a State-Local Government and Amateur Division under which will fall all police, fire, highway maintenance and other safety services; an Industry-Commerce Division which handles all industrial and land transportation mobile radio services; and the Authorization Analysis Division. The Authorization Analysis Division represents a new venture of the FCC in an attempt to expedite and streamline the handling and processing of all safety and special services' applications which meet the FCC rules, regulations and standards. Instead of having separate units process the applications of different mobile radio services, it is planned to establish an "assembly line" procedure which will handle all applications after they have been scrutinized as to meeting the FCC rules and standards. The Service Divisions have as major functions frequency coordination and studies and initiating policy decisions for the Commission.

**NEW DUTIES FOR FCC CHIEF ENGINEER**—Under recent FCC reorganization plan FCC Chief Engineer Curtis Plummer, who has gained an excellent reputation for his handling of television policies and technical problems, was given jurisdiction and responsibility over the encouragement and formulation of standards for experimentation in the electronic arts and general research and scientific use of radio. The Chief Engineer also continues his responsibility for restricted and incidental radio regulation such as low power industrial radio and electronic services, diathermy etc.

**FORTUNATE IN TWO COMMISSIONERS**—The radio industry, both manufacturing and broadcasting-mobile operating, is most fortunate in having two members of the FCC who are distinguished radio engineers in their own right. They are Commissioners George E. Sterling and E. M. Webster, the latter being a retired Commodore of the U. S. Coast Guard where for many years he headed the extensive wire and radio communications system of the Coast Guard on both coasts and the Gulf of Mexico. Commissioner Sterling, veteran of government radio engineering regulation since 1923 and a former FCC Chief Engineer, was confirmed unanimously by the U. S. Senate for reappointment for a seven-year term on the FCC.

**WORK OF RADIO-TECH COMMISSION**—During 1950 the famous Radio Technical Commission for Aeronautics SC-31 plan progressed substantially, with VHF Omni-Directional Radio Range Systems about 87% completed; Instrument Landing Systems 52% completed; Distance Measuring Equipment 50% completed; Approach Surveillance Radar 30% installed; Precision Approach Radar 26%; and VHF Automatic Direction Finder 19% completed. By the end of this year, the commercial airliners of the nation will have 80% of the airplanes equipped with airborne Omnirange and Instrument Landing apparatus through the work of Aeronautical Radio Inc., the cooperative radio-electronic organization of the air lines, which has been coordinating the equipment specifications, supplying and installation for the air lines of the airborne equipment.

**NEW MOBILE RADIO FCC SETUP**—The mobile radio services' regulation by the FCC appears to be one function that will not be dislocated too much by a serious war emergency because of the importance of the mobile radio operations to key fields such as power and gas utilities, petroleum, forestry, highway maintenance, bus-truck-taxicab-ambulance-physicians' cars, police-fire departments, aviation, and marine shipping which are vital cogs in the national defense. In order to streamline and make more efficient its regulatory operations in the non-broadcast radio services (mobile radio), the FCC has just established a new staff organizational setup—the Safety and Special Radio Services Bureau. Edwin L. White, a veteran staff engineer of the FCC and of its predecessor, the Federal Radio Commission, who holds the rank of Colonel in the U. S. Air Force after having served during the entire war in the Pacific and China-India-Burma theaters, has been appointed Chief of the new Bureau. He is ranked as an able and decisive administrator and has had a wide background of experience in radio engineering both with the Commission and the Air Force and previously with the Naval Research Laboratory and the Army Signal Corps.

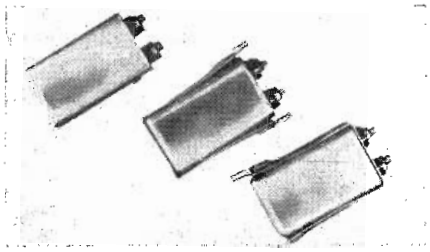
*National Press Building*
*Washington, D. C.*

*ROLAND C. DAVIES*
*Washington Editor*

# NEW EQUIPMENT for Designers and Engineers

## Capacitors

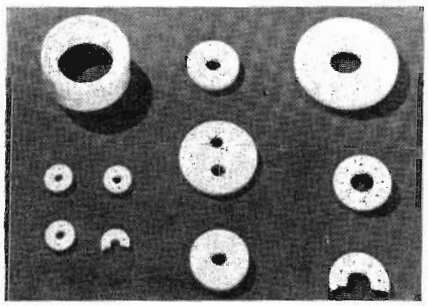
A line of zero temperature coefficient capacitors have been developed as the result of a need for relatively large capacitances (.0 to



.5uf) for a 400 cps resonant filter, operating from —60° to +75° C. Plasticon AS capacitors have a positive temperature coefficient of 1000 ppm/°C and Plasticon LS capacitors are negative 1000 ppm/°C. By combining matched capacitor elements of each type in a single container, temperature coefficients from +1000 ppm to —1000 ppm/°C can be supplied.—**Condenser Products Co. 1377 North Branch, Chicago, Ill.**—TELE TECH

## Insulators

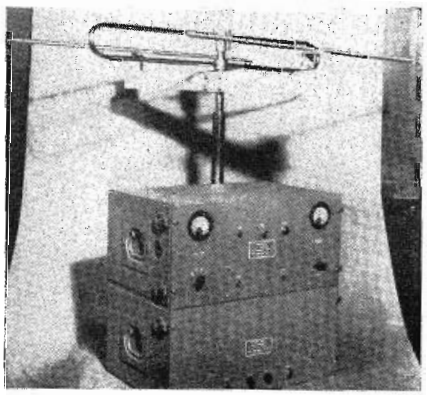
Low power factor and low dielectric constant are featured electrical properties of Chemlon, a new packing material which is



being fabricated into highly efficient electrical insulating spacers and anchor heads. Loss factor, dielectric constant and dielectric strength do not vary with the temperature changes below 400° C. Volume resistivity is not affected by moisture and surface resistivity is quite high. The material is also resistant to arc exposure; as soon as the arc is extinguished, full insulation strength is restored.—**Crane Packing Co., Dept. R-4, 1800 Cuyler Ave., Chicago 13, Ill.**—TELE-TECH

## Radio Link Equipment

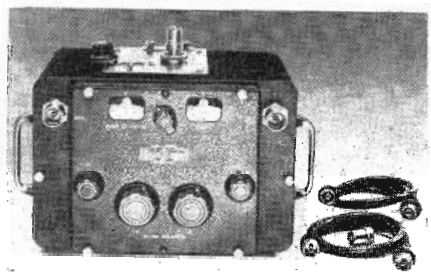
REL model 695 remote pick-up and mobile transmitter link equipment is intended to duplicate as closely as possible the broadcaster's fixed studio facilities, thus permitting the presentation of remotely-originated programs with comparable quality to those in the studio. A 12-v. dc power supply is



available for pickup truck operation. Emergency broadcasts can be on the air as soon as the pickup truck gets its microphones on the site of the remote. The photo shows the ac power supply and the transmitter and the antenna which is usually mounted atop the truck during operation.—**Radio Engineering Laboratories, Inc., 36-40 37th St., Long Island City 1, N. Y.**—TELE-TECH

## VHF Impedance Bridge

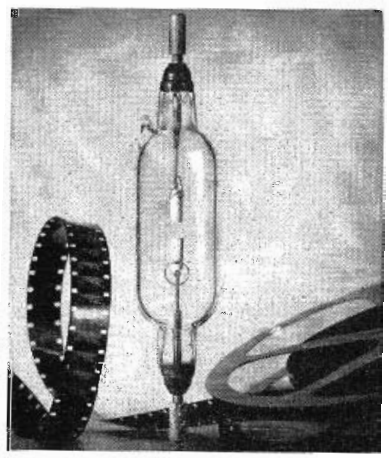
The frequency range of conventional bridge technics is extended up to 165 MC by the new 1601 VHF bridge. Similar to the 916-A



r-f bridge, this instrument measures the impedances of antennas, lines, networks, and components between the frequencies of 10 and 165 MC. Overall accuracy is ±2% for resistance and ±5% for reactance. The resistive and reactive components of the unknown impedance are measured in terms of incremental capacitances and are indicated on separate dials. The direct-reading resistance range is from 0 to 200 ohms and is independent of frequency except for small corrections. The direct-reading reactance range is from 0 to 230 ohms at 100 MC and is inversely proportional to frequency.—**General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH

## Flashtube for Motion Pictures

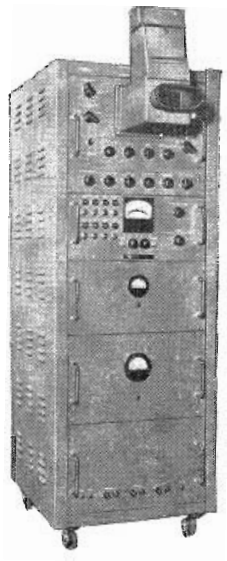
No. 231 Flashtube is a new TV light source development which is capable of emitting thousands of intense flashes of light with



durations down to 1/2,000,000th of a second. It is designed for certain types of equipment used in synchronizing the tube's 60 flashes per sec. with the motion picture's 24 film frames per sec. This new flashtube provides a steadier arc, resulting in reduced picture flicker; marked reduction in bulb blackening with a corresponding improvement in maintenance of light output; greatly increases lamp life; and simplified adjustment of the transmitter for best picture quality. When compared with the filament lamps used for TV motion picture projection, this new flashtube produces a surprisingly small amount of heat. Thus the film can be stopped at the first frame for focussing without danger of scorching. There is no need for a mechanical shutter to block off the light as the film is moved from frame to frame because the tube's powerful flash is so brief there is no unwanted light on the film during the pull-down period.—**General Electric Co., Nela Park, Cleveland 12, Ohio**—TELE-TECH

## Oscillograph

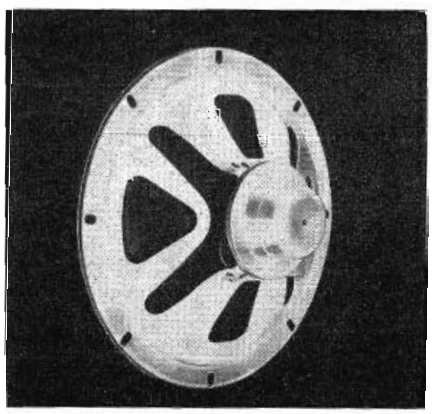
Type 293 oscillograph is DuMont's latest contribution to the field of impulse-testing of high voltage transformers, insulators, light-



ning arrestors, and other equipment designed to withstand surge potentials of great amplitude. It may be used with any standard impulse-test installation and can be triggered by a sample of the test impulse. A pulse generator has been incorporated in the instrument to trigger external circuits. An accurate quantitative measurement of the test impulse is provided by metered voltage calibration of deflection along the Y axis and time calibration, accurate within 0.1%, along the X axis. Permanent records are obtained with a specially-designed 35mm oscillograph-record camera which is supplied as standard equipment with the 293. Driven, logarithmic sweeps may be initiated from an external signal, internal signal, by manual push-button, or from any point in the cycle of the 60 cps line voltage. Sweep duration is adjustable from 0.5 to 1000 microsec. Delay of the sweep with respect to the trigger output of the instrument, is continuously variable from 0.5 to 15 $\mu$ sec., permitting detailed display of any portion of the impulse waveform.—**Allen B. DuMont Laboratories, Inc., 1000 Main Ave., Clifton, N. Y.**—TELE TECH

## TV Speaker

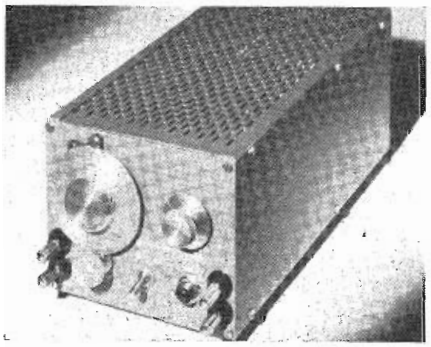
A television loud speaker has been developed with a magnetically enclosed motor structure, enabling it to be mounted close



to the picture tube. It has a high efficiency magnetic structure which utilizes the minimum weight of Alnico V, resulting in a considerable saving in the cost of the magnet. Models are made in sizes ranging from 5 to 12 in.—**Rola Co., Inc., Aircraft Bldg., Cleveland, Ohio**—TELE-TECH

## Filter

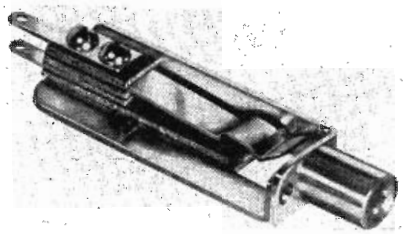
Model 300 filter has a continuously variable cutoff within the frequency range of 20 cps to 200 KC. With an attenuation rate of 18



db per octave it is analogous in performance characteristics to the constant-K inductance capacitance filter. High-pass and low-pass sections as well as four decade frequency ranges are selected by a range switch. Several filters can be cascaded so that attenuation rates of 36, 54, etc. db per octave can be realized. Light in weight and, compact in construction, the model 300 has low noise level and incorporates a regulated power supply.—**Spencer-Kennedy Laboratories, Inc., Dept. TT, 186 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH

## Patch Panel Jack

A new tooled telephone-type jack, designed for pateh panels, uses nickel-silver contact springs, pure silver contact and 1/16 in. steel



frame. It can be installed in standard Western Electric and Cinema-type jack mounting strips. Catalog umber is 1399-B.—**Cinema Engineering Co., 1510 West Verdugo Ave., Burbank, Calif.**—TELETECH

## Ohm's Law Calculator

A new pocket-size Ohm's Law Calculator, featuring separate slide rule and parallel resistance scales, provides a simple and handy means of solving resistance problems. Two new scales on the back provide a standard slide rule as well as a quick, one-setting means of solving parallel resistance problems. List, $0.25—**Ohmite Manufacturing Co., 4937 Flournoy St., Chicago, Ill.**—TELE-TECH

## Recording Paper

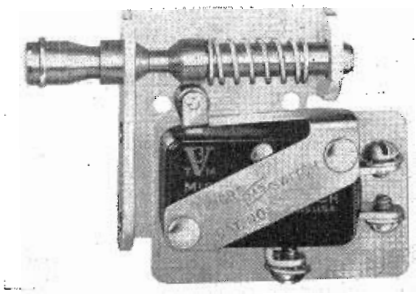
The recording of computor totals, radar signals, sonar signals, infra-red signals, and telemetered data are facilitated by the use of Alfax direct marking recording paper which records an instantaneous trace that is permanent, smudge-proof and stable to light and water. Alfax paper has a wide range of response, being capable of recording a strong signal immediately adjacent to a faint one. At high speeds a recording of transients of 30 μsec. duration can be made.—**Alfax Paper & Engineering Co., 40 Riverside Ave., Brockton 27, Mass.**—TELE-TECH

## Hand Operated Press

Designed as a result of numerous requests from radio technicians and manufacturers, the Pioneer Ham-R-Press operates on the principle of transmission of hammer pressure, through the vertical ram, directly to the working point. Pressure on the arms and back of the frame is eliminated. The machine frame is made of strong nickel alloy and a moveable ram is precision piloted in the upper frame arm. The ram's movement in a vertical plane is free and alignment with the work table is always maintained. Four models are available with throat depths of 5, 7½, 12, and 24 in.—**Pioneer Broach Co., 1424 South Main St., Los Angeles 15, Calif.**

## Snap-Action Switch

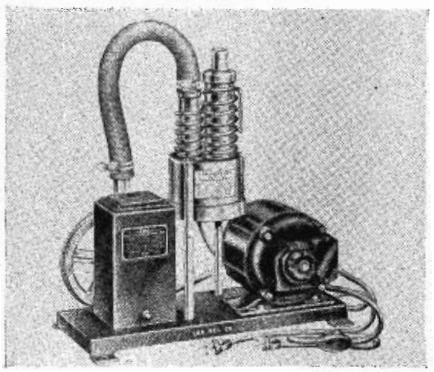
The recently-developed Acro open-blade, snap-action switch now carries Underwriters' Laboratories rating of 15 amps at 125 volts or



7½ amps at 250 volts ac. Made in two models, the switch features a fast-action rolling spring and is available with return or set type action. The large model is more ruggedly constructed with oversize contacts to assure longer life where the continuous load closely approximates the rated load.—**Acro Electric Co., 1442 Superior Ave., Cleveland 14, Ohio.**

## High Vacuum Pump

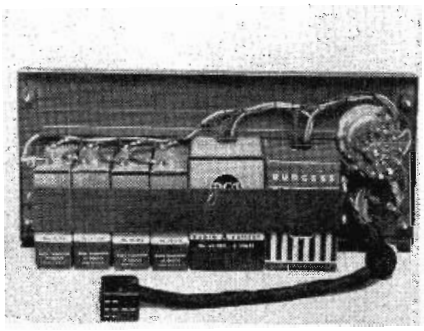
The 93280 vacuum pump has a pumping speed of 20 liters/sec. or better at $10^{-4}$ mm pressure. It consists of a motor driven Cenco-



Pressovac backing pump, an all-metal diffusion pump with self-contained heater, vacuum rubber tubing connection, and special support for the diffusion pump, all mounted on a well-finished steel base. Power demand of heater is 200 watts. List, (115-v. model) $175; (230-v. model) $185.—**Central Scientific Co., 1700 Irving Park Road, Chicago 13, Ill.**—TELE-TECH

## Battery Container

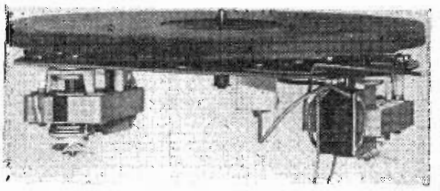
A new battery container and cover has been designed for the type BN-2A remote amplifier, used in remote AM and FM broad-



casting, thus eliminating the problem of carrying standard "A" and "B" batteries in a separate battery case. The battery-container an cover, which can be mounted on the BN-2A in place of tho usual top cover, contains an ac receptacle, a switch to select ac or battery operation, and a clamp for holding two 6-v. "A" batteries and four 67½-v. "B" batteries. This battery pack will supply power for the remote amplifier for 1½ to 2 hours of continuous operation.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**

## Record Player Assembly

The new Dual-Speed Phonomotor assembly uses two motors to drive either a 10-in. or 12-in. turntable at 33 1/3 or 78 rpm. Each motor develops sufficient torque to drive the



turntable at the proper speed when loaded with any existing record type including large transcriptions. A single, three position. lever provides the required electrical and mechanical control for switching the desired motor on or off and for engaging or disengaging the appropriate idler tire between the motor pulley and the turntable rim. Motor inputs are interconnected so that only one power lead to the assembly is necessary. Units can be furnished to operate from 110-volt to 220-volt power sources at 50 or 60 cps.—**Alliance Manufacturing Co., Alliance, Ohio.**

## Laboratory Kit

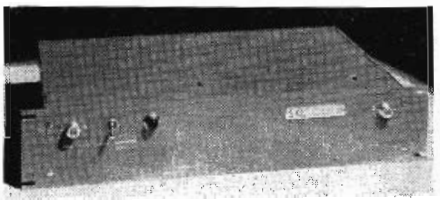
Designed for the assembly of experimental electronic circuits, the UniChassis is a breadboard kit which includes an 18-gauge sheet steel chassis, specially designed bus bars, plug-in leads, miniature tube adaptors and miscellaneous connectors. The generous number of sockets on the chassis facilitates the use of plug-in components. Holes in the vertical panel of the chassis provide means for mounting potentiometers, variable capacitors, switches, jacks and other panel components. —**Uni-Products, Inc., 1048 Potomac St., N. W., Washington 7, D. C.**—TELE-TECH

## Pickup Arm

Model 190 pickup arm has been developed to overcome the disadvantages inherent in conventional arms and to enable a high quality cartridge to meet the stringent requirements for playing LP records without distortion and free of record and stylus wear. Characteristics of the 190 include: a low-as-possible vertical-to-lateral moment of inertia; a minimized vertical mass in order to track any reeord without imposing extra vertical load on grooves so that badly warped records as well as flat ones can be played; absence of spurious arm resonance at any frequeney; lower than 3 gram centimeters pivot friction; static balancing about the vertical axis to eliminate tendency to jump grooves when subjected to bumping or jarring.—**Pickering & Co., Oceanside, N. Y.**—TELE-TECH

## Amplifier

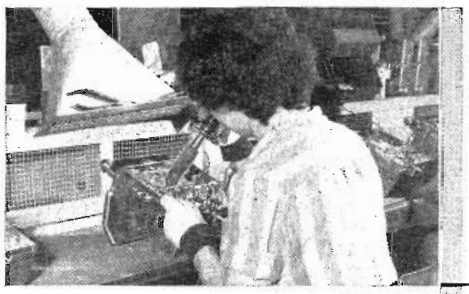
Model 212TV amplifier, specifically designed for television applications, is a single untuned amplifier having a band width of



40 to 240 MC and a gain of 20 db into a 72 ohm unbalanced load, and 25 db into a 300 ohm balanced line. Capable of replacing up to 12 single channel TV or FM amplifiers, it has a transmission charactristic of ±2 db over the bandwidth and an impedance of 200 ohms. In addition to an integral power supply, transformers can be supplied to match 52, 72. and 93 ohm unbalanced and 300 ohm balanced lines.—**Spencer-Kennedy Laboratories. Inc., Dept. TT, 186 Massachusetts Ave., Cambridge 39, Mass.**

## Transmission Test Set

In addition to measuring the electrical characteristics of carbon microphones, receivers, and magnetic microphones, the 693 multi-purpose test set may be used for efficiency tests on capacitors, generators, insulation resistance, dials, and continuity. Key switches and dials are used to select and control the test circuits. Portable and compact, the unit is powered by external batteries.—**Shallcross Manufacturing Co., Collingdale, Pa.** —TELE-TECH



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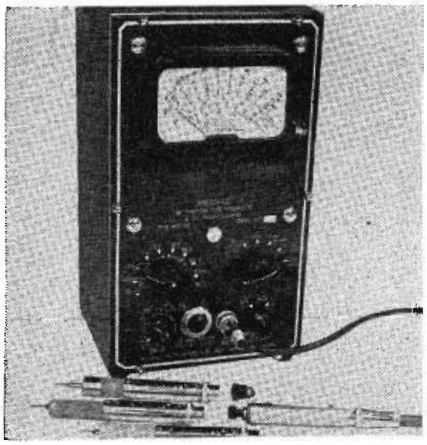
## R-F Millivolt Meter

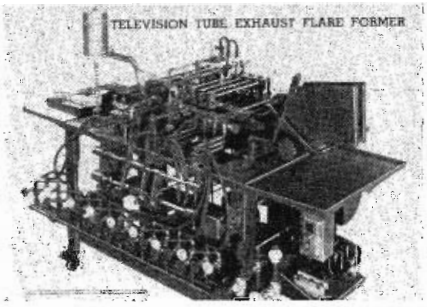
Frequencies from one to 200 MC flat can be measured with direct calibration and higher frequencies up to 2500 MC can be measured



with calibration charts by the Millivac MV-18b high frequency vacuum tube millivolt meter. A new carrier-type dc amplifier having exceptionally heavy negative feedback to insure accuracy and stability has been incorporated in the instrument. Germanium crystal probes are used to rectify weak r-f signals with minimum circuit loading.—**Millivac Instruments, P. O. Box 3027, New Haven, Conn.**—TELE-TECH

## Television Tube Flare Machine

A fully automatic flare machine for making large flares of uniform diameter from cut tubing has been developed. This machine's design makes it suitable for mass production




of a new type television flared stem. The use of this flare exhaust tubing eliminates the need for a button type stem. Automatic hopper glass feed, driving rollers, forward mechanism, hold-down rollers, forming tools and necessary burners are mounted on the table. The unit is equipped with adjustable speed reducer control and forwarding cam shafts are mounted beneath the table. Cam shafts for operating tools are located in front of the machine —**Eisler Engineering Co., Inc., 750 South 13th St., Newark 3, N. J.**—TELE-TECH

## Coil Bobbins

Coil bobbins are now being manufactured with a new plastic-coated core, and the flanges are locked firmly in place on this core

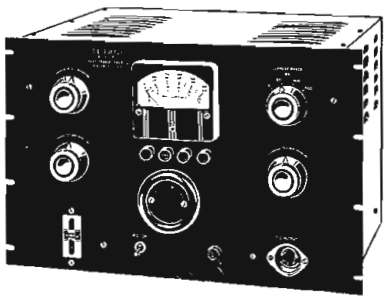
by the plastic. Thus, wire cannot be crowded on the bobbin, nor become loosened, as it does when loose flanges slide along the tube or off it. As a result, coils can be wound to much closer tolerances with **fewer rejects.—Precision Paper Tube Co., 2045 West Charleston St., Chicago 47, Ill.**—TELE-TECH

## Oscilloscope

An outstanding design feature of the new WO-57A oscilloscope is the direct-coupled vertical amplifier which is used to provide flat low-frequency response. This circuit assures excellent low-frequency square-wave reproduction, essential for correct sweep alignment. Deflection sensitivity is better than 30 mv./in. and the frequency response of the vertical amplifier is flat within 2.3 db from zero to 500 kc, down only 6.8 db at 1 MC, and useful beyond 2 MC. The instrument has a frequency-compensated and calibrated step attenuator and a vernier control and a calibrating voltage source. Advanced sweep features which have been incorporated are: a linear sweep range from 15 to 30,000 cps with present fixed sweep positions for viewing vertical and horizontal deflection-circuit waveforms; positive and negative synchronizing for easy lock-in of upright or inverted pulse waveforms; and an exclusive sweep direction-reversing switch for left-to-right or right-to-left traces. In addition, the instrument has a phase-controlled 60-cps sweep. Traces may be expanded 2 times screen diameter for sweep-alignment applications.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**—TELE-TECH

## DC Power Supply

A DC power supply (model 1170) has been developed which provides four continuously variable current ranges: 5 ma, 25 ma, 100 ma,



and 500 ma. Maximum output voltage is 270 v. dc. The noise level is —92 db. This unit has been designed primarily for use as a dc supply for Freed's incremental inductance bridge 1110.—**Freed Transformer Co., Brooklyn 27, N. Y.**—TELE-TECH

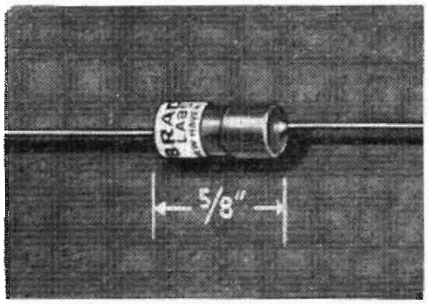
## Voltage Reference Standards

A line of voltage standards which may be used as laboratory standards or as components has been developed. All units are


sealed and guaranteed to maintain rated output for a period of six months. This means that batteries, standard cells or the usual regulator-rectifier combinations can be eliminated by this packaged unit when it is used with self-balancing potentiometers or other "bridge-type" equipment. Model VS50-50 (illustrated) has an output of 50 v. dc. Dual output terminals are provided, either of which has a capacity of 50 ma. Ratings of all units range from 2 to 300 v. dc, from 15 to 50 ma.—**Sorenson & Co., 375 Fairfield Ave., Stamford, Conn.**—TELE-TECH

## Copper Oxide Rectifier

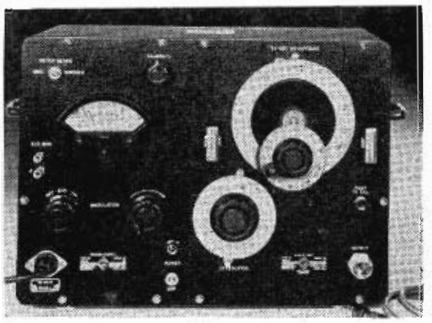
A new copper oxide rectifier has been designed which provides an extremely high reverse resistance of over 1 megohm per plate. It is useful in circuits where very low leakage




and maximum stability are essential. Featuring vacuum-processed gold contacts, the rectifier is rated up to 5 ma dc. The rectifier is ⅜ in. long and ¼ in. in diameter.—**Bradley Laboratories, Inc., 82 Meadow St., New Haven, Conn.**—TELE-TECH

## Signal Generator

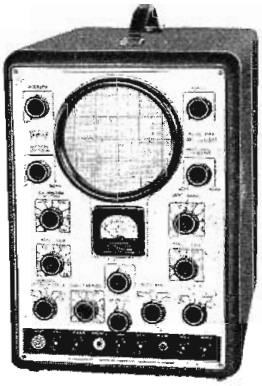
Type 1021-A standard signal generator offers, for the uhf and vhf bands, the simplicity and convenience of operation that has



hitherto been available only in generators operating at much lower frequencies. The 1021-AV operates at frequencies between 50 and 250 MC and the 1021-AU is designed for frequencies between 250 and 920 MC. Both models use butterfly tuning elements, and coaxial, 50-ohm output systems. Frequency dial is direct-reading to ±1%. Internal amplitude modulation is provided and external modulation between 30 cps and 15 KC can be applied. With the 1023-A amplitude modulator, audio modulation up to 80% can be produced at carrier frequencies up to 250 MC, and with the 1000-P6 crystal diode modulator, TV video modulation can be produced over the entire carrier frequency ranges of the generator.—**General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH

## Oscilloscope

An exclusive pattern reversing switch and a calibrated meter for peak-to-peak voltage measurements are features of the model 3440



5-in. oscilloscope for television and general laboratory use. The unit has high vertical sensitivity —.009 RMS volts per in. and a conventional return trace eliminator. A telescoping light shield, linear sweep voltages up to 60 KC and a wide frequency range (20 cps to over 1 MC) are also included. A demodulator probe is also available for signal tracing. —**Triplett Electrical Instrument Co., Bluffton, Ohio.**—TELE-TECH

## Sound Waves Photographed

A new technic recently developed at the Bell Telephone Laboratories makes actual photographs of sound wave patterns possible. The method will be used for studying the sound waves from telephone receivers and similar communications equipment, and for observing microwave radio wave patterns

Equipment used in this work consists of a tiny microphone and a neon lamp, mounted on a swinging beam which scans the wave field. As the beam moves through the field, a clear picture of the sound radiation is built up by scanning, similar to the way in which television images are formed.

In one of the first experiments using the new technic, Bell scientists W. E. Kock and F. K. Harvey, who developed it, made photographs showing the precise acoustic focusing effect of lenses. The lenses are similar to those used in microwave radio relay systems.

The microphone used in taking the pictures of sound is about the size of a quarter. It is mounted on the end of an aluminum arm four feet long along with a tiny, 110-volt neon lamp. A small loudspeaker radiating a sound wave is directed at one side of the acoustic lens. On the other side of the lens, the metal arm swings up and down, inscribing a three-foot arc through the path of the sound waves as they emerge from the focusing lens. Sound picked up by the microphone is carried to an audio-amplifier. As the sound level varies, the brightness of the neon lamp varies in proportion.

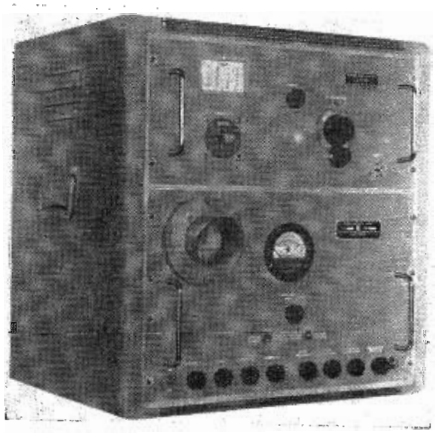
Viewed in a darkened room, the lamp glows brightly, then fades, then brightens again. As it traces its vertical pattern, it automatically moves horizontally away from the lens. Thus in a ten-minute time exposure, a sound wave pattern may be photographed.

## Audio in United Nations

It is understood that the new UN sound reinforcement system and translation circuits will feature low level switching and a noise level on the lines of −70 db. This latter is somewhat difficult to achieve in circuits stretching over long lines and covering many pickup and switching circuits. If the FM transmitter scheduled for the roof of the new New York building ever is installed this high quality line will be extremely valuable.

## *Universal Spectrum Analyzers*

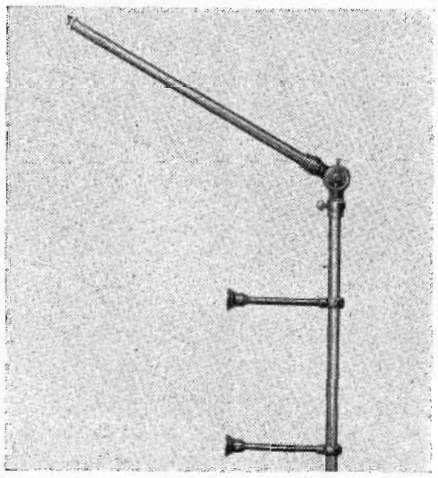
Accurate determination of r-f pulse characteristics are facilitated by a new series of microwave spectrum analyzers. Each analyzer



consists of a type 850 power supply, i-f and video unit, together with a demountable r-f section appropriate for the particular frequency range of interest. Available analyzers now cover the S-band and X-band regions of the microwave spectrum, with a special combination instrument, type 855, containing r-f section for both frequency ranges.—**Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.**—TELE-TECH

## *Microphone Support Arm*

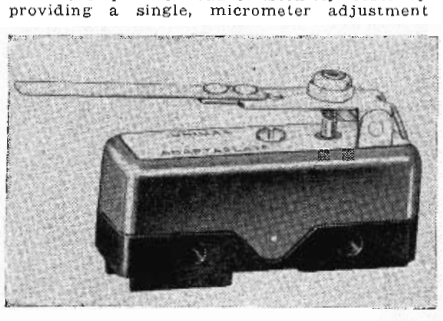
An all-purpose boom bracket kit has been developed for microphone support on switchboards, consoles, ceiling and wall surfaces and



desks or tables. The set-screw assembly makes it possible to cut down any tubular section so that the support bracket can be custom built to meet the specific requirements. The microphone cable feeds through the entire support arm as well as the adjustable elbow mechanism. All parts are finished in opalescent bronze enamel. Maximum length of boom is 23 in.—**Atlas Sound Corp., 1449 39th St., Brooklyn, N. Y.**—TELE-TECH

## *Precision Switch*

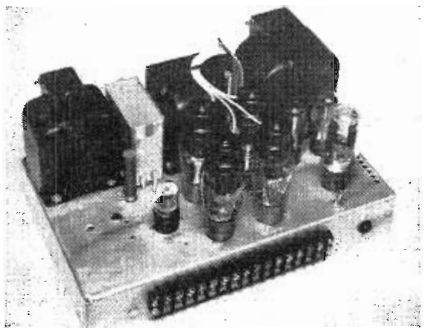
A simple screw adjustment on the leaf actuator of the Unimax snap-acting precision switch type. MXT-1-2131 allows the operating point to be set at exactly the correct position for the desired action. This switch was developed to reduce assembly costs by providing a single, micrometer adjustment



which compensates for the cumulative effect of tolerance variations in mass-produced assemblies. Turning the Allen-screw head on the hinged arm of the leaf "Adaptaplate" raises or lowers the operating point through a range of ⅜ in.—**W. L. Maxson Corp., 460 West 34th Street, New York 1, N. Y.**—TELE-TECH

## *Power Amplifier*

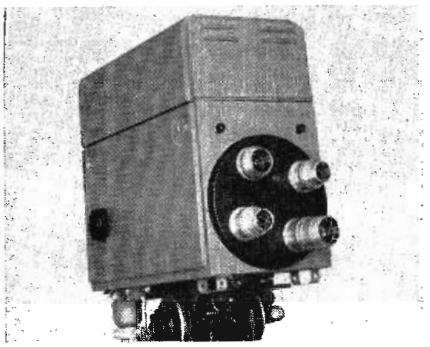
A two-stage bridging power amplifier, featuring inverse feedback control and a voltage-regulated power supply, has been developed



for high-power sound systems. Designated the MI-12188, it will provide excellent frequency response from 30 to 15 KC with low distortion. Normal power consumption is 240 watts and 70 watts can be supplied to any one of several load impedances when bridged across a line of 3.3 v. RMS maximum. Provisions are made for adding a relay to control plate voltages, and the amplifier will also supply well filtered dc plate voltage and 6.3 v. ac heater voltage to an external amplifier.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**—TELE-TECH

## *TV Camera Chain*

The C V-2 field television camera chain incorporates the latest design image orthicon (type 5820) pickup tube which enables it to



be used readily under conditions of poor illumination as well as in bright sunlight. The units comprising the chain have simplified interconnections enabling the equipment to be placed quickly in operation. The view finder unit plugs and clamps to the camera unit. All components are packaged in suitcase type containers of approximately the same size.—**Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.**—TELE-TECH

## *Magnetic Record Tape*

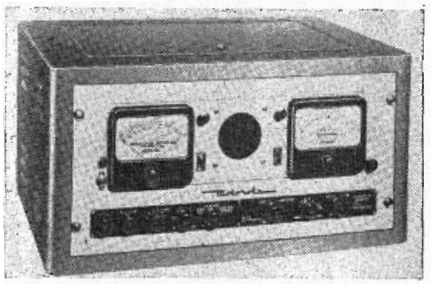
Audiotape, a new tape for magnetic recorders, is cut by a superior straight-line slitting process which makes it track and wind absolutely flat. It has no curl and lies flat on the magnetic head without increased tension, giving better frequency response and more uniform motion. Audiotape is completely free from any tendency to stick, layer to layer. Unwinding is uniform and there is no tendency to create wows. It is supplied on plastic or paper base with red or black oxide. List plastic base on 1250-ft. reel, $5.50; 600-ft. reel, $3.50. List of paper base on 1200-ft. reel, $3.50; 600-ft. reel, $2.25.—**Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.**—TELE-TECH

## *Ceramic Disc Capacitors*

A new line of miniature ceramic disc capacitors, known as the "Tiny Mike", are available for bypass and coupling in assemblies that are very compact. Diameter of the new capacitor is 19/32 in. and thickness is 5/32 in. It is being manufactured in capacities of 50 to 500 μμf, ±20% and in 500 to 5000 μμf guaranteed minimum capacity within a temperature range of +10° C and +65° C.—**Cornell-Dubilier Electric Corp., South Plainfield, N. J.**—TELE-TECH

## *Frequency Deviation Monitor*

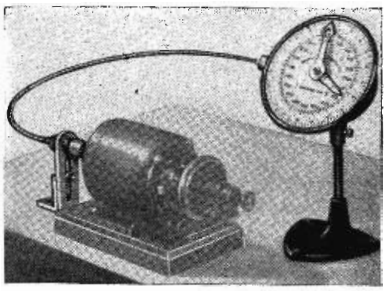
The maintenance of good communications in 2-way FM radio systems can be made easier with the use of a new, highly sensitive fre-



quency-deviation monitor. The unit performs the following functions: measures relative strength of signals being transmitted; measures the magnitude of frequency modulation; and measures the error displacement of the signal from its assigned center frequency. Designed for 117-v., 60 cycle operation, it monitors up to 5 carrier frequencies in either the 25-50 MC band or the 152-174 MC band. Additional frequencies may be monitored by the simple exchange of control crystals.—**Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.**—TELE TECH

## *Coil Winding Counter*

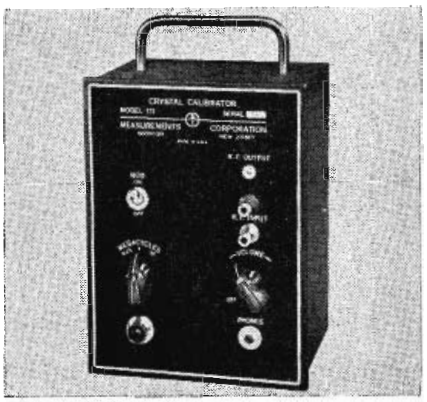
Quarter-turn accuracy at high speed is provided by the Clipper quarter-turn coil winding counter which counts to speeds of



10,000 turns per min. It is equipped with a large 6-in. dial calibrated in quarter turns, which indicates 2500 turns and repeats. The pointers are mounted on specially designed friction hubs which permit reset to zero with one quick motion. The Clipper can be furnished with flexible shaft drive, which permits counter to be installed directly back of coil, or for direct connection to the motor shaft.—**Production Instrument Co., 708-34 W. Jackson Blvd., Chicago 6, Ill.**

## *Crystal Calibrator*

Calibration of the frequency of signal generators, transmitters, receivers, grid-dip meters and other equipment in the range of




250 KC to 1000 MC is facilitated by model 111 crystal calibrator. Accuracy is ±0.001%. A dual-purpose calibrator, it not only provides a test signal of crystal-controlled frequency but also has a self-contained receiver with a sensitivity of 2 microwatts. A new circuit arrangement utilizes the cross modulation products of three separate oscillators operating at the fundamental frequencies of .25, 1.0 and 10 MC. Power requirements are 117 v., 50/60 cps.—**Measurements Corporation, Boonton, N. J.**—TELE-TECH

## ERIE RAILROAD RADIO

(*Continued from page 45*)

joints. Also, ground stations which are unattended must be capable of operation without continuous maintenance.

The Capehart-Farnsworth type M 100-2 VHF, FM transmitter is used in all stations, both fixed and mobile. This transmitter operates on 117 v. ac. In the case of fixed stations the power supply operates off standard lighting circuits via an ordinary power supply. But for mobile stations other means have to be devised to operate the necessary ac power to operate the equipment.

The maximum deviation permissible is 15 KC, controlled by an automatic deviation limited. A modified Pierce oscillator uses separate crystals and tubes for each of the two frequencies provided. Phase modulation is applied to the crystal fundamental. The signal is then multiplied 36 times via two doubler and three tripler stages. The final stage is a type 829 B tube, operating in push-pull.

Normally 15 watts RF output is obtained with the equipment as installed, although 30 watts can be obtained by using a 400 volt supply. The stand-by primary drain is of the order of 55 watts for the tube filaments and crystal oven. The audio drain is 6 watts for B plus. When the transmitter is operating the input drain becomes 170.5 watts. The audio range is confined to frequencies required for adequate communication, i.e., 200 to 300 cps, plus or minus 2 db.

### Receiver

The receiver, type M 200-2, is a fixed frequency crystal controlled, double conversion, superheterodyne, designed for a carrier deviation of plus/minus 15 kc. The crystals are contained in an oven to maintain frequency stability. Cascade limiters remove amplitude variations, and carrier and noise operated squelch mutes the receiver except when an actual modulated signal is received.

Double conversion is used, and after RF amplification the signal is mixed with the eighteenth harmonic of the crystal and a first i-f frequency of between 13.76 and 14.76 MC is produced. The actual i-f frequency depends on the channel on which the receiver is operating. The carrier is always higher than the 18th harmonic with which it beats. After one stage of amplification the signal is mixed at the second converter with the second harmonic of the crystal. The second i-f operates at 1.6 MC, which is always higher than the signals from the first i-f. By the use of double conversion high image and adjacent channel rejection is obtained, plus low i-f drift with temperature changes, and high i-f gain without risk of regeneration.

For 20 db quieting 1 microvolt is required. A maximum audio output of 5 watts is obtainable from the 6V6GT/G audio stage. The total power input required is 70 watts. Both loudspeaker and handset phone operation is possible so that the speaker can be used to attract the attention of the crew, and the handset then used for greater intelligibility in cases where there is high ambient acoustic noise.

For the fixed power supply is generally no problem since 117 volts ac are generally available, but for the mobile units a more complicated setup is often necessary.

For units used on diesels there is always an adequate supply although it may require modification before

## POWER TRIODE (Continued)

to the external circuit through a large diameter, low inductance copper cylinder and grid ring. The grid structure and grid ring provide for the isolation of plate and cathode circuits to allow stable operation without neutralization in grounded grid circuits. The grid ring is constructed of oxygen-free high conductivity copper which is superior to other useable metals, due to the skin effect at very high frequencies. Suitable provisions are made to allow for three dimensional alignment of the grid with respect to the filament and a rigid mechanical structure is utilized throughout to avoid any displacement of elements.

The anode is fabricated from oxygen free, high conductivity, heavy wall copper allowing a more uniform heat distribution and higher dissipation than a thin wall anode. The heavy wall anode also permits a higher exhaust temperature resulting in better degassing. The use of a re-entrant cup is incorporated in the anode to shorten internal grid and filament leads and to provide a suitable glass insulation path between grid and anode. Cooling of the anode is accomplished by an integral water jacket, Fig. 3, which facilitates the use of the tube in coaxial circuits and allows it to be built in as a portion of the plate tank line with a minimum of discontinuity of the r-f field. The jacket has been designed with a quick-change feature, a few turns of a screw driver being all that is required to loosen the tube from its base plate and break the water connection. The tube need be raised only 2-in. to remove it from the socket, representing a considerable saving of space as compared to a conventional jacket. The water seal is made with two small diameter hydraulic "O" rings.

As a result of care in assembly and close tolerances, electrical and mechanical characteristics are quite uniform. The high mutual conductance makes it possible to obtain 25 KW output at 7.5 KV eliminating the high cost of 10 or 15 KV rectifiers usually associated with high power tubes. The lower plate voltage also makes the tube more desirable for use in wide band amplifiers. Electrical characteristics are listed in Table I.

A water flow of 7 GPM is required for cooling of the anode and low pressure air is required on the filament stem to limit maximum glass temperature to 150°C. Constant current curves are shown in Fig. 4.

**TABLE I**

| | |
|---|---|
| Filament Voltage | 6.2 v. |
| Filament Current | 435 Amp |
| Amplification Factor | 38 |
| Interelectrode Capacitances | |
| Grid-Plate | 52 $\mu\mu$f |
| Grid-Filament | 72 $\mu\mu$f |
| Plate-Filament | 1.2 $\mu\mu$f |
| Max. Ratings—Class C Telegraphy to 110 MC | |
| Plate Voltage (dc) | 9,000 v. |
| Grid Voltage (dc) | -1,500 v. |
| Plate Current (dc) | 10 Amp |
| Grid Current (dc) | 0.9 Amp |
| Plate Input | 80 KW |
| Plate Dissipation | 25 KW |

**TABLE II**

| | |
|---|---|
| Typical Operation—Grounded-Grid—110 MC | |
| Plate Voltage (dc) | 7,200 v. |
| Grid Voltage (dc) | -270 v. |
| Plate Current (dc) | 5.35 Amp |
| Grid Current, approx. (dc) | 0.45 Amp |
| Driving Power, approx. | 4.2 KW |
| Power Input, approx. * | 26 KW |

*Includes power transferred from driver stage.

The test circuit is essentially a conventional grounded grid coaxial amplifier. As shown in Fig. 5, the filament tank is three-fourths wavelength long, piston tuned from 80 to 115 MC, with provision for feeding driving power at points of suitable impedance for the frequencies involved. The filament power is fed through concentric lines which also provides for the low pressure air supply required in stem cooling, the air passing through the main body of the filament tank as it is expelled.

In the design of the grid grounding capacitor, the size precludes the use of a single mica sheet as dielectric while the normal heat transmission prevents the use of plastics. In the search for a suitable material, silicone impregnated fibre glass was decided upon and the grid capacitor area was made to conform to the requirements established under these conditions.

The plate circuit is a half-wave tunable open line of characteristic impedance comparable with the filament system. Plate voltage is fed to a point close to the glass anode seal by means of a tunable quarter wave stub which also provides passage for the anode cooling water to the tube jacket.

In each circuit, the large center line is supported by two sets of four diametrically opposed rectangular mycalex bars. It is interesting to note that there have been no dielectric failures of insulating materials.

Load coupling is accomplished by a link inserted into the plate tank and supported by coaxial stubs which provide the necessary features of link tuning stub and load impedance matching. The load itself is a conventional 50 ohm water cooled device.

The measured values of power gain in the test circuits using the F-5512 are in excess of 5 to 1 at the maximum rated frequency with normal efficiencies. See Table II.

Acknowledgment is made to H. W. Baker, Wm. Happe, Jr., and other members of the engineering staff for their suggestions and contributions to the circuit and tube design.

## Noise Generators

*Appendix I for "Noise Generators and Measuring Technics" by I. J. Melman which appeared in the May, June and July issues is presented below. Appendices II and III will appear in a subsequent issue.*

**Derivation[25] of fundamental diode noise generator formula, $F=20IR_a$.**

From Fig. 2c of text, the total receiver noise may be represented by a noise generator whose mean-squared noise current output is $F\,i_a^2$ where F is the noise factor and $i_a^2$ is the mean-squared noise current of the antenna resistance, $R_a$.

From Eq. (1a) of text:

$$F\,i_a^2 = (4KT\Delta f_1/R_a)\,F$$

where $\Delta f_1$ is the signal channel noise bandwidth of the receiver.

From Eq. 5 of text the noise diode is represented by a current generator of mean-squared value:

$$i^2 = 2eI\Delta f_2$$

where I is the direct current through the diode and $\Delta f_2$ is the overall noise bandwidth which includes the spurious responses of the receiver. Let the receiver noise output be $N_1$ when the noise diode is turned off and $N_2$ when the noise diode direct current is I. Let:

$$N_2/N_1 = M$$

then the noise power added by the diode is (M-1) times the original receiver noise power or:

$$2eI\Delta f_2 = \frac{(M-1)\,4kT\Delta f_1\,F}{R_a}$$

Solving for F

$$F=(e/2KT)\ (IR_a/M-1)\ (\Delta f_2/\Delta f_1)$$

Substituting the values of the constants e and K in (5) and T=290°K:

$$F=(20IR_a/M-1)\ (\Delta f_2/\Delta f_1).$$

In general the spurious responses of most receivers will have negligible effect on $\Delta f_2$, and for this general condition $\Delta f_2$ can be considered equal to $\Delta f_1$, or:

$$F = 20IR_a/M-1$$

In the usual procedure the noise diode is made to double the noise power output, i.e., M=2 and:

$$F = 20IR_a$$

# PERSONNEL

**Rodney D. Chipp** has been elected chairman of the New York section of the IRE for 1950-51. He is director of engineering for the Du Mont television network and previously held the offices of IRE treasurer and secretary.

**John V. L. Hogan** on July 1 succeeded **Donald G. Fink** as Chairman of the Joint Technical Advisory Committee of RMA and IRE to advise the government on technical matters as a successor to the former Radio Technical Planning Board. **I. J. Kaar** succeeds Mr. Hogan as vice chairman of the committee. Other JTAC members are: **Dr. Ralph Brown; Dr. T. T. Goldsmith, Jr.; Haraden Pratt; Philip E. Siling; David B. Smith.**

**Francis X. Rettenmeyer** has joined Philco Corp. as executive engineer to assist in the engineering administration of the company's Government and industrial electronics program. For the past five years he has been chief engineer for Federal Radio Telegraph Co.

**John A. Green** has established the John A. Green Co., manufacturers' representatives, and the Equipment & Service Co., consulting engineers and electrical manufacturers, at 6815 Oriole Drive, Dallas, Texas.

# TELE-TECH's NEWSCAST

## Empire State Bldg. Antenna Installation

Work has commenced on the 200-ft. tower which will carry the antennas for five TV and three FM stations on the top of the world's highest building. At the present time WNBT and WJZ-TV antennas occupy the pillar which was intended as an airship mooring mast. As the newcomer, and because of space considerations, WJZ-TV's antenna is on the top of the tower, above WNBT. When the installation is completed the antennas for the five TV stations will probably stack up as follows, from top to bottom: WPIX, WJZ-TV, WABD, WNBT, WCBS-TV. This is dictated by construction considerations which require the smaller, high frequency antennas to be above the larger, low-frequency radiators. This puts the TV antennas in order of channel number as follows: 11, 7, 5, 4, 2, not excluding the FM outlets for WJZ-FM, WNBC-FM, and WCBS-FM. It is understood the new RCA screened dipoles will be used for each of the transmitters since use of a single antenna type assists in reducing problems of mutual interference.

During the time that the new steelwork is being installed the antennas for WNBT and WJZ-TV will be mounted on gin poles and slung over the top of the building at slight angles to the vertical. In this manner there will be no disruption of the present TV service. The newly located TV stations are reported to be installing new transmitters so that they will be able to continue operations from their old locations until the new installation on the Empire State Building is completed.

## New Skiatron Quarters

The Skiatron Corp., developers of large screen television using the supersonic cell and opaque tube; and Subscribervision, a method of subscription television programming which requires only a radio signal for reception of TV programs, has moved to larger premises. The new location at 30 East 10 Street, New York City, has over twice the floor space of the former premises. Accelerated work on the various patents in the TV and communications field owned by the corporation is now proceeding at the new premises.

## Loran Used in Gulf Stream Survey

The Sperry Gyroscope Company's laboratory vessel M/V Wanderer, in conjunction with tankers equipped with Loran, has been engaged for over a year in plotting the position and current speeds of the Gulf Stream. A total of eight vessels was used and by taking constant fixes and sailing various charted courses it was determined that a speed increase of as much as 3.8 knots could be obtained "down stream".

The survey is continuing with the object of producing Hydrographic charts which will enable ships to follow Gulf Stream currents in much the same manner as aeroplanes today fly pressure patterns.

## Reeves Rectangular Tubes

Reeves Soundcraft Corp., Colorcraft Division, 35-54 36th St., Long Island City 6, N. Y., has announced that production is now under way on three types of rectangular television picture tubes at their new Springdale, Conn. plant. Recently acquired by Reeves Soundcraft Corp. from Remington-Rand, the Springdale plant is concentrating production on the 16KP4, 16TP4, and 16RP4 types of rectangular tubes. Production of 17 and 19 in. rectangular picture tubes is expected during August.

## GE ENGINEERS ON SOUTH AMERICAN TV TOUR


Five General Electric TV engineers who will operate the television equipment to be used for "Video Medic" demonstrations in Latin America and Henri Gendron, director of the project co-sponsored by International General Electric Company, Inc., and E. R. Squibb & Sons International Corp. Photographed in the Pan American Overseas Airways building at La Guardia Field, New York, just before boarding their plane for Puerto Rico are (left to right) Raymond Danley, George Stratton, Gendron, Harry Doutt, Richard Ocko and Charles A. Shaw. They will provide demonstrations of surgical operations, as well as special programs to show the vast educational value of television. "Video Medico" programs will be staged in San Juan, Sao Paulo (Brazil), Buenos Aires (Argentina), Caracas (Venezuela).

## Coming Events

**August 27-September 1—Radio Parts Distributors Convention** (NEDA), Cleveland Auditorium, Cleveland, Ohio.

**August 28-31—Associated Police Communication Officers, Inc.,** National Conference, Hotel Hollenden, Cleveland, Ohio.

**September 13-15 — IRE West Coast Convention and 6th Annual Pacific Electronic Exhibit,** Municipal Auditorium, Long Beach, Calif.

**September 25-27—National Electronics Conference,** Edgewater Beach Hotel, Chicago, Ill.

**October 16-20—Society of Motion Picture & Television Engineers,** 68th Semi - Annual Convention, Lake Placid Club, Lake Placid, N. Y.

**October 17-19—Communications Section, Association of American Railroads,** 27th Annual Convention. French Lick Springs Hotel, French Lick, Ind.

**October 23-27 — AIEE Fall General Meeting,** Oklahoma City, Oklahoma.

**October 26-28 — Second Audio Fair, Audio Engineering Society,** Hotel New Yorker, New York City.

**October 30-November 1 — IRE and RTMA, Radio Fall Meeting,** Hotel Syracuse, Syracuse, N. Y.

## Pentron Acquires Assets of Sound Incorporated

The Pentron Corp., manufacturers of tape and wire recorders, announces the acquisition of the assets and facilities of Sound Inc., 221 E. Cullerton St., Chicago, Ill.; management will be directed by the present officers of the Pentron Corp.

Sound Inc. is also engaged in the manufacture of magnetic recorders in addition to a complete line of sound equipment.

## Erie Radio

(*Continued from page* 53)

being suitable for radio use. However, the caboose installations entail more work since cabooses normally do not have a source of electricity, but depend on oil lamps when artificial illumination is required. The problem is generally met by installing a 32 volt generator, driven from the road wheels. The output of this generator and its associated accumulator bank then operates either a rotary convertor producing ac which powers a standard ac power pack, or a dynamotor supply which delivers B plus and heater voltages direct to the transmitter and receiver.

The same type of antenna is used for all mobile units. This is the Farnsworth "Firecracker" antenna. It is shown in Fig. 7. It consists of a folded quarter wave antenna, and is mounted directly on the roof of the vehicle since it is at dc ground potential. It resembles both a firecracker (hence its name) and a locomotive whistle. The height is only 11.5 in., and with a standing wave ratio of less than 1.5 to 1 over the operating band it presents a 52 ohm impedance. Connection is via the bottom.

All the fixed stations use a vertical co-linear array, which has a horizontal gain of 3 db over a half wave dipole. Operating at dc ground potential lessens lightning hazards. It has the same electrical characteristics for impedance and swr. as the "Firecracker".

## Color-TV on Film

(*Continued from page* 39)

shutter and at 24 f/sec. with a 288° open shutter. Completion of the new Badgley camera equipped with a 288° open shutter and the f/0.7 lens will permit recording of RCA Color TV at 24 f/second.

The color temperature of the RCA color TV receiver image is approximately 6500° K. During the first recording attempt, the following films and filters were tried:

| Film | Filter |
|---|---|
| Daylight Kodachrome | Harrison C ¼ |
| Daylight Kodachrome | None |

(*Continued from preceding page*)

Commercial Kodachrome — Wratten #83
Ansco Tungsten — Ansco No. 11 Conversion Filter

Exposures were good and the best results were obtained using commercial Kodachrome and the Wratten #83 Filter. It was the consensus of opinion that the film record was superior in quality to the image on the color TV receiver as viewed with the naked eye.

The amount of light emitted by the RCA three tube, Dichroic Mirror Receiver, as with the CBS Receivers, permitted good exposures to be secured at a light meter reading of from 0.75 to 1.00 foot candles measured at the recording camera lens with a Model #63 Weston foot candle meter.

If standard speed (f/1.4) lenses are used for color TV recordings, an increase in color film speed, TV tube light output, or a combination of both amounting to 2 stops (400%) is necessary. In other words, doubling the speed of presently available color film and doubling the TV tube light output would permit recording of color TV with f/1.4 lenses. The major problem thus far has been that of obtaining sufficient exposure and it will remain so until faster color films or brighter color TV tubes become available. The quality of the image produced by the F/0.7 lens cannot compare with results produced by conventional high grade motion picture camera lenses. The problems introduced by color TV are remarkably similar to those encountered in the three color film process.

### REFERENCES


J. L. Boon and J. Stoiber, "Television Recording Camera". Journal of the SMPE, Page 117, August 1948 Issue.

T. T. Goldsmith, Jr. and Harry Millhalland, "Television Transcription, Motion Picture Film", Journal of the SMPE, Page 107, August 1948 Issue.

R. M. Fraser, "Motion Picture Photography of Television Images". RCA Review, Page 202, June 1948 Issure.

M. A. Trainer and W. J. Poch, "TV Equipment for Aircraft", RCA Review, December 1946 Issue.

R. E. Shelby, F. J. Somers and L. R. Moffett, "Naval Airborne TV Reconnaissance System", RCAReview, September 1946 Issue.

Polaroid Corporation, Report on Optical Plastic Synthesis Fabrication and Instrument Design, Office of Scientific and Research Development Report No. 4417; 1945.

E. K. Kaprelian, "Objective Lenses of F/1 Aperture and Greater", Journal of the SMPE, Page 86, July 1949 Issure.


## Scanning Coils

(*Continued from page 35*)

tion of the yoke on the tube neck, Fig. 9. Eventually there is a possibility of having these conditions reversed — the major part of the yoke on the cone with a small part or none on the tube neck!

A yoke for a small projection tube which gave increased deflec-

tion and improved picture quality but required a redesign of the cone of the tube to accommodate the deflection yoke is of interest. Increasing the inner diameter of the coil from ⅞ to 1-in. ID decreased the sensitivity of the yoke for this tube from 100% for the ⅞-in. ID coil to 87.5% for the 1-in. ID coil. Assuming the geometric center of both deflection yokes to be located on a common point, the larger ID coil can have an effective length of 1⅜ instead of 1⅛-in. for the smaller ID coil. This means the larger ID coil has 18.19% greater sensitivity due to its increase in length. The effect of increasing the ID of the coil and length is a net gain of 5.69% in sensitivity. This does not include the merit of having a better picture with good focusing properties. The greater the distance between the focus coil and scanning coil, the smaller the cross-section of the electron beam entering the deflection field.

Stray fields, which have been neglected in theory and computations, are being used to the advantage of increased deflection and better quality pictures. Stray fields are often shaped to the desired pattern by core style and shape where the magnetic field is maintained perpendicular to the electron path throughout the deflection field. Preliminary checks have already shown increased deflection sensitivity. As illustrated, Fig. 9, the stray fields are shaped to be perpendicular to the electron path at wide angle scans to increase linearity at the corners.

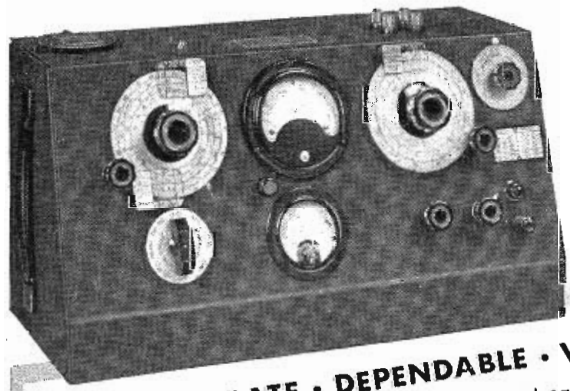
Powdered iron cores which have not been used extensively as yet in domestic television sets, will be finding great application as preshaped cores for deflection yokes. However, higher scanning frequencies may mean the abolition of all iron core deflection yokes with the possible exception of such powdered iron. Air core yokes, along with special winding orientation to reduce stray capacitance will doubtless be developed. Pin wound coils, which heretofore were eliminated because of cost, may prove less expensive due to a reduction in the total turns for higher frequencies and the possibility of applying unique styles which may introduce special features.

## Metal-Cone Kinescope

(*Continued from page 43*)

ever, the quantity of glass used for kinescopes became great enough to justify the production of neutral-gray light-absorbing glass which has been designated by RCA as





(*Continued from preceding page*)

Filterglass. It is interesting to note that the value of additional light-absorption, chosen after tests by kinescope manufacturers, is very close to the 20 per cent value proposed by Dr. Law. A high-quality, drawn sheet Filterglass was especially manufactured for the 16GP4, to minimize halation and ambient room lighting effects and stray light reflections within the tube ore reduced by roughening the darkening the inside surface of the metal cone.

In order to produce the illusion of a flat screen for the viewer, it is desirable that the face plate be as nearly flat as possible. The 27-in. face plate radius of curvature on the 16AP4 has been fairly satisfactory but a flatter face produces a noticeable improvement, particularly with rounded-end pictures. It was found possible to increase the radius of curvature to 40-in. by increasing the glass thickness from 3/16 to 7/32-in. Experience indicated that glass of this radius of curvature and thickness provides a safety factor as high as that of all-glass bulbs because the metal cone, which carries the principle stress, does not have as severe fatigue effects as glass.

The new features of the 16GP4 can be summarized by pointing out the changes made compared to the 16AP4.

A 5-in. decrease in overall length was made possible by increasing the deflection angle from 53° to 70° and reducing the neck length about 1-in.

Focus quality improved by a redesign of the ion-trap gun and a new design of deflection coil in combination with better centering of the electron beam.

Higher deflection sensitivity attained by the design of a new glass cone section.

Contrast of the image improved by the use of Filterglass, by an increase in face radius of curvature from 27 to 40-in., and by light absorption on the inside of the cone.

The use of a lower-cost segment socket acceptable to the Underwriters' Laboratory was made possible by the removal of two unused pins from the base.

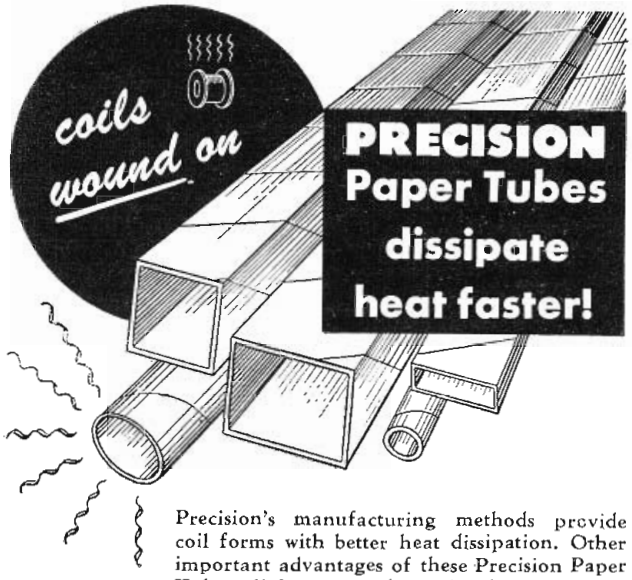
### REFERENCES


"Development of a Large Metal Kinescope for Television", H. P. Steier, J. Kelar, C. T. Lattimer, R. D. Faulkner, RCA Review, March 1949, p. 43-58.

"High Speed Production of Metal Kinescopes", H. P. Steier, R. D. Faulkner, Electronics, May, 1949, p. 81-83.

"Contrast in Kinescopes", R. R. Law, Proceedings of the IRE, August, 1939, p. 511-524.

"Characteristics of High-Efficiency-Deflection and High-Voltage Supply Systems of Kinescopes", RCA Review, March, 1950.

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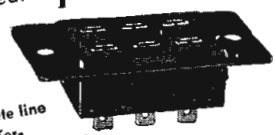

S-2406-SB
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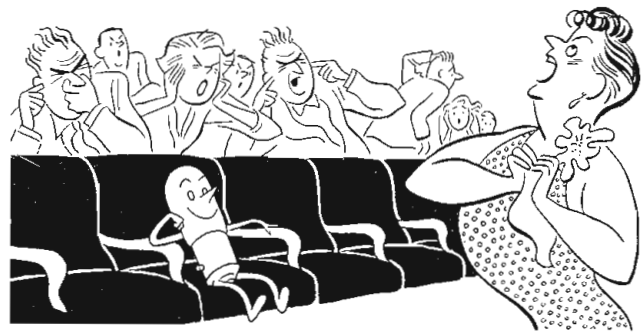
# The little lamp that knows how to stand the high notes



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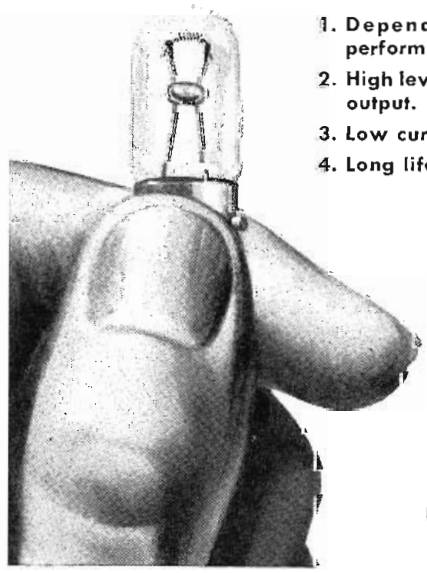

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## BULLETINS

### *Audio Equipment*

Just released by Stephens of Manufacturing Corp., 8538 Warner Drive, Culver City, Calif., is an 8-page booklet entitled "Installation Instructions and Suggested Uses for Stephens Tru-Sonic High-Fidelity Audio Equipment." It contains construction detail of Stephens cabinets and wiring diagrams for Stephens speaker systems.

### *Vibrator Guide*

A complete new communication equipment vibrator replacement guide is now available on request from the James Vibrapowr Co., 3224 W. Armitage Ave., Chicago 47, Ill.

### *Frequency Standard*

Bulletin 49-A describes the model SF50-A frequency standard, developed by Rex Bassett, Inc., Fort Lauderdale, Fla. This instrument has been designed to meet the needs of quartz crystal manufacturers, government agencies and laboratories.

### *High Nickel Alloys*

Two new technical bulletins on the properties of high nickel alloys are being distributed without charge by the International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. Bulletin T-7 ("Engineering Properties of Inconel") and bulletin T-9 ("Engineering Properties of K Monel and KR Monel") are each 24 pages long and contain charts and tables on compositions and other properties.

### *High Fidelity Speaker*

Innovations of come design on the Permoflux 8T-8-1 Royal Eight speaker are described in a bulletin published by Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill. Construction details and laboratory response curves are given.

### *Tape Glossary*

Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn., has recently released a glossary of terms commonly used by tape recording technicians. "Time for Sound Talk" includes four pages of technical terms and definitions, plus details on various sizes and types of sound recording tape, dual- and single-track recording, and different tape speeds.

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## War Mobilization

(*Continued from page* 22)

machinery and glass lathes becomes one of the k's and its production an $X_k$. It is obvious from this, that a dynamic model requires far greater supporting information, but is of much more value in evaluating industrial capabilities than the static one previously considered.

The dynamic solution involves a system of m simultaneous linear first order differential equations as the rate of increase of capital stock must be included.

Linear programming extends the input-output methods to include two areas of particular interest to the logistics planner. First, it treats the problem of scheduling the events associated with a system of activities. Secondly, it deals with the problem of choosing the optimum set of events associated with systems having multiple choices in the selection of activities or coefficients.

In dealing with the former area,

(*Continued on page* 64)

# TELE-TECH

## *Advertisers August 1950*



While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

it is necessary to introduce the concept of "storage." We shall define storage as special activity which absorbs time. It accounts for the difference between the time an output is created by one activity and the time this same output is reflected in the output of a new activity.

Experience has shown that a system of activities can be made more efficient if the respective inputs and outputs can be programmed according to a properly chosen schedule.

Let us refer once more to the previous example of the air-sea rescue set production. It will be recalled that the $Y_i$'s represented the total outputs from the system while the $X_i$'s the total amounts produced within the system. These quantities and the coefficients remained constant during the period concerned. This period was not specified and was assumed to be long compared with the internal storage times.

If the period is specified and is of a duration shorter than the storage times, the equations (III) no longer describe the problem completely.

Let it be assumed that the rescue set program calls for the following schedule of deliveries. The span of the schedule is divided into 12 discrete time periods. (Time period 7 corresponds to the earlier example, but the period is now short compared with the storage time.)

For example, let it be required to ascertain the individual output $X_i^{(j)}$ as a result of the requirements $Y_i^{(j)}$ in Table I. The coefficients have the same numerical values as before with the following storage times added:

$a_{21}^{(3)}=0.5 \quad a_{31}^{(3)}=0.5 \quad a_{41}^{(4)}=0.166$
$a_{42}^{(2)}=0.333 \quad a_{43}^{(1)}=0.166 \quad a_{32}=0$

If we wish to solve for $X_1^{(j)}$, $X_2^{(j)}$, $X_3^{(j)}$, $X_4^{(j)}$, we set up the following:

$$
\begin{aligned}
X_1^{(j)} - a_{21}^{3} X_2^{(j+3)} - a_{31}^{3} X_3^{(j+3)} - a_{41}^{4} X_4^{(j+4)} &= Y_1^{(j)} \\
X_2^{(j)} - 0 - a_{42}^{2} X_4^{(j+2)} &= Y_2^{(j)} \\
X_3^{(j)} - a_{43}^{1} X_4^{(j+1)} &= Y_3^{(j)} \\
X_4^{(j)} &= Y_4^{(j)}
\end{aligned}
\qquad (V)
$$

Equations (V) represent a set of four equations with nine unknowns whereas equations (III) represented a set of four equations with four unknowns. The missing equations are obtainable by setting up (V) for other periods starting with the final period and working back until the entire schedule is complete.

$$X_1^{(12)} - 0.5X_2^{(15)} - 0.5X_3^{(15)} - 0.166X_4^{(16)} = Y_1^{(12)} = .15$$

$$X_2^{(12)} - 0 - 0.333X_4^{(14)} = Y_2^{(12)} = .5$$

$$X_3^{(12)} - 0.166X_4^{(13)} = Y_3^{(12)} = .35$$

$$X_4^{(12)} = Y_4^{(12)} = .23$$

(all $X_i$'s and $Y_i$'s after period 12 are zero)
giving:

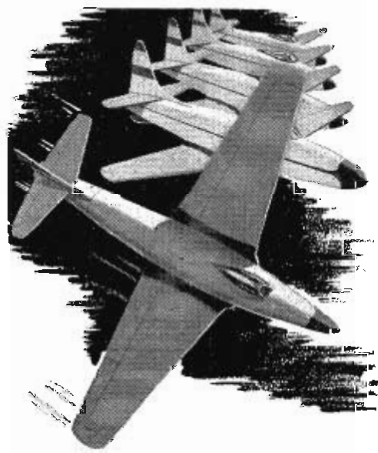
$$X_1^{(12)} = 0.15 \quad X_2^{(12)} = 0.50 \quad X_3^{(12)} = 0.35 \quad X_4^{(12)} = 0.23$$

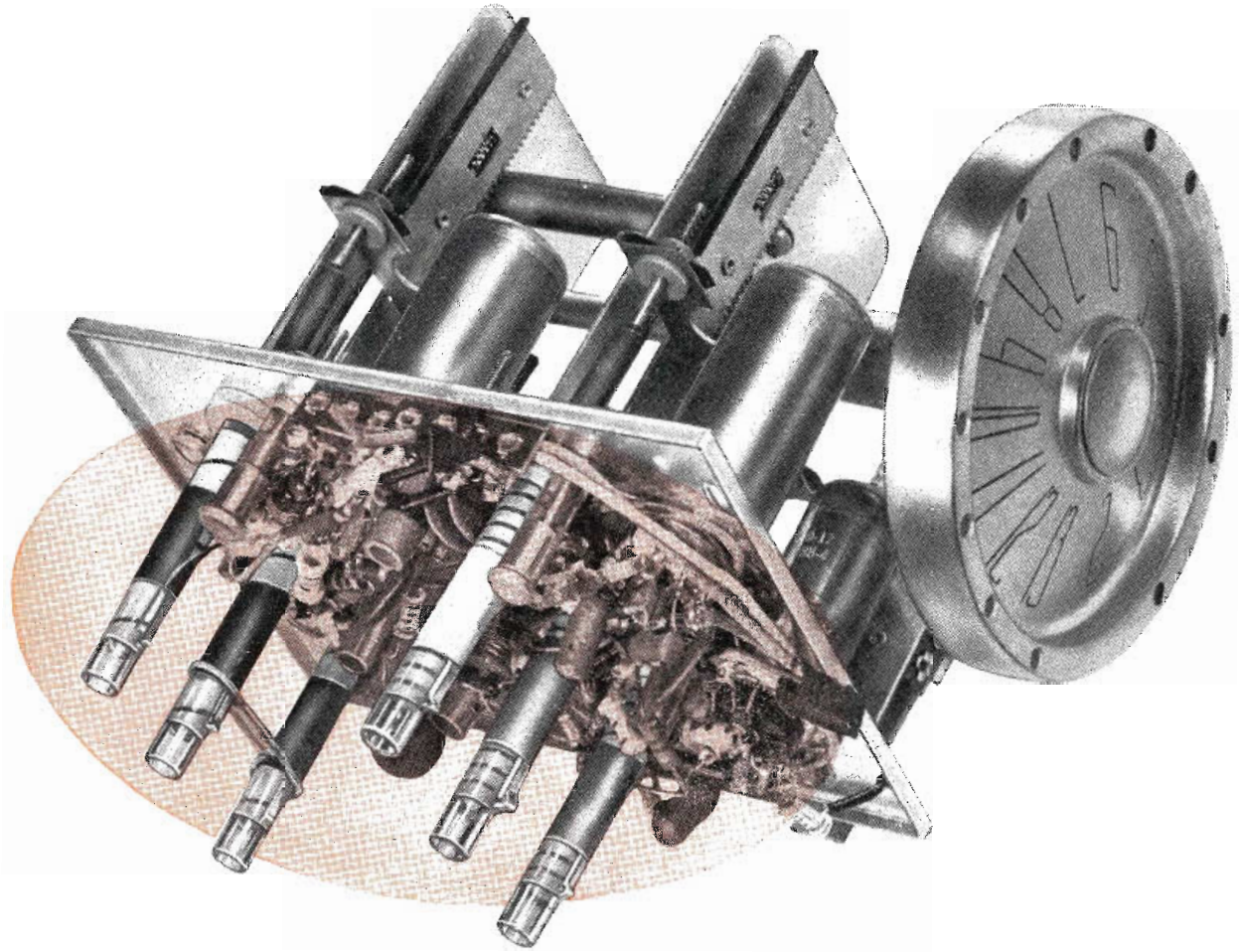
The procedure is similar for periods 11 through 1 giving the schedule in Table II.

The example was again trivial. It does point out, however, not only the advantage but also the complexity of scheduling on an industry-wide basis in electronics. Fortunately, this type of solution lends itself to present-day computer technics, but programming will never be any better than the coefficients which are used.

[1]Producer goods in this instance refer to wire, plastics, glass, metal foil, etc.; i.e., all unfabricated foods peculiar to the radio-TV industry.







# WHY A LEADING TELEVISION MANUFACTURER SPECIFIES CORNING METALLIZED GLASS INDUCTANCES

In high frequency tuning applications, stability is extremely important, both for ease of alignment and customer satisfaction. That is one of the reasons why the Stromberg-Carlson Company specifies Corning Metallized Glass Inductances. With Corning Inductances drift is negligible even under unusually variable ambient temperatures. Why? Because the integral contact of the fired-on metallizing with the dimensionally stable glass coil forms results in high temperature stability. High Q is inherent.

The inductance characteristics of the coils cannot be changed by rough handling or vibration. This is because the integral contact between the fired-on metallizing and the glass coil form eliminates voids between conductor and form. When used with powdered iron cores, the accuracy and rigidity of the glass insures stable, noiseless tuning.

Corning Inductances of any given type can be accurately duplicated in quantity on a production basis. That means no assembly time wasted on coil adjustments. They are easily installed by conventional methods and can be supplied with terminals or solder spots as required.

Design versatility is another characteristic of Corning Inductances. They can be manufactured to the most exacting specifications in uniform, variable or double pitch windings. Fixed tuned, permeability tuned or permeability tuned inductance-trimmer combinations are available with standard cores and fittings. Let Corning help you increase performance at lower costs. Our engineers will be glad to discuss your inductance problems with you.

**CORNING GLASS WORKS**

ELECTRONIC SALES DEPARTMENT

PYREX

**CORNING, N. Y.**

*Corning means research in Glass*

**METALLIZED GLASSWARE: INDUCTANCES · CAPACITORS · BUSHINGS · ALSO A COMPLETE LINE OF TELEVISION TUBE BLANKS**


# ...for mobile communications

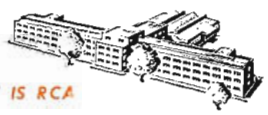
HERE ARE TWO unbeatable VHF power tube combinations for mobile transmitter designs where high efficiency and extreme compactness are paramount requirements. All four of these RCA-developed tubes have high power gain and may therefore be operated at relatively low plate voltage to provide large power output with small driving power.

The RCA-5763 miniature type beam power tube is very suitable as an output stage of low-power mobile transmitters and as a doubler or tripler in higher-power units. It can be operated with full input up to 175 Mc. The RCA-2E26 is intended primarily for use in the driver stages or the output stage of emergency mobile or FM transmitters. It can be operated with full input up to 125 Mc. and will provide an output of about 13 watts at 160 Mc.

The RCA-5618 power pentode and the RCA-2E24 beam power tube are quick-heating types with low filament drain, and are particularly suitable for mobile and emergency-communications transmitters where the operating power supply must be kept small. Both types are designed for intermittent operation. The RCA-5618 is superior as a doubler or tripler; the RCA-2E24, as the final amplifier in low-power FM transmitters.

Already proved in thousands of installations, these RCA tubes can be depended upon for their quality, ruggedness, and superior performance.

**RCA Application Engineers** are ready to work with you in applying any of these or other RCA tube types to your specific designs. For further information write RCA, Commercial Engineering, Section H57R, Harrison, New Jersey.



RCA Laboratories, Princeton, N. J.
*THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA*

**RADIO CORPORATION of AMERICA**
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