TELE-TECH

Formerly ELECTRONIC INDUSTRIES

TELEVISION • TELECOMMUNICATIONS • RADIO

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

•

Manufacturing

TELEVISION • FM
LONG & SHORT WAVE RADIO
AUDIO AMPLIFYING EQUIPMENT
SOUND RECORDERS & REPRODUCERS
AUDIO ACCESSORIES
MOBILE • MARINE • COMMERCIAL
GOVERNMENT
AMATEUR COMMUNICATION
CARRIER • RADAR • PULSE
MICROWAVE • CONTROL SYSTEMS

Research, design and production of special types

TUBES, AMPLIFIERS, OSCILLATORS, RECTIFIERS, TIMERS, COUNTERS, ETC. FOR
LABORATORY • INDUSTRIAL USE
ATOMIC CONTROL

Operation

Installation, operation and maintenance of telecommunications equipment in the fields of

BROADCASTING • RECORDING
AUDIO & SOUND • MUNICIPAL
MOBILE • AVIATION
COMMERCIAL • GOVERNMENT

SEPTEMBER, 1950

COVER: A RAPIDLY INCREASING NUMBER of organizations engaged in the activities shown, are using microwave relay facilities to replace or supplement their wire communication systems. Reduced installation and maintenance costs, together with improved operating reliability, ease of multiplexing, and relatively wide choice in types of intelligence which can be transmitted, account for the popularity of microwaves. For further details, see page 55.

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Publishers also of RADIO & TELEVISION RETAILING

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Formerly ELECTRONIC INDUSTRIES

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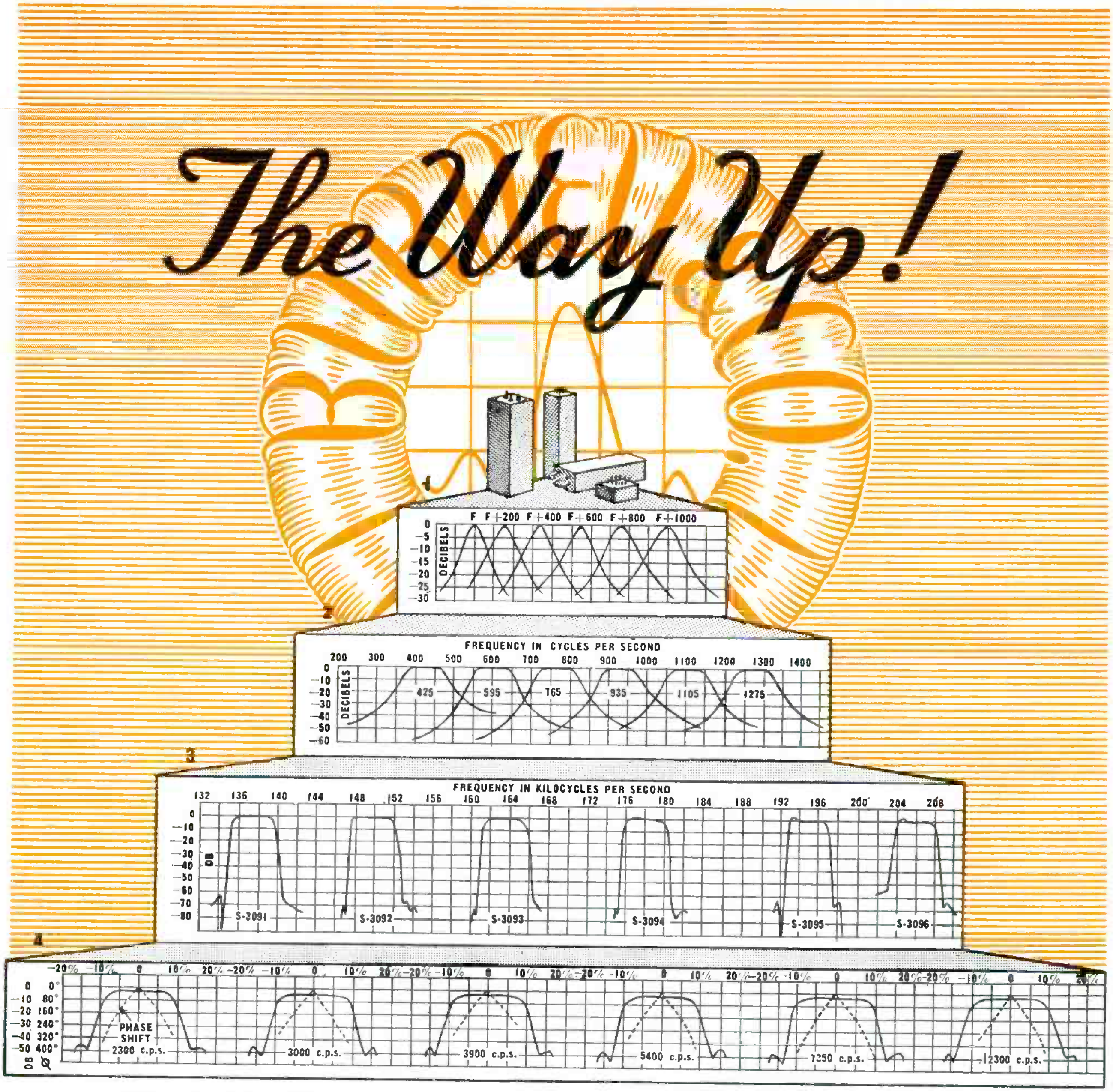


1 SUB-MINIATURE "GUIDED MISSILES" FILTERS

For security reasons details of this development in miniaturization must be omitted. It can be told, however, that all six channels are contained in a total volume of 18 cubic inches or 3 cubic inches per channel.

2 TONE CHANNEL FILTERS

Available for either 170 or 340 cycles spacing between channels. These filters have received wide acceptance and are extremely popular among manufacturers of carrier telegraph equipment. In addition to the many standard types of tone filters we are supplying, special characteristics can readily be incorporated into designs to suit your application.

3 CRYSTAL ELEMENT CHANNEL FILTERS

These extremely sharp wide band filters employing crystals and toroidal coils, were so compact that they were substituted in Air Force equipment for ordinary I.F. transformers. Result was tremendous improvement in selectivity and signal to noise ratio. We derived great satisfaction from this achievement.

4 TELEMETERING FILTERS

Among the earliest to be employed in the improved telemetering system now in general use. Particular attention has been paid to linearity of phase shift and good transient suppression as well as high inter-channel attenuation in order to eliminate distortion in telemetering reception.

"Filters such as these are included in a wide variety of types which we are now producing for manufacturers and users of microwave communications and relay equipment. We would be pleased to discuss your application for filters in this field and bring you up to date on the latest developments in the application and design of filters which have resulted from our close association with the carrier communications industry."

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

Exclusive Manufacturers of Communications Network Components

TELE-TIPS

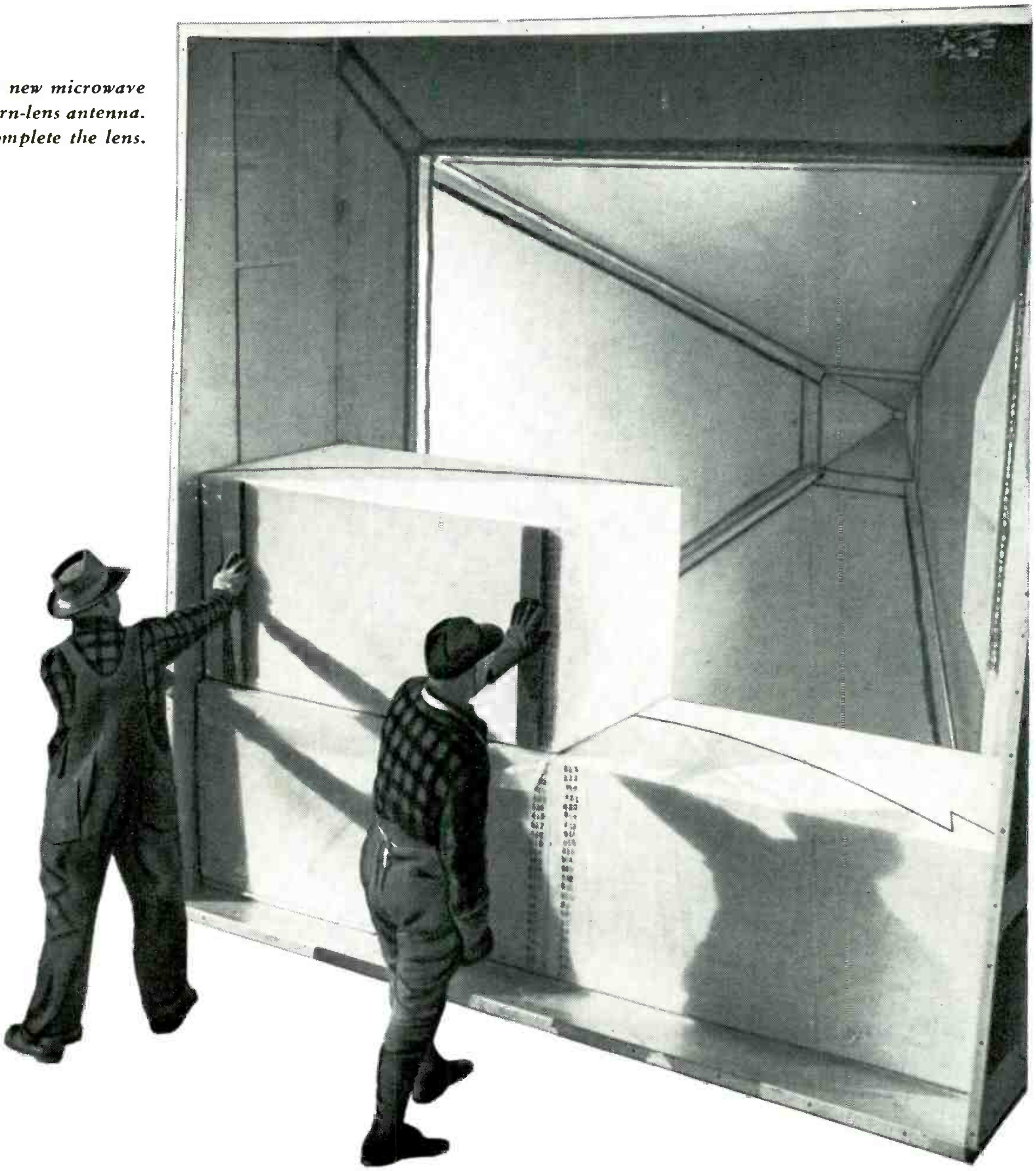
BATTLE REPORTING IN 1950—"The modern radio and television war correspondent," says CBS' Wells Church, "resembles a pack soldier. He carries with him not only his typewriter, but a Minitape recorder, a shoebox-sized recording machine for actual sounds and voices of battle, and a 16mm camera to film the war as well as report it for television news." CBS correspondents at or heading for the Korean front, Church reveals, are all equipped with these up-to-date paraphernalia of combined radio-TV coverage. The newest gadget is a small playback machine, the size of two packs of cigarettes, that enables correspondent to listen to the Minitape recordings he has made under far-from-perfect conditions.

PHONEVISION'S delayed test in 300 homes in a Chicago suburb is finally scheduled to commence on October 1. For a time it seemed possible that the FCC had taken umbrage at various advertisements concerning Phonevision adapters in contemporary receivers that the Commission would ban the proposed tests. However, Zenith officials thoroughly satisfied the Commission regarding licensing plans and various statements which had appeared in the press, and the original STA has been extended to commence on October 1, 1950. The programs made available in this test will be indicative of what might be shown over Phonevision if it becomes regular operation.

PUNCH-CARD KEY—While the forthcoming Phonevision tests in Chicago will be carried out using an unscrambling signal sent over the telephone wires, the Zenith engineers have other methods and patents up their sleeve, if needed. One of them is a system of punched cards in the Hollerith tradition. Such a card, when inserted in the subscriber's receiver, would effect contacts clearing the picture. Such keycards could be mailed to subscribers weekly, conforming to the weekly change of scrambling impulses transmitted. Carrier impulses over electric light wires have also been considered.

(*Continued on page 6*)

Mounting Bell's new microwave lens in a horn-lens antenna. Other blocks will complete the lens.



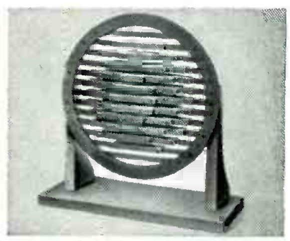
A focus on better, low-cost telephone service

In the new microwave radio relay system between New York and Chicago, giant lenses shape and aim the wave energy as a searchlight aims a light beam.

Reasoning from the action of molecules in a glass lens which focuses light waves, Bell Laboratories scientists focus a broad band of microwaves by means of an array of metal strips. To support the strips these scientists embedded them in foam plastic which is virtually transparent to microwaves. Rigid and light in weight, the plastic is easily mounted on relay towers.

This unique lens receives waves from a wave guide at the back of the horn. As they pass across the strips, the waves are bent inward, or focused to form a beam like a spotlight. A similar antenna at the next relay station receives the waves and directs them into a wave guide for transmission to amplifiers.

This new lens will help to carry still more television and telephone service over longer distances by microwaves. It's another example of the Bell Telephone Laboratories research which makes your telephone service grow bigger in value while the cost stays low.



Laboratory model of the new lens. A similar arrangement of metal strips is concealed in the foam plastic blocks in the large picture.

BELL SYSTEM — AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES

BELL TELEPHONE LABORATORIES

Working continually to keep your telephone service big in value and low in cost.

TELE-TIPS (Continued)

SMOKESTACK TV—Television is being tested by the Consolidated Edison Co. of New York as an aid in keeping the city's atmosphere clear and in increasing the efficiency of the company's generating stations. The company has installed two television cameras and two receivers to monitor the tall smokestacks. The object is to tell the boiler operators of the amount of emission from the tall stacks. In the past, operators had to find out about the waste gases and fly ash coming out of the stacks by having some one look out of a window. Now they have each stack in constant view, its image alongside the control panels.

CONTINUOUS TV BAND—Television is bound to expand. One hundred and six stations are now in operation, but 2000 will eventually be needed to give a truly nationwide service. Television must have more than its present 12 channels. The logical expansion would be to annex a number of adjoining channels above present Channel 13. Forty such channels — substantially continuous — could easily be obtained now. (See pp. 22, 23, August TELE-TECH).

SOLAR CYCLES have by now pretty well demonstrated their influence on radio propagation. But did you realize that also choice wines, as selected by connoisseurs, reveal the solar or ultraviolet cyclic influence? Not long ago, a confiding restauranteur sent us his tabulation of best vintages over the years, so we asked Dr. Harlan T. Stetson, MIT's solar-cycle authority, now living in Fort Lauderdale, Florida, if the wine experts' selections bore out solar theory. His reply: "Thanks for passing on the Vintage Chart. It is interesting to note the score of 5 occurred at the sunspot maximum in 1929 and almost the same in the sunspot maximum years of 1937 and 1947; whereas, for the minimum years, the score was 4 for 1934 and 2.6 for 1941 and 1942. This is not too bad a suggestion of a solar cycle."

ARTHURHOLICS ANONYMOUS!—On a recent Arthur Godfrey TV program, the head man himself, no less, read the following letter from G. N. Carmichael, chief engineer of Trio Manufacturing Company of Griggsville, Ill. The letter said:

"I am confronted with a problem. My family are confirmed Arthurholics. Personally, I can take you, or leave you alone. But not with the family pressure.

The problem is this: Our TV reception, until recently, has been from KSD-TV, the only station within 100 miles. My professional work as design engineer has led to development of a new TV antenna, the Phasitron, which makes possible reception from somewhat distant stations. It had been my hope that the choice of programs would make it possible to avoid your beaming countenance. However, on Wednesday night at 6:00 standard time, WFBM-TV in Indianapolis carries a kinescope of your last week's Chesterfield show. At 7:00 WBKB, Chicago, carries your this week's show. At 8:30 KSD-TV, St. Louis, repeats the same show carried by Indianapolis.

Don't you think that three hours of Arthur Godfrey in one evening is too much punishment except for an Arthurholic?"

STOCK PILING?—It is true that deliveries of resistors have been running 40 weeks behind, electrolytic capacitors 16 weeks, volume controls 12 to 15 weeks, and panel stock for wood cabinets 60 to 120 days. But, insist parts and component suppliers, these deficiencies have resulted from the stockpiling by manufacturers in excess of their demands as originally scheduled at the beginning of the year. The parts people declare their deliveries are well abreast of original orders for the year. But customers' appetites or demands have meanwhile gone up so much that these long-time delivery cycles have resulted.

QUIZ—IRAQ (Mesopotamia) country of Asia Minor, surrounded by Iran, Turkey, Syria and the Holy Land. **IRAC** (Interdepartment Radio Advisory Committee) surrounded by secrecy, bureaucracy and ambitions to dominate all radio!

STYRENE is preferred moniker for polystyrene, according to survey just made by Monsato Chemical. Vote was: Styrene 1061, Polystyrene 102.

(Continued on page 10)

PRODUCED BY THE MILLIONS
- by the top specialists in the ceramic field

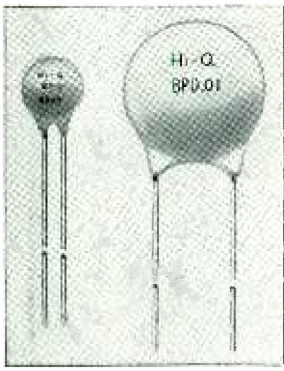
HI-Q

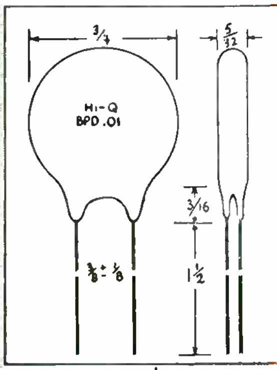
CERAMIC DISK CAPACITORS

HI-Q Ceramic Disk Capacitors for by-passing, blocking, or coupling are being used by the millions by television receiver manufacturers who demand the utmost in performance.

Unit cost, time and labor may be saved by using several of the multiple capacity **HI-Q** Disks where applicable in your television circuit. Multiple capacities having a common ground are available in standard units as shown in the chart below. **HI-Q** Disks are coated with a non-hydroscopic phenolic to insure protection against moisture and high humidities. **HI-Q** Disks like all other **HI-Q** components assure you of the highest quality workmanship at the lowest possible cost.

Our Engineers are ready and willing to discuss the application of these highly efficient, dependable capacitors in your circuits. Write today for your FREE copy of the new **HI-Q** Datalog.





Type	A Diameter	B Lead Width	C Thickness
B.P.D. .00047	5/16" max.	3/16" ± 1/16"	5/32" max.
B.P.D. .0008	5/16" max.	3/16" ± 1/16"	5/32" max.
B.P.D. .001	3/8" max.	1/4" ± 1/16"	5/32" max.
B.P.D. .0015	3/8" max.	1/4" ± 1/16"	5/32" max.
B.P.D. .002	7/16" max.	1/4" + 1/8" − 0	5/32" max.
B.P.D. .004	19/32" max.	1/4" + 1/8" − 0	5/32" max.
B.P.D. .005	19/32" max.	1/4" + 1/8" − 0	5/32" max.
B.P.D. .01	3/4" max.	3/8" ± 1/8"	5/32" max.
B.P.D. 2x.001	19/32" max.	3/8" ± 1/8"	5/32" max.
B.P.D. 2x.0015	19/32" max.	3/8" ± 1/8"	5/32" max.
B.P.D. 2x.002	19/32" max.	3/8" ± 1/8"	5/32" max.
B.P.D. 2x.003	3/4" max.	3/8" ± 1/8"	5/32" max.
B.P.D. 2x.004	3/4" max.	3/8" ± 1/8"	5/32" max.
B.P.D. 3x.0015	3/4" max.	3/8" ± 1/8"	5/32" max.
B.P.D. 3x.002	3/4" max.	3/8" ± 1/8"	5/32" max.

Insulation: Durez and Wax impregnated.
Leads: 22 gauge pure tinned dead soft copper.
Capacity: Guaranteed mininum as stamped.
All capacitance measurements made at 25°C at 1 KC at a test voltage not over 5 volts RMS.

Insulation Resistance: 7500 megohms min.
Power Factor: Max. 2.5% at 1 KC at not over 5 volts RMS.
Test Voltage: 1500 volts D. C.

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HI-Q *Electrical Reactance Corp.*
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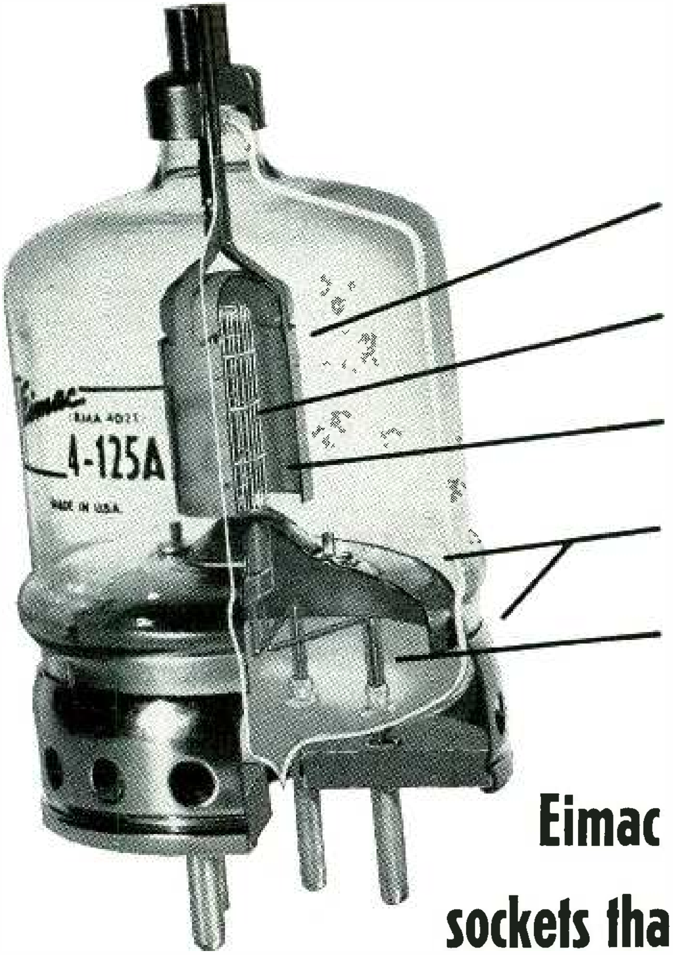
SALES OFFICES: New York, Philadelphia, Detroit, Chicago, Los Angeles

PLANTS: Olean, N. Y., Franklinville, N. Y. Jessup, Pa., Myrtle Beach, S. C.

Because Of 5 Outstanding Features



Eimac 4-125A tetrodes fill more key sockets than any other 125-watt tetrode.

The Eimac 4-125A is the heart of modern radio communication systems. Its dependability-of-performance has been proved over years of service in many thousand transmitters. It will be to your advantage to consider carefully the economy and circuit simplification the Eimac 4-125A offers.

As an example of Eimac 4-125A performance, two tubes in typical class-C telegraphy or FM telephony operation with less than 5 watts of grid-driving power will handle 1000 watts input; or, two 4-125A's in high-level modulated service will handle 750 watts input.

Take advantage of the engineering experience of America's foremost tetrode manufacturer . . . Eimac. Write for complete data on the 4-125A and other equally famous Eimac tetrodes.

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 4-125A is another Eimac contribution to electronic progress.

TELE-TIPS (Continued)

GROWING LIKE TOPSY—The American Broadcasting Company in New York City, although it has the largest TV center in the country, has already outgrown its britches! Plans just announced call for the construction of new studio space *under* the existing Studio One. The new studios, which are scheduled for very early completion, will eliminate some of the crowding which now occurs in planning shows. It is interesting to note that ABC is a triple landlord. It rents the rear half of its huge auditorium to WOR-TV which has built a very comprehensive studio installation; WOR-TV rents one of its studios to NBC-TV for a cigarette manufacturer's program. Now, who pays who?

DON'T BANISH TV to the Siberia of the UHF! Don't impose costly UHF TV-sets and installations on the public when plenty of good channels are available adjoining the present TV bands—channels empty and unused, though held by greedy Government departments. These Government agencies should be forced to disgorge their wavelengths, freeing these channels for the use of future millions of television-set owners.

Tuner Complaints reduced to 04%

with the use of Corning Metallized Glass Inductances!

A leading television manufacturer*, in a run of over 60,000 sets, has had only 25 complaints resulting from faulty tuners. There are good reasons for this. One of them is the fact that Corning Metallized Glass Inductances are included in the design.

The integral contact of fired-on metallizing with the special glass form makes Corning Inductances inherently stable. Drift is negligible, even under unusual temperature changes.

Tough and durable, Corning Inductances are not damaged by repeated handling. They are unaffected by vibration. The smooth glass wall assures noiseless tuning. They will give years of trouble-free service. When a receiver is shipped from the factory you know it will stay in alignment—complaints are minimized.

That's just part of the story. Corning Inductances make assembly rapid and easy. Installed by ordinary soldering or grommeting methods, they can be obtained with any length leads or just solder spotted. Tracking is assured by fine trimmer adjustments and consistently accurate inductance ratings. There is no time-consuming adjustment of coils as with inaccurate or less substantial inductances.

All of the above quality points regarding Corning metallized coils afford a precision inductance section of the tuner at an overall cost comparable to less stable coils plus compensating units.

Whatever your high frequency inductance requirements, Corning Metallized Glass Inductances can be designed to fit them exactly. Uniform, variable or double pitch windings are as easily manufactured as are fixed tuned, permeability tuned or permeability tuned inductance-trimmer combinations.

Let Corning engineers help you reduce tuner complaints and improve quality. Write for further information today.

**Name on request.*

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Corning means research in Glass

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News that reaches you in less than a second!

How mobile television vans flash pictures from the field

No. 8 in a series outlining high points in television history

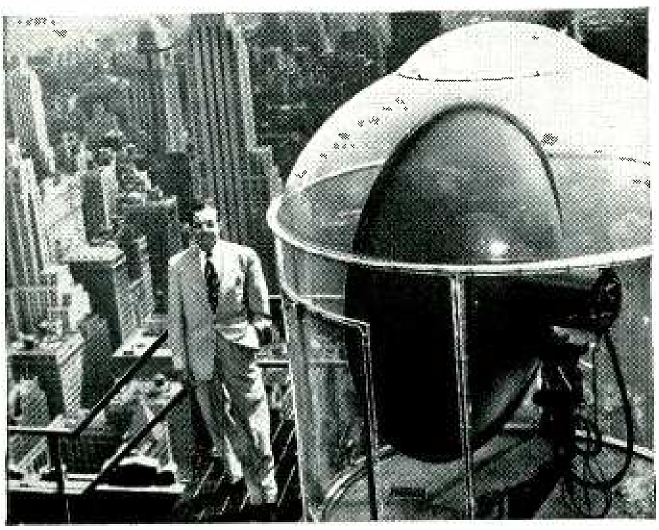
Photos from the historical collection of RCA

Mobile television van *operating "in the field"—note complete camera facilities, and microwave relay apparatus.*

• A fire starts miles away from your home, yet you are on the scene in a jiffy—perhaps as fast as the first hook-and-ladder!

This is television reporting—virtually, by any practical measurement, instantaneous—and making all other methods of news coverage seem slow. Behind it are basic research developments from RCA Laboratories.

"Eyes" of the mobile television vans which gather spot news are supersensitive RCA image orthicon television cameras, which "see" in the dimmest light. This sensitivity, since the light at a news event is usually outside human control, is a definite *must.*



Bowl-shaped antennas *at the parent television station pick up the microwave beam from the remote mobile van.*

Developed by RCA scientists on principles uncovered by the invention of its parent the *iconoscope,* an image orthicon pick-up tube is essentially three tubes in one. A phototube first converts the visual image into an electron image. This is then "scanned" by the electron beam of a cathode-ray tube—creating a radio signal. An electron multiplier next takes the signal and amplifies its strength for the trip through circuits to the transmitter.

Such compactness is characteristic of every operation inside a mobile television van, and RCA engineers have designed equipment—which might fill entire rooms in a standard studio—to fit the limited space of a truck. Yet every studio facility is present, even monitoring equipment and cameras that can swing quickly from a wide-angle view to a close-up.

Interesting, too, is the technique by which these mobile television vans flash what the camera sees back to the point from which it is telecast. Sharply focussed directional radio beams are used to carry the signal with a minimum loss of power.

More and more, as television spreads across the country, you may expect it to play a larger part in getting news to the public *fast.* And you may expect, from RCA laboratories, developments which will continue to increase the effectiveness of mobile television vans.

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

Opportunities for Saving

CLEVELAND CONTAINER

LOW COST, SPIRALLY LAMINATED, PAPER BASE PHENOLIC TUBING.

Manufacturers of radio and television receivers know the outstanding advantages of Cleveland Cosmalite* on both performance and cost.

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Designed to replace at a considerable saving the ordinary phenolic and fibre tubing . . . its properties include great strength, low moisture absorption, high dielectric strength, low loss and good machineability. Made in lengths up to 8½ ft. with types, diameters and thicknesses as desired. May be punched, notched, threaded and grooved to meet individual needs.

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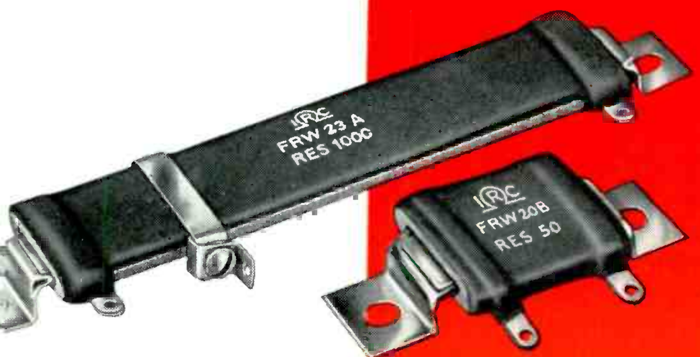
Exploration

for resistors too!

*S*pecialization in resistors* lets IRC concentrate on research and quality control to a greater degree than any other supplier.

Result:—IRC exploration *anticipates* future resistor needs—*improves* existing products—and *controls* quality and uniformity in every IRC unit. Largest resistor manufacturer in the world, IRC attracts the finest of engineering talent. We're using more of such talent than ever, now, to keep step with today's electronic requirements—while we plan for tomorrow's advances.



FLAT POWER WIRE WOUND RESISTORS

For high-wattage dissipation in limited-space applications, IRC Type FRW Flat Wire Wound Resistors have higher space-power ratios than standard tubular units. FRW's can be mounted vertically or horizontally—singly or in stacks. Non-magnetic mounting brackets permit easy, economical mounting, aid in heat distribution along the entire length, and transfer internal heat to the chassis. Available in 9 sizes—fixed and adjustable. Send for full details in Bulletin C-1.

is important

HIGH OHMIC RESISTORS

Engineered for high voltage applications where hig resistance and power are required, IRC Type MV Resistors are particularly suited to mony types c television and electronic circuits. Unique application c IRC's proven filament resistance coating in helicc turns on a ceramic tube provides a conducting pat of long, effective length. Result: A unit of high resis tance value with resistance materials having relative ly low specific resistance. Type MVX's have 2 wa rating, are exceptionally stable—permit the use c high voltage on the resistor while keeping voltag per unit length of path comparatively low. Sen coupon for complete details in Bulletin G-2.

DEPOSITED CARBON PRECISTORS

A unique combination of accuracy, stability and economy makes IRC Deposited Carbon PRECISTORS ideal for applications where carbon compositions are unsuitable or wire-wound precisions too expensive. Instrumentation, advanced electronics and critical television circuits also benefit from their wide range of values, low voltage coefficient, excellent frequency characteristics, predictable temperature characteristics, high voltage rating, low noise level and small size. Coupon brings full particulars in Bulletin B-4.

VOLTMETER MULTIPLIERS Sealed-precision IRC Type MF Resistors are completely impervious to moisture—have proved themselves dependable voltmeter multipliers for use under the most severe humidity conditions. Each multiplier consists of a number of IRC Precision Resistors, mounted, interconnected, and encased in a glazed, hermetically sealed ceramic tube. MF's are compact, rugged, stable, easy to install, and may be used with very little drain on the power supply. Individual precision resistors may be either inductive or noninductive, so that they may be used on AC as well as DC. Mail coupon for full data in Bulletin D-2.

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- ☐ Deposited Carbon PRECISTORS (B-4)
- ☐ High Voltage Resistors (G-2)
- ☐ Voltmeter Multipliers (D
- ☐ Name and address of local IRC Distributor

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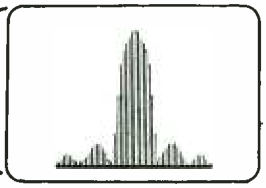
10 MCS to 16,520 MCS



Polarad's Model LSA Spectrum Analyzer is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an r.f. signal.

Outstanding Features:

- Continuous tuning.
- One tuning control.
- 5 KC resolution at all frequencies.
- 250 KC to 25 MCS display at all frequencies.
- Tuning dial frequency accuracy 1 per cent.
- No Klystron modes to set.
- Broadband attenuators supplied with equipment above 1000 MCS.
- Frequency marker for measuring frequency differences 0-25 MCS.
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- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

The equipment consists of the following units:

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Model LTU-2 R. F. Tuning Unit—940 to 4500 MCS.
Model LTU-3 R. F. Tuning Unit—4460 to 16,520 MCS.
Model LDU-1 Spectrum Display Unit
Model LKU-1 Klystron Power Unit.
Model LPU-1 Power Unit.

Where Used:

Polarad's Model LSA Spectrum Analyzer is a laboratory instrument used to provide a visual indication of the frequency distribution of energy in an r.f. signal in the range of 10 to 16,500 MCS.

Other uses are:

1. Observe and measure sidebands associated with amplitude and frequency modulated signals.
2. Determine the presence and accurately measure the frequency of radio and/or radar signals.
3. Check the spectrum of magnetron oscillators.
4. Measures noise spectra.
5. Check and observe tracking of r.f. components of a radar system.
6. Check two r.f. signals differing by a small frequency separation.

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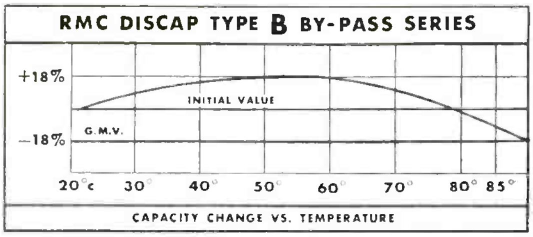

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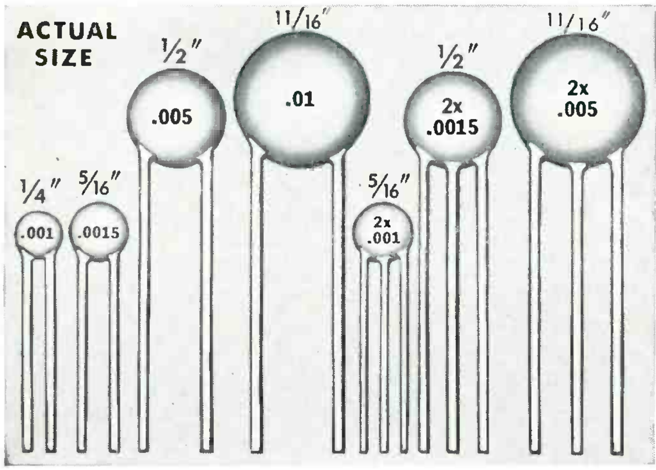
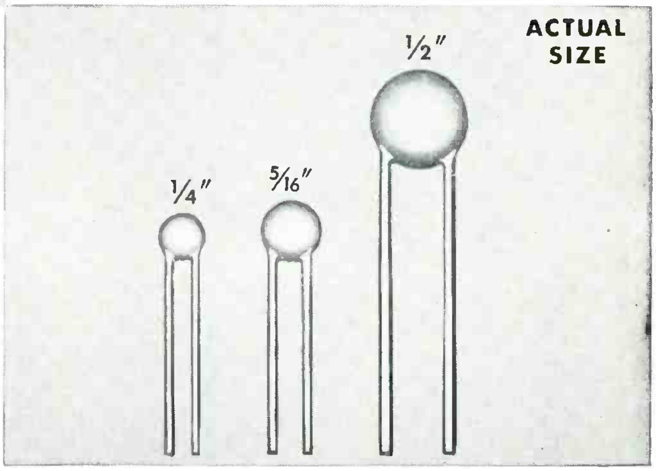
N750	5-25	26-50	51-150

Available Tolerances: ±5%, ±10%, ±20%





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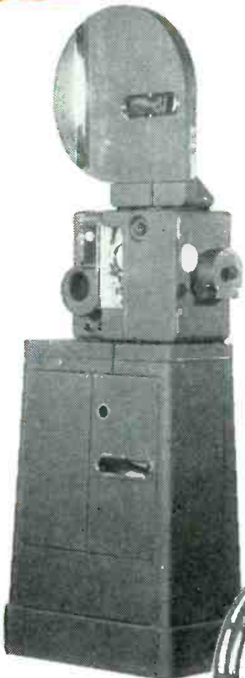
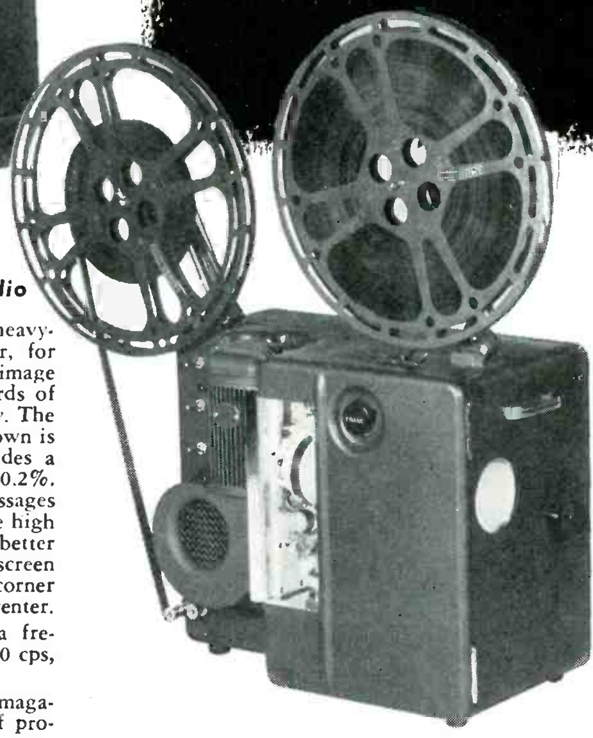




TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

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

All Voluntary; 20-25%; No "Conversion"

Military Authorities Encourage Radio-TV Industry to Continue Civilian Production at 75-80% Level as Aid to National Economy, Morale, and Safety.

The situation, as we go to press, is described in the key terms above, which mean:

The radio-electronic industry will be called upon for military production at a rate of about a billion dollars yearly from now to December 31, 1951.

This military output will be handled on a voluntary basis, *without* such all-out military conversion as occurred in World War II.

So huge is our industry and such has been its television expansion since V-day 1945, that only 20 to 25% of its plant facilities will be needed for the above military output.

Meanwhile manufacturers will be encouraged to *keep their organizations intact and busy with civilian production* of TV and radio, as contributions to (1) the national economy and (2) national morale, and (3) as a safeguard to readiness for partial or complete conversion should the war situation blacken.

On the above basis, industry leaders, after close contact and discussion with Washington military echelons, expect our industry to complete and sell in 1950 6,000,000 TV sets and 10,000,000 radio sets. This huge civilian output, it is agreed, can be carried on parallel to and simultaneously with the billion-dollar task of military production.

The billion-a-year rate of electronic military production, or about $1½ billions by the end of 1951, accounts for all radio-electronic needs growing out of appropriations now made or planned by Congress to date, including (1) Armed Forces procurement orders already placed, (2) the $10 billion supplemental bills, 3) the $4 billion foreign-aid program, and the Navy appropriation bill. However, orders placed during the 1950-1951 period may reach $2 to $2½ billions, the excess going to 1951 emergency completion or '52 carryover.

National Electronic Mobilization Committee

To bring about a rapid and orderly allocation and assignment of voluntary military radio-electronic production and to work for national security in an advisory capacity, a new industry committee has been announced by President Robert C. Sprague, who is also chairman of the Radio-Television Manufacturers Association. This committee is being appointed jointly with the National Security Industrial Association which RCA's Frank M. Folsom heads as chairman of the board. The NSIA has as its sole purpose facilitating of military armament in every way, so that the new committee working through task groups to allocate and assign military radio-electronic production on a voluntary priority basis, will be lifted well above questions of trade or industry relationships.

Frederick R. Lack, vice-president Western Electric Co., is expected to head the new committee, other members of which in addition to RTMA Chairman Sprague, and NSIA Chairman Folsom, are: Malcolm P. Ferguson, president of Bendix Aviation Corp.; W. J. Barkley, vice-president of Collins Radio Co.; Benjamin Abrams, president of Emerson Radio & Phonograph Corp.; Harold Buttner, vice-president of International Telephone & Telegraph Co.; Dr. W. R. G. Baker, vice-president of General Electric Co.; W. A. MacDonald, president of Hazeltine Electronics Corp.; William Balderston, president of Philco Corp.; C. F. Adams Jr., president of Raytheon Manufacturing Co.; R. E. Gilmour, vice-president of Sperry Corp.; Walter Evans, vice-president of Westinghouse Electric Corp.; Paul V. Galvin, president of Motorola, Inc.; E. F. McDonald, Jr., president of Zenith Radio Corp.; Ross Siragusa, president of Admiral Corp.; Max F. Balcom, chairman of the board of Sylvania Electric Products, Inc.; A. D. Plamondon, Jr., president of Indiana Steel Products Co.; Ray F. Sparrow, vice-president of P. R. Mallory & Co.; J. J. Kahn, president of Standard Transformer Corp.; Arie Liberman, president of Talk-A-Phone Co., and W. J. Halligan, president of Hallicrafters Co.

The RADARSCOPE

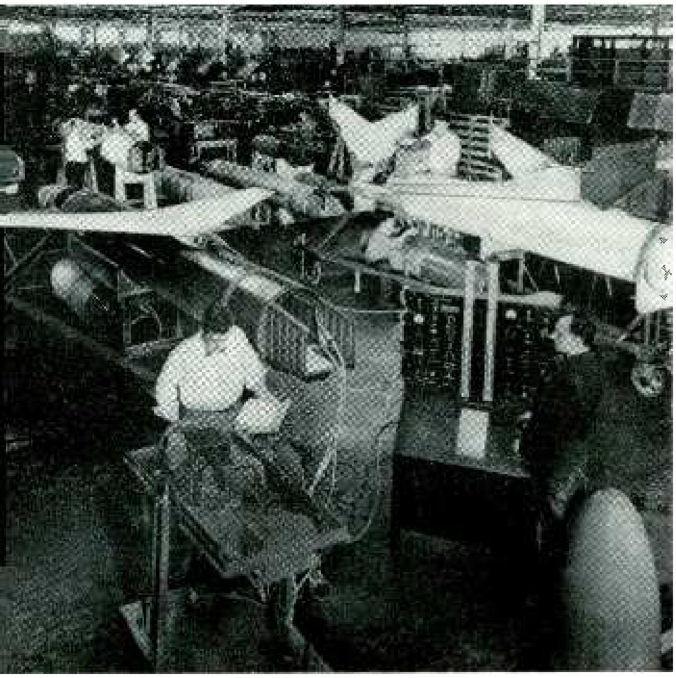
Revealing at a Glance

THE PENTAGON

MILITARY DEMANDS TO GROW—Authoritative Defense Department estimates place the initial procurement volume (as of our press deadline) for the communications-radio-electronics equipment at approximately $1.5 billion, and this amount might possibly soar to a total of $2 billion in the immediate future. The US Air Force in its procurement of new airplanes, as of mid-August, will expend more than a half billion dollars at least, together with around $300 million on other projects including the radar air-raid-warning network; and the Navy will expend almost $500 million on continued electronic modernization.

MATERIALS

ALLOCATIONS are expected on many materials, not alone steel. Aluminum, copper and tin will be among the first to have controls clamped on. These will be in the form of inventory regulations applied to suppliers and manufacturers. Already Washington officials have asked steel makers to divert steel from less-essential purchasers and direct it to processors of products essential to a war-time economy. Same pattern may be applied to other materials essential to production of radio parts and components. Orders already on the books may suffer delays, as materials already in production are diverted in order to meet promptly urgent requirements of the national defense agencies.



The Navy's new Martin KDM-1 pilotless target drones come off the sleepless Baltimore production lines. Powered by ram-jet engines, the target-drones are remote-controlled by radio and tracked by radar, to simulate the flight of an attacking airplane

MUNITIONS BOARD

INDUSTRY COMMITTEE IMPORTANCE—As as all-important gauge on the future of television-receiver production and other civilian radio equipment manufacturing during the international crisis, the Electronic Industry Advisory Committee to the Munitions Board considered at a specially called meeting in mid-August the emergency requirements in critical deficiencies of components and fabricated parts. The industry advisory committee, which is headed by vice president Frederick R. Lack of Western Electric and is composed of top executives of 29 leading radio-electronic end-equipment and component manufacturing companies, submitted its recommendations and views on these subjects. The general equipment requirements of the Armed Services were also reviewed at the meeting. The critical component areas are principally capacitators, resistors, special-type tubes, and transformers.

AVIATION

KOREAN EVENTS have shown the necessity for having as many airports as possible installed with allweather flying and blind-landing equipment, an issue that has become more urgent with the recent happenings in the Far East. CAA officials are understood to be pushing for more equipment for more airports, to be installed in short order. It seems very probable that Congress will authorize the extra expenditures since the last war emphasized the need for reliable air communication. As soon as weather has been completely conquered, military operations will become reliable and less open to diversion due to inclement weather. Manufacturers of ILS and GCA may expect warmer receptions for their salesmen in CAA offices.

OVERSEAS

THE VOICE OF AMERICA may be expending itself in pretty thin air insofar as Russian listeners are concerned. Latest figures from the United Nations show that there are only about 1,300,000 radio receivers in the USSR, most listening being done via radio relay exchanges, of which about 11,000 operate in large and small villages. By this "radio diffusion" method about 6,500,000 loudspeakers in Sovietland are fed Red propaganda for collective listening. These figures would seem to indicate that less than one percent of the population can be exposed to US broadcasts. This is pretty disheartening in view of the need to indoctrinate the Russians in the way of democratic living. One solution might be to establish super-high-power UHF transmitters in nearby friendly countries and endeavor to supply outside programs by beaming high-power transmissions at the relay receivers so that cross modulation in the receivers, or even the audio circuits, would transmit the programs from outside the iron curtain to the homes of subscribers.

TELEVISION

GOLDEN RIVETS in the Empire State Building mark the beginning of construction for the new five-TV-antenna installation above the "crow's nest". When completed in December, five TV stations and three FM stations will operate from the one, lofty location. Marking the first time in history that five competitors have joined forces in transmitting from a common point, it is a lesson in the American way of getting along together. The only similar site is Mount Wilson in Los Angeles where seven TV stations share the same mountain—not quite the same thing. When the Empire State installation is completed the heat will be off the engineers and on the program directors, for viewers should find their only grounds for station preference in program content not—for once—signal characteristics.

MILITARY

MANY INVENTIONS which were developed in the last war have been applied to civil operation and entertainment. It is not unusual for the roles to be reversed and for variants of civil applications to be used in military service. For instance, the Subscriber-vision patent of the Skiatron Corp. has a very strong appeal to military operations for it offers a secret form of visual transmission of objects such as maps, or plans, in much the same way that the decoder machines of the Signal Corps operate. The easily destroyed key, which is the secret of the system, can be changed daily or as often as required. The radio feature of the system eliminates the need for physical connections, and yet secrecy is assured in spite of the widespread coverage radio gives.

FILMS

KINESCOPING, VITAPIX, VIDEO RECORDING, or what have you, is in for a lot of attention these days. The networks have recently been reporting prodigious gains in picture quality, obtained by the use of new lighting technics such as better front lighting, improved video amplifiers which are reputed to have a more brilliant contrast range, and projector light sources which provide superior illumination. But the fact remains that until changes in the method of film transmission and recording are made, recorded films will not be as good as live shows. One of the BBC's TV engineers, Herbert Baker, who is the inventor of the BBC's continuous-movement TV film camera has just spent three weeks here in the US, inspecting the facilities of the various nets. It would not be surprising if one of the American networks announced a radical change in its system of film recording in the near future. The BBC's continuous film system will be described in a forthcoming issue of TELE-TECH.

AM-FM

BINAURAL RADIO TRANSMISSION is a natural for those broadcasting companies owning AM and FM outlets in the same city. The necessary two channels are available in the two frequencies, and programming would be no different from present FM practice which is usually to duplicate the AM program. It would merely require an extra microphone, or microphones, in the studio, feeding the FM transmitter. Listeners could be told which transmission was left or right and arrange their receivers accordingly. Homes without FM—or AM (!)—receivers would receive the program as usual. It would be of interest to the whole industry to learn what results were obtained by a broadcaster trying out this scheme.

For latest on "How to Sell to Uncle Sam" see charts and text on following pages, showing radio purchasing procedure of the Army, Navy and Air Force.

Rubberized fabric radome made by Firestone to protect Air Force radar installations from wind, snow, sleet and ice. Radome will be mounted atop a 25-foot tower. The balloon-like shelter, held up by a twentieth of a pound of air pressure, over all measures 167 feet in circumference and 36 feet in height. Inflated to half-pound pressure, the radome is designed to withstand 125-mile-an-hour winds. Deflated, it packs into a canvas bag like the one on Army truck in foreground.

US Armed Forces Gear-Up

Korean crisis and resultant world events prompt revised line-up of military purchasing practices. See chart and text for latest data on how to sell radio-radar-electronic-communication equipment to the Signal Corps, Air Force and Navy buying agencies.

IN view of new military requirements, TELE-TECH has revised and is publishing herewith all available and latest information which will serve as an accurate guide to manufacturers who wish to sell radio-electronic equipment to the Army, Navy and Air Force.

The accompanying chart presents a clear visual picture of the procurement agencies maintained by the Signal Corps, the Air Force and the Navy for purchasing communications and related equipment.

There is nothing complicated in selling to these agencies. If you are a supplier and wish to bid on a military contract, register with any or all of the procurement agencies. They will send you an invitation to bid when they believe that your facilities are suitable for production of a particular item.

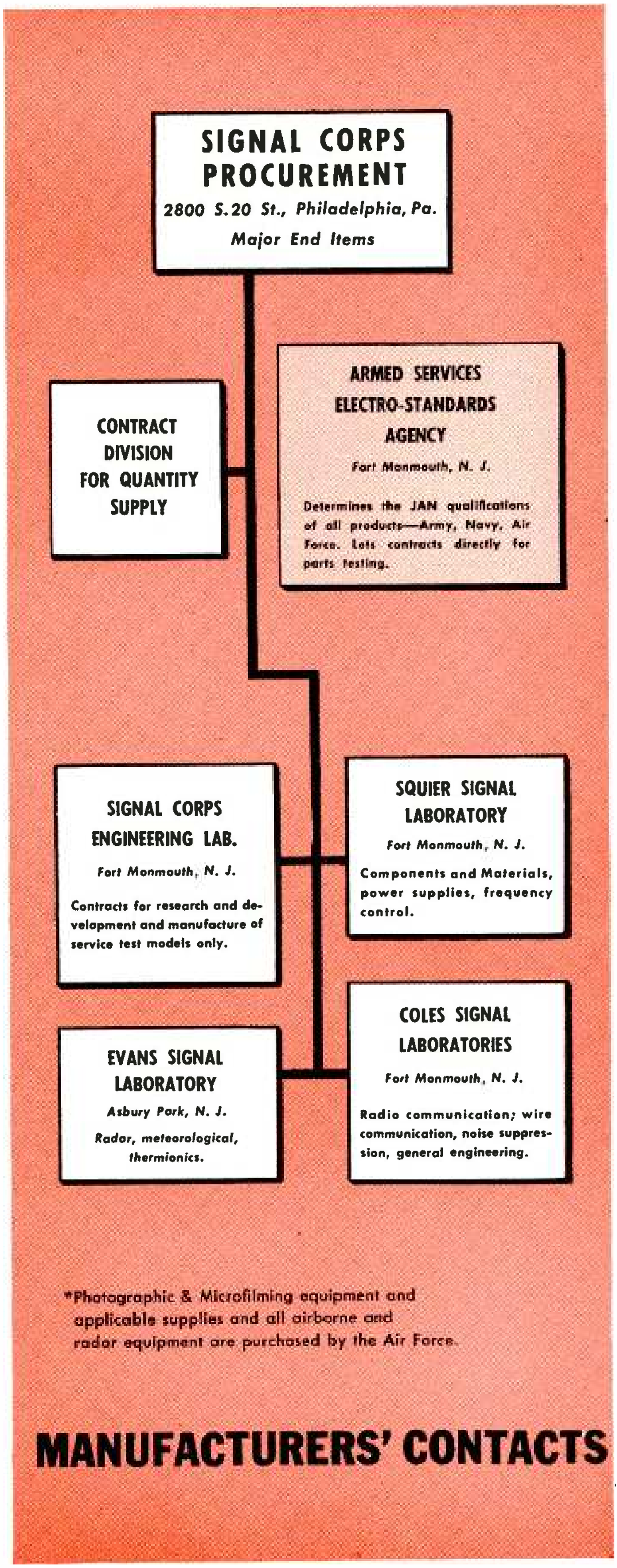
If you wish to take the initiative, simply visit the nearest regional office of the U. S. Department of Commerce or local Chamber of Commerce where mimeographed lists are available daily of all items under procurement. You are free to write to the procurement office handling any item listed and request "bid" papers.

If you wish to subcontract from a prime contractor, the same Chambers of Commerce and regional offices of the U. S. Department of Commerce have lists available once a week, usually on Friday, of all contract awards made during the past week. Award winners' names are listed and you need only communicate directly with the manufacturer to sell your subcontracting services.

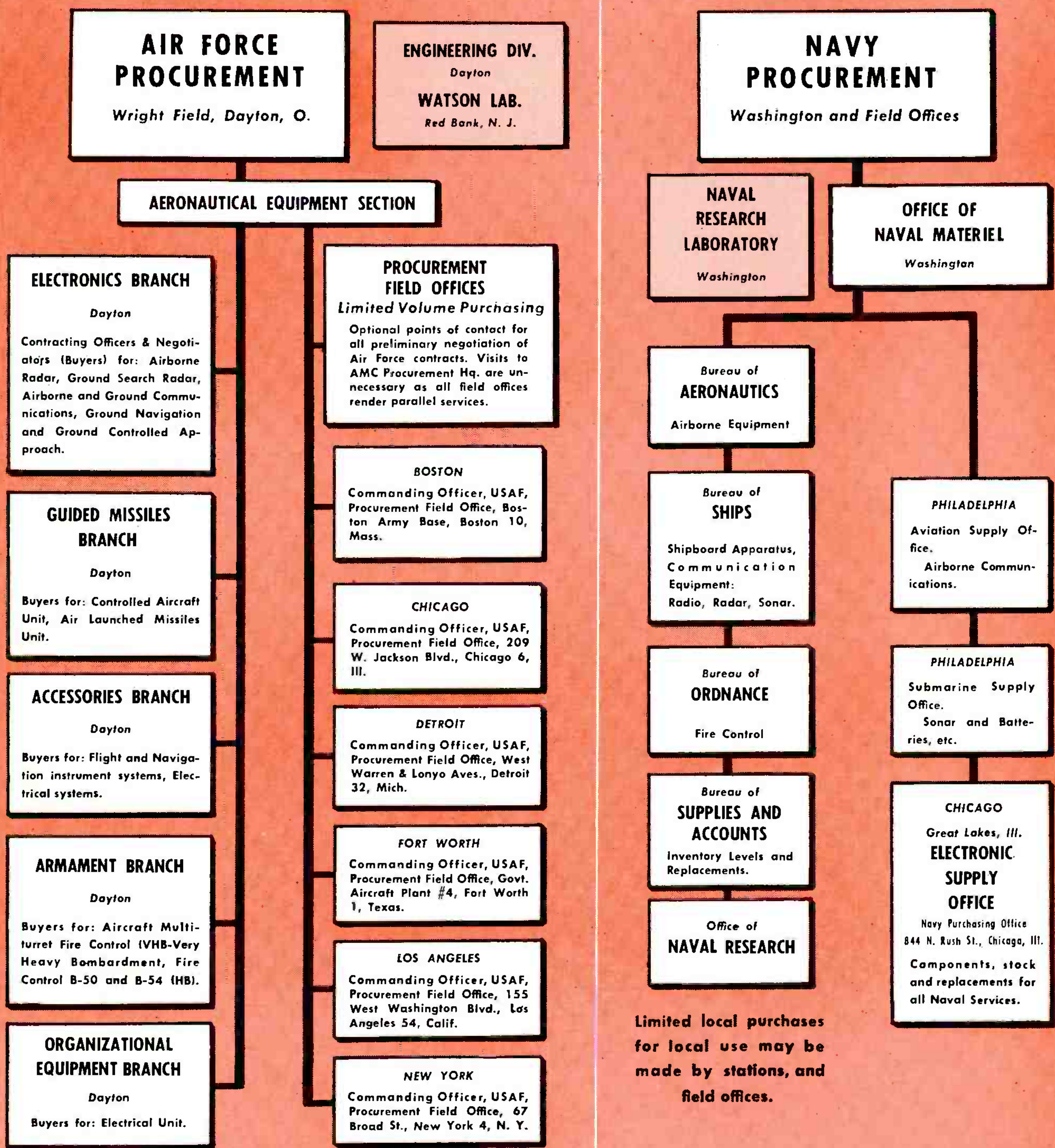
Three booklets are also available to serve as guides in selling to our government. These are:

1. *How to Sell to the U. S. Army*—available for 30 cents from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.
2. *Selling to the Navy*—available for 15 cents from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.
3. *A Guide to Selling to the U. S. Air Force*—available free from the Air Materiel Command, Wright Field, Dayton, Ohio.

For information not otherwise available, write to the Central Military Procurement Information Office, Munitions Board, Pentagon, Washington 25, D. C.



for Speedy Procurement



BY PRIME AND JAN CONTRACTORS.

A Tetrode Power

New coaxial cavity tetrode watts at 1000 MC; 10 kw

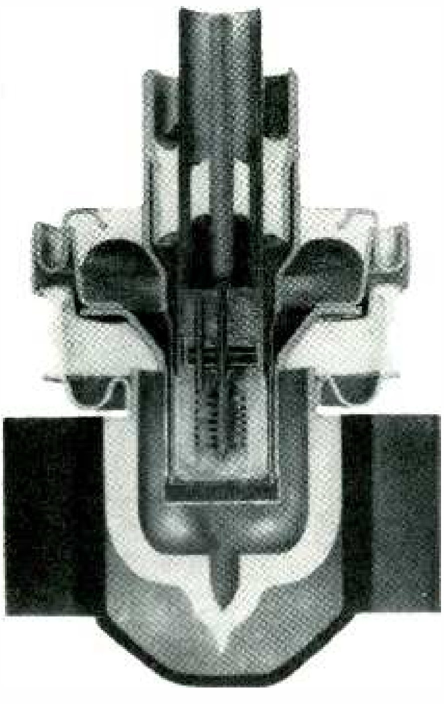


Fig. 1: Cross-sectional view of Eimac 4X150G

By DONALD H. PREIST,
Research Engineer,
Eitel-McCullough, Inc.,
San Bruno, Calif.

UNTIL recently it had been thought necessary to use triodes rather than tetrodes for the purpose of generating CW power of around 100 watts up to 1000 MC, or pulse power of the order of 10 KW, up to around 1500 MC. It was generally believed that a tetrode for these frequencies and power levels would be very difficult to make, and that the circuit problems incurred by its use would present such difficulties that the end result would be complicated and costly and of doubtful superiority over a triode generator.

Within the past year it has been shown possible, however, to make UHF tetrodes commercially and to solve the circuit problems involved in their use with a significant improvement in performance over comparable triode generators. One of the most important aspects of this improvement is the increased power output per unit area of electrode cross-section obtainable with a well-designed tetrode.

New Tube Design

The Eimac 4X150A tetrode which has been on the market since May 1947 gives satisfactory performance up to frequencies as high as 750 MC as a CW amplifier or oscillator, and 1000 MC as a frequency doubler. Because of the way the grid and cathode are brought out through the pressed glass base, rather serious losses occur above about 600 MC. Accordingly a modification to the tube was made in which the grid and cathode were brought out coaxially through metal cylinders passing straight through the glass base, giving minimum lead inductance and resistive losses. With this tube, known as the 4X150G, it is possible to attain very much better performance at frequencies above 600 MC. The rest of this article will be devoted to a description of an oscillator using this tube at frequencies between 500 and 1000 MC CW, and 1000 to 1500 MC pulsed.

It will be seen that because of the tube design the principal circuit problem is to find a suitable means of returning the screen grid to the cathode outside the tube in such a way that the necessary characteristics are produced. This applies to both amplifiers and oscillators. A further problem in the oscillator is to provide suitable feedback means, adjustable both in phase and amplitude, with preferably a maximum of independence between them. One solution is embodied in the oscillator circuit for a coaxial tetrode, (taking the Eimac 4X150G as a practical example), shown in Figs. 1 and 2. Fig. 1 shows an axial section through the oscillator cavity and Fig. 2 shows the equivalent circuit. It will be seen that the control grid is connected to an open-ended cylinder of adjustable length, and that the cathode is returned to the screen grid via a movable plunger and a capacitor "C" between the screen-grid connector and ground. Thus, there is a folded-back transmission

Fig. 2: (Left) Circuit elements for UHF tetrode oscillator

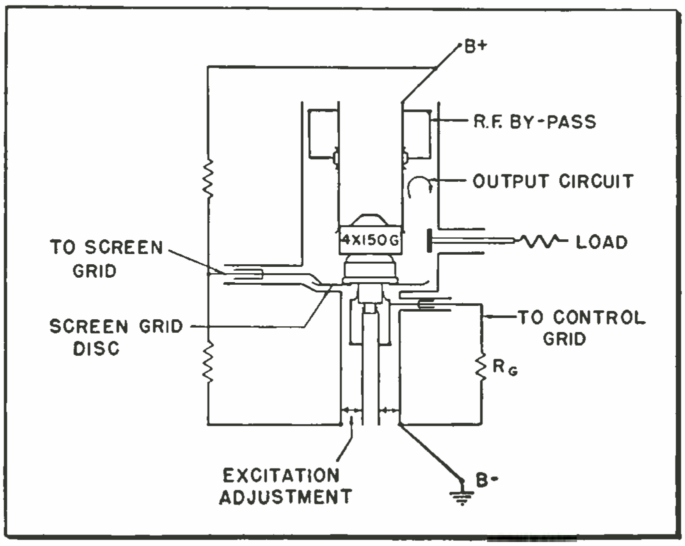
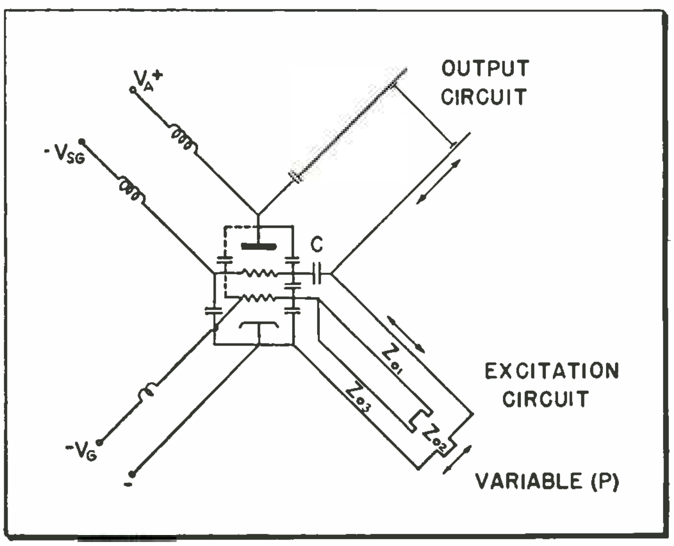


Fig. 3: (Right) Equivalent circuit of oscillator in Fig. 2



Oscillator for UHF

produces CW power of 100
pulse power at 1500 MC

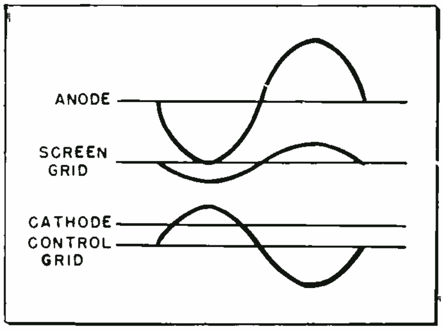


Fig. 4: Electrode potentials for r-f cycle

line having three distinct sections between the control grid and cathode terminals of the tube, considered as one termination, and the control grid and the screen-grid terminals, considered as the other. The anode circuit is a simple coaxial line returned via the capacitance "C" to the screen-grid, and including a suitable dc insulating r-f bypass system such as a linear quarter wavelength choke. For simplicity, these coaxial lines are represented in Fig. 2 by parallel-wire lines.

It can be shown that for optimum operation the output circuit must be adjusted to be slightly less than an odd number of quarter wavelengths electrically, so that an inductive impedance is presented between the anode and screen-grid electrodes. The open-ended grid line is adjusted to be about a whole number of half wavelengths electrically, the shorting plunger "P" is adjusted so that the net screen-to-cathode reactance is capacitative, and "C" is adjusted to the value found by experiment to give optimum feedback.

The equivalent circuit seems complicated but is amenable to treatment. In lieu of a complete mathematical analysis, which is somewhat lengthy, a brief description of the function and behavior of the different elements of the circuit follows.

Considering first the basic feedback system, this is similar to the series grid capacitance system used with success in triode oscillators. Briefly, in both the triode and tetrode versions the magnitude of the series capacitance, which is common to both the output and excitation circuits, principally determines the amplitude of the fed-back voltage, while the adjustment of the excitation circuit principally determines the phase. In the tetrode oscillator circuit shown, it is valid to consider the excitation circuit primarily as the circuit between the screen-grid and cathode, with the addition of a means for applying an r-f voltage between grid and cathode of controllable amplitude which, in general, is always either exactly in phase or exactly out of phase with the screen-grid to cathode voltage, and in this particular circuit is out-of-phase. The resulting electrode potentials are shown for one r-f cycle in Fig. 3, assuming transit time effects to be negligible.

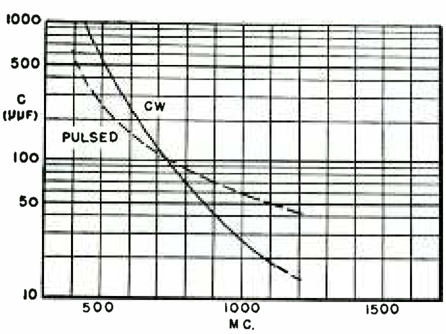
In this type of oscillator, having a large amount of feedback between the output, or screen-grid to anode circuit and the input circuit, the output circuit is the principal frequency-determining element, and adjustment of the cathode and control grid circuit parameters has only a slight effect on the frequency. Thus, the oscillator is definitely not an "electron-coupled" oscillator; this type of operation can be brought about, however, by bypassing the screen-grid heavily to ground ($C \rightarrow \infty$) and arranging the screen-grid, control grid, and cathode as a triode oscillator. Because the best geometrical proportions for this kind of operation are quite different from those in the oscillator depicted in Fig. 1, there is in the latter no problem with parasitic oscillations in the input circuit, although at first sight this might seem to be an inherent weakness in the design.

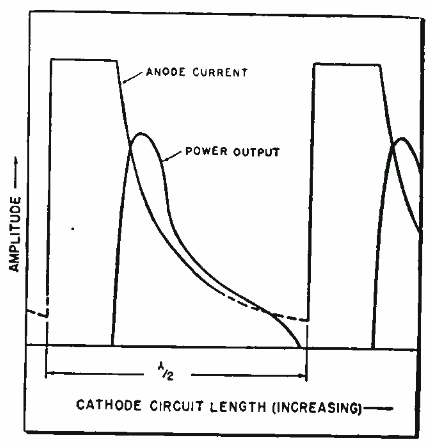
Adjusting the Circuit

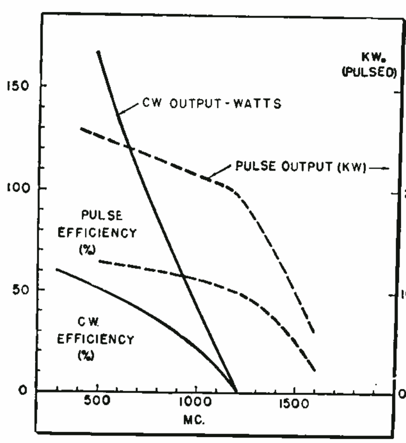
In practice the circuit is quite easy to adjust. Firstly, the output, or screen-grid to anode circuit is adjusted to approximate resonance at the required frequency. This is the principal frequency-determining part of the oscillator. The capacity "C" should be made according to the curves given in Fig. 4 which have been found experimentally to give optimum results, and should invariably consist of a circular plate separated from the

(*Continued on page* 76)

Fig. 5: (Below) Curves showing optimum values of C. Fig. 6: (Center) Effect of varying position of "P". Fig. 7: (Right) Test results on tetrode oscillator with Eimac 4X-150G







Narrow-Band FM Doubles Number

20 KC channel of effecting

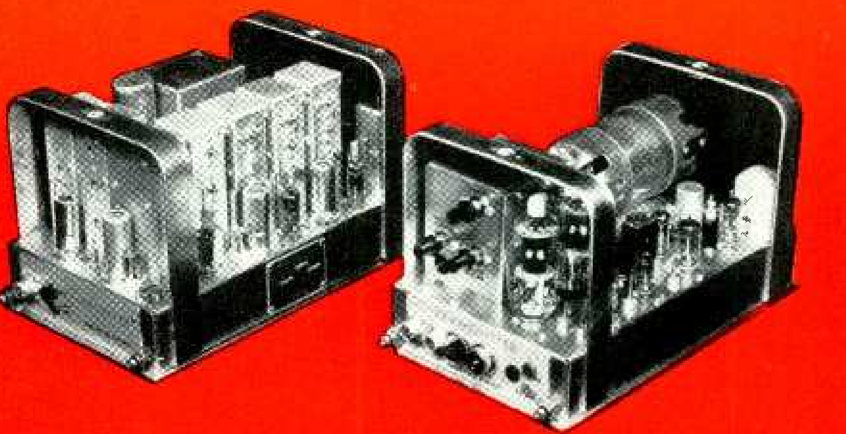


Fig. 1. Mobile transmitter (right) and receiver (left) for mobile narrow band FM

By CONAN A. PRIEST, CHARLES M. HEIDEN, and DAVID C. PINKERTON,

Commercial Equipment Div., Electronics Dept., General Electric Co., Syracuse, N.Y.

FOR the past several years it has been apparent that the increased demands for radio communication facilities by currently authorized users and new services would inevitably require a great number of additional channels in the VHF region. It was equally apparent that more selective equipment would be necessary to make these additional channels fully practicable. To fulfill these needs, much basic research and development was carried on in the laboratories of the General Electric Company, at Electronics Park, to establish what could be done quantitatively with available technics at reasonable costs.

The ultimate result of this work was the production of two companion designs of radio communication equipments. A "Wide-Band" system utilizing a swing for 100% modulation of 15 KC, designed initially for additions to existing radio communication systems in order to provide the best possible performance utilizing the full 40 KC channel widths presently assigned, and a "Narrow-Band" system utilizing a swing for 100% modulation of 6 KC having performance equivalent to the "Wide-Band" but providing interference - free communication when operating on channels spaced 20 KC apart, provided only that some reasonable restrictions are observed in assigning these channels.

Field Tests—The Proof

Field testing of these two types of systems started almost immediately after the first samples were completed in the laboratory, to prove once and for all, whether or not cutting the transmitter swing would degrade the performance to a point where the readability in the fringe area would be unacceptable as compared to the conventional 15 KC system. All of the conditions that are normally encountered in an operating system were explored: Quiet rural areas, rural areas where the ambient noise level was high, and city areas. These tests convinced all that the narrow-band systems are more than practical.

These trials brought to light many requirements which must be adhered to if consistent and truthful results are to be obtained. Proper modulation is of utmost importance. Overmodulation, received on receivers which have been designed for a steel walled selectivity curve, can produce unreliable results. To prove this, modulation of approximately ±17 KC was transmitted and two receivers, a "Wide-Band" and "Narrow-Band" version, were compared as the fringe area was approached. When well within the fringe area, the modulation from the narrow receiver became mushy and then the signal began to chop up and become unreadable. The reception on the wide-band receiver was still coming through so that the signal could be copied. The modulation was then cut to the proper level for the narrow receiver and again the signal was fully readable.

In the test cars, which were fitted with both narrow and wide-band equipment, various precautions were taken to insure that as many of the variable factors as possible were fixed. A coaxial antenna relay was installed to switch the antenna from one set of equipment to the other. On the original field tests it was found that speakers and their positions in the vehicle gave different tonal results which confused the listener during critical tests. To switch one speaker between the two receivers, controls were installed which operated the speaker relay and the antenna relay simultaneously so that the observers could switch from one set to the other with little or no interruption.

Another precaution that had to be taken, to insure the least amount of confusion to the observers, was to balance the audio response of the receivers under test so that the audio quality of one receiver, as compared to the other, would not enter into the results. The sensitivity and selectivity of the receivers had to be comparable to fairly represent what could be expected from production equipment.

Incidentally, Syracuse has as nearly a perfect geographical setup for field tests as can be desired. Electronics Park is situated a few miles north of Syracuse. Due north of the Park is 50 or 60 miles of very level land terminated by Lake Ontario and the Thousand Islands. To the South is the metropolitan area with its outlying district of steep hills and deep valleys which provide excellent tests for reflec-

# of VHF Channels for Mobile Use

assignments demonstrate unquestioned feasibility of new methods spectrum economy in the Land Transportation Radio Services

PART ONE OF TWO PARTS

tions of the higher frequencies. East and West of the Park is fairly rolling terrain which provides enough attenuation so that a test for fringe area operation can be completed in a few hours without driving too many miles. Yet the hills are not sharp or steep enough to change conditions so rapidly that the conclusions cannot be properly interpreted.

Narrow-Band vs. Wide-Band

The first test was made to compare narrow-band and wide-band operation with reference to the distance from the transmitter and to the noise level. Here a 50-watt station delivered a signal which was modulated one minute at ±6 KC swing alternated with one minute at ±15 KC swing. The one minute period was divided into one-half minute voice and one-half minute 1000 cycle tone. At any time in the test that the observer wanted any one of the modulating conditions repeated in a different manner, such as voice transmissions for extended periods, he could break in with the mobile transmitter and give the station operator the needed instructions. The station antenna was mounted approximately 65 feet above the ground. The test frequency was 42.98 MC.

On a typical test the following results were obtained: Traveling east from the Park the signals on both receivers were essentially the same until the small town of Chittenango was reached, approximately 15 miles airline from the antenna. Chittenango lies in a deep valley and is completely in the shadows of the surrounding hills. The buildings are built close to the edge of the highway and the business district, which is approximately four blocks long, is very typical with its colorful neon signs, traffic lights, etc. This town became one of the favored test spots because of the high ambient noise and weak signal strengths encountered. There was a difference in signal to noise ratio between the two systems, but the difference was so little that if silent periods of a minute or two between transmissions were ordered, the narrow-band system could seldom be differentiated from the wide-band system.

Proceeding east the country is very gentle rolling terrain with villages at five or six-mile intervals. In each of these villages, tests were made and results obtained similar to those in Chittenango. By the time that the Village of Vernon was reached, approximately 32 miles airline from the Park, the reception of both the narrow and wide-band transmissions became very spotty. The conclusions drawn from the tests were that there is a difference in signal to noise ratio between the narrow and wide-band systems, but the difference is slight and no serious degradation of intelligibility is experienced.

This conclusion became obvious again on the return trip to the Park, when the route was chosen, which led directly into the heart of the City of Syracuse where extreme noise conditions are found. During this portion of the test, the signal level of the transmitter was dropped to the point where the background noise was definitely heard in the wide-band receiver. The increase in noise in the narrow-band receiver was then noted and found slightly greater, but only to the extent that it was greater and not great enough to impair the readability of the signal.

Interference Rejection

Next tests were made to compare the ability of the receivers to reject interference caused by a 40 KC adjacent station employing ±15 KC modulation. The 250-watt interfering station, 40 KC higher in frequency than the desired signal, was modulated by 1000-cycle tone and was keyed on and off while the car proceeded with the test.

With the interfering signal off the air, the test car was driven close to the antenna (approximately 75 feet). The desired signal strength was reduced until the receiver was

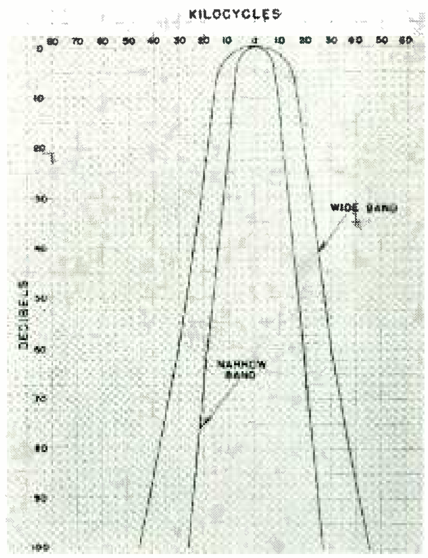


Fig. 2. Selectivity curves comparing narrow and standard (wide) band receiver performance

just quieting and the voice modulation is readable. The interfering signal was then put on the air. A weak 1000-cycle tone could be heard in the background but the desired signal modulated by voice overrode it with 100% readability on the narrow-band receiver, while on the wide-band receiver the 1000-cycle signal blocked out the desired signal and it was unreadable.

As the car moved away the 1000-cycle signal drops in and out of the background, due apparently to reflections and cancellations, until at a distance of approximately 1000 yards the tone entirely disappears from the background of the narrow-band receiver. This same type of action occurs on the wide-band receiver, but the distances were much greater and the interfering signals "hang" on longer.

The results of this test, especially in view of the intermodulation properties of the receivers, immediately show the possibility of using adjacent 40 KC channels in the same service area, using some of the previously unusable channels.

Finally a narrow-band run was made to show 20 KC channel selectivity and performance. Although the equipment was not designed to work adjacent 20 KC channels in the same service area, it was felt necessary to know the possibility of 20 KC adjacent channel operation when the stations were located in the immediate vicinity of each other and when they were geographically separated.

First Test Results

The first test was run with the desired signal of a 50-watt station modulated ±6 KC with tone or voice. An interfering signal from a 250-watt station, also modulated ±6 KC with tone, was located 20 KC higher in frequency. Transmitting antennas were separated just enough so that interaction between the transmitters did not occur.

With this ratio of powers of 5 to 1 (2.2 to 1 voltage ratio), the desired signal would "ride" through satisfactorily, although the signal was somewhat distorted because of the high-powered interfering signal. Since the antennas were relatively close together, except for minor reflections which cause the two signals to reach the vehicle antenna by different path lengths, the ratio of signal level remained fairly constant as the car moved away. Some improvement in quality was noted as distance increased because the selectivity is more effective on weaker signals. This test, although interesting to observe, does not represent a practical case, since systems in the 25-50 MC bands are seldom, if ever, located together.

The second part of the test gave a better picture of the limits of signal strength that can be tolerated from an interfering signal 20 KC off. After the car reached a point approximately 12-14 miles away, the desired signal dropped to the noise level, and the 250-watt equipment, 20 KC higher in frequency, was modulated ±6 KC. Measurements of the ratio of interfering to desired signal strength averaged about 18 to 1. On the return trip the interfering signal, which could just be detected in the background, remains fairly constant except again for the reflections. When the car was approximately 1000 to 1500 yards from the antennas, the interfering signal was so strong that the receiver blocked and there was complete silence.

Thus, if the systems were physically separated far enough so only skip signals appear on adjacent channels, 20 KC channel assignments could be made practical. This was tested out shortly thereafter in South America where many communication systems were working only 7 to 10 miles reliably because of the heavy barrage of signals from the United States. Running a receiver between channels and listening for the signals which he was hearing on the other receivers, indicated that the selectivity was great enough to reject signals 20 KC removed.

A pipe line company was using a pair of General Electric 250-watt transmitters operating on 39 MC to cover a 150-mile hop between Porto La Couz, Venezuela, located on a 1500-foot mountain with a 135-foot tower for the antenna, and Guasimito which utilized a directional antenna on a 400-foot tower on an elevation of approximately 500 feet. The stations on 39.020 and 38.980 were literally pouring in on the conventional equipment and so the system, although being used to good advantage, was anything but satisfactory. A narrow-band receiver at each end so reduced the interference that stations on 39.020 and 38.980 did not open the squelch even when it was set on the edge.

Design Factors

On all of the field tests described above, the equipment used in comparing wide-band and narrow-band performance was identical except for the critical features of receiver selectivity and transmitter swing. Both types have been in production now for more than a year with extremely satisfactory results in many operating systems which have verified the tests made in the developmental period.

Factors which pertain to the outstanding features of this equipment are in particular: Receiver spurious response attenuation, receiver selectivity, receiver intermodulation, spurious response attenuation, transmitter spurious, and harmonic radiation, and phase modulation limiting.

Spurious response attenuation is a measure of the ability to discriminate between a desired signal to which it is resonant and an undesired signal at another frequency to which it is simultaneously responsive. The main spurious response of superheterodyne receiver, the image, can only be attenuated by having adequate selectivity in the receiver circuits preceding the first IF amplifier. Other spurious responses likewise are attenuated by the selectivity of the r-f stages of the receiver unless they are very close to the desired frequency. In the GE receivers, Types ER-6-A and ER-7A, (Fig. —), five high Q tuned pre-selection circuits preceding the first converter grid result in an image attenuation of more than 100 db. The five tuned circuits are: A double-tuned antenna coil, and a triple-tuned r-f transformer following the r-f amplifier tube.

Since spurious responses are caused by mixing the undesired signal with the harmonics of the local oscillators, thus generating frequencies within the pass bands of the intermediate frequency amplifiers, many spurious can be inherently eliminated by reducing the number of harmonics generated in the local oscillators. So a triplex, or third overtone type of crystal, is employed for the first oscillator in order to obtain the high frequency required without frequency multiplication. This eliminates many spurious that are present in the older receiver designs which employ lower frequency crystals and frequency multipliers.

The selectivity of the first or high intermediate frequency amplifier, and, to a lesser extent, the selectivity of the second i-f, also affect the spurious responses by reducing the pass band of the amplifiers. The first i-f operates at 6 MC and has six, high Q tuned circuits contained in the two triple-tuned, first i-f transformers. Spurious responses of the narrow-band receiver are attenuated at least 90 db and on the wide-band receiver they are at least 85 db down.

Selectivity

For all practical purposes in the 25-50 MC band, no greater selectivity is necessary than has been obtained in these designs. The selectivity curves of both the wide-band receivers are shown in Fig. 2. This performance is obtained by three, carefully designed triple-tuned, second i-f transformers which operate at 455 KC in the narrow-band design, and 750 KC in the wide-band design. The transformers each contain three horizontal, parallel coils so that all tuning controls are easily accessible from above the chassis.

Part Two will appear in the October issue.

Condon Report Supports Proposal to Extend VHF-TV Band

TELE-TECH'S Suggestion for Continuous Band of 40 TV Channels Would Provide for 2000 Stations

THE editors of TELE-TECH have proposed that television be granted a practically-continuous tuning band extending upward from Channel 13 through Channel 41 as shown by accompanying chart. (See also August TELE-TECH, pp. 22, 23.)

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 extensions 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.

Text from Condon Report

Support for the allocation plan suggested by TELE-TECH in the July issue continues to appear. Examination of the Condon Report published in July 1950, reveals that annex "C", a statement by the Senate Advisory Committee on Color TV, pursues a theme which is identical with the argument put forth by TELE-TECH. It states . . .

"The proposal to allocate UHF channels is open to a number of serious objections which stem from differences in the performance of transmitters and receivers and in the propagation of radio waves. The available power of transmitters and the sensitivity of receivers are lower, in any given state of the art, in the UHF band than in the VHF band. The performance of the UHF system is impaired further than the VHF system by natural impediments to transmission over the earth's surface. These technical factors have important implications, which may be summed up in the statement that UHF television stations cannot cover as large an area (by a factor of the order of 3 times) as can VHF stations of the same effective radiated power.

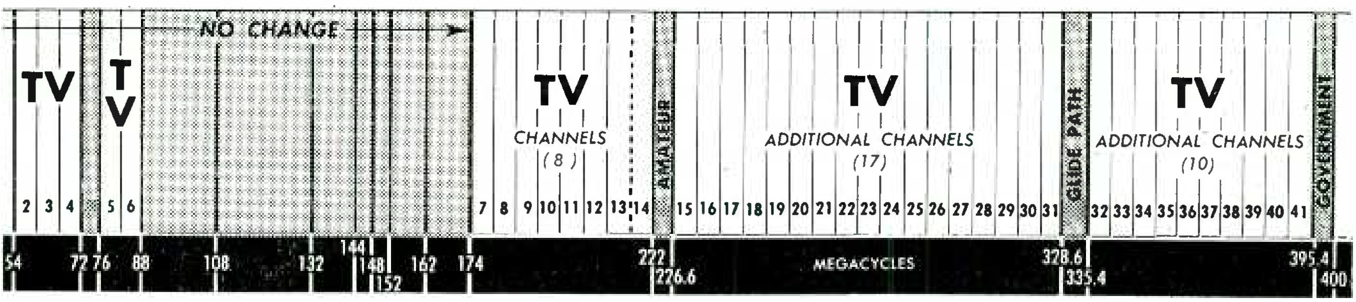
". . . A second effect of a UHF allocation which is against the public interest is the tendency to foster monopoly. In areas of dense population, such as the eastern seaboard, a VHF station can reach an audience much larger than can an equivalent UHF station. Accordingly there is serious doubt that a UHF station could, under these circumstances, compete with the VHF stations in the same area. The limited number of stations on the existing 12 VHF channels would then operate at a substantial competitive advantage.

"These disadvantages of a UHF allocation may have to be faced, provided that no additional VHF channels can be found. But to the extent that space in the VHF spectrum could be transferred to the television service from other services, the technical, social, and economic shortcomings of UHF television service could be obviated . . . without the necessity of the extensive UHF allocation proposed by the FCC. Allocations must be made on a high administrative level, by a group of judicial merit, having knowledge of, and properly responsive to, the needs of *all* the radio services.

"It is the considered opinion of this committee that the distribution of the VHF and UHF regions of the spectrum to various services has not been carried out in the past on the basis just suggested.

Conflict of FCC and IRAC Policies

"This failure has stemmed from the fact that no government agency has been given the authority or responsibility to make a judicial review of the use of the entire portion of the spectrum involved. Two groups, operating with different procedures and policies, have been responsible for the main features of the allocation. These are the FCC, which allocates frequencies to non-government services and the IRAC (Interdepartment Radio Advisory Committee) which allocates frequencies to government, including military services, and, in addition, allocates frequencies for assignment by the FCC to non-government services. These groups have not operated, during peacetime, under a common policy and the IRAC has not reviewed, in the manner employed by the FCC for non-government requirements, the needs of all government and non-government services. Unless and until such a review is carried out, at an administrative level sufficiently high to command the respect and cooperation of the industries and government departments affected, serious doubt will remain that the allocations, as they stand now, are for the maximum benefit of the public and the national security . . ."



Test Equipment in TV Receiver

Development of specialized instruments to operate in conjunction with modern production technics has reduced original testing costs by 80%

BEFORE television turned the well known "corners" sometime ago the attainment of efficient receiver production layouts was handicapped by low production volume. At that time the advanced studies seemed to show that the elaborate testing facilities needed would make small scale receiver production impractical. The outlay for test equipment was considered too costly and it was therefore predicted that the manufacturing of television receivers would settle down to a few big scale producers. Experience has shown that this viewpoint was extreme. The following review of present TV receiver test methods shows that remarkable simplification has taken place in the solution of this problem.

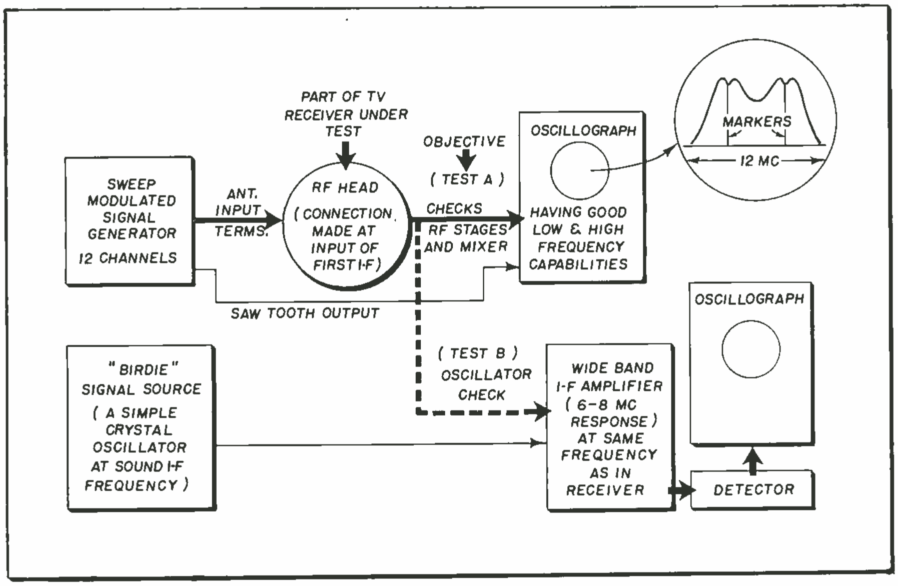
As may be deduced from records of the troubles that television receivers have encountered in the field, widely different systems of production tests exist in the various manufacturing plants. Some sets quickly get a reputation for certain types of failures. A trouble-inviting "cheap" receiver becomes one of the most expensive models to the owner —who has to pay the price of repair bills that not only cover the cost of replacing a part, or readjusting a circuit, but also the more costly work of transporting the receiver to a repair shop (or the shop to the set) and in removing the chassis and locating the fault.

Many of the worst offenders have been sets that were given little more than an "air" check at the plant to see if it would receive the particular station that was "on the air" at the time. Since a full daytime schedule is not present in many places, sets had to be run through pretty fast whenever a station was on.

At the present time most manufacturers have worked out a fairly satisfactory test procedure and are continually improving the method as new techniques are developed.

It is not difficult to determine just what ought to be tested, but the problem of setting up equipment that will do the job quickly and accurately is another matter. For this reason several organizations have specialized on the problem, and a completely integrated test line can be now set up for about one fifth of that cost believed necessary a few years ago. As might be imagined, most tests are set up to check the receiver a section at a time. Complete workable units are preassembled ahead of their connection to the chassis, and as many of the preliminary adjustments as possible are made before hand. Then a complete chassis check up is made some time prior to its final mounting in a cabinet. In most instances either of two test procedures are possible —depending on the ideas of the test engineer. These are: (a) the forward plan—starting with the r-f assembly, the i-f sections, video amplifiers, power supply and scanning circuits; or (b) the reverse system which starts with getting the picture tube to function and focus, to scan correctly, to be modulated by a suitable video signal, and so forth back to the r-f amplifier.

Fig. 1: Block diagram showing a common arrangement of equipment for testing r-f and mixer stages of a television tuner (Test A) or checking oscillator tuning range and output (B)



Timing is Important

On a production line everything must function by the clock. Specific test instruments, developed to do a single job, are the rule. For example consider the testing of an r-f tuner head. Fig. 1 shows a common test setup developed specifically for this work. The problems connected with this part of the test are: (1) a check on the effectiveness of any antenna network circuits (if present) in the receiver, (2) a check or readjustment of the tuning characteristics and gain of the r-f stages and mixer, and (3) a check on oscillator tuning range and output.

As will be evident many special circuits must be available in the signal generators that are capable of handling these tests. For production efficiency it is necessary that all tests be made easily, at a single test position and require as few wire connections as possible to the receivers. A description of the Tel-Instrument Type 1200A R.F. Wobbulator, illustrated in Fig. 2, will indicate how these tests are accomplished on many assembly lines.

The generator furnishes 12 output signals (one for each channel) each swept over approximately a 12 megacycle range, centering on that channel's frequencies. The sweep rate is a double excursion, up and

Manufacture

FIRST OF A SERIES

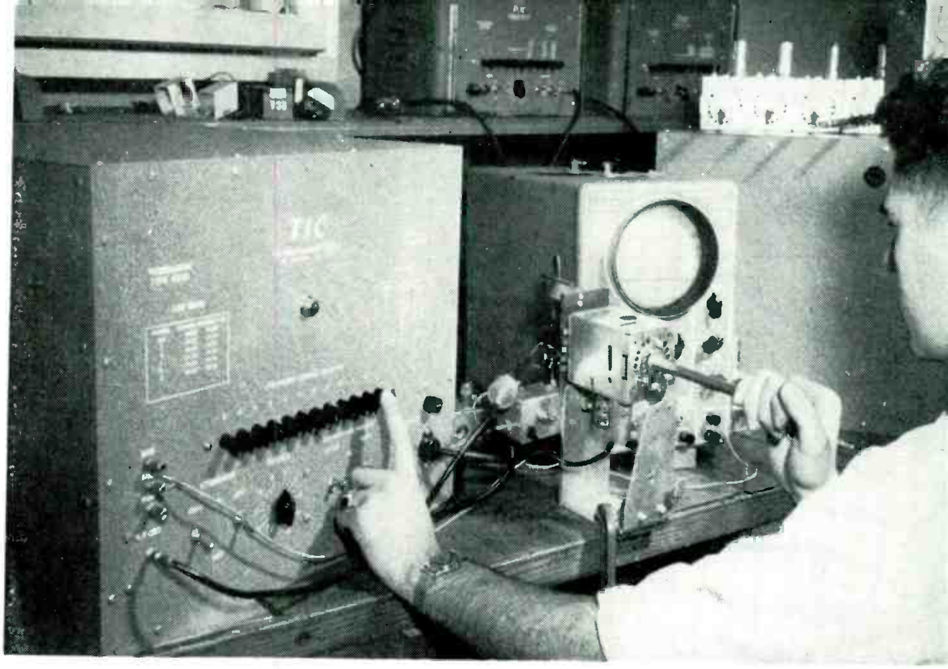


Fig. 2: Physical appearance of test diagrammed in Fig. 1. Tel-Instrument 1200-A r-f wobbulator is at left, tuner and test jig in center, and DuMont 274-A oscilloscope at right. Photo taken in advanced development laboratory of Air King Products Inc., Brooklyn, N. Y.

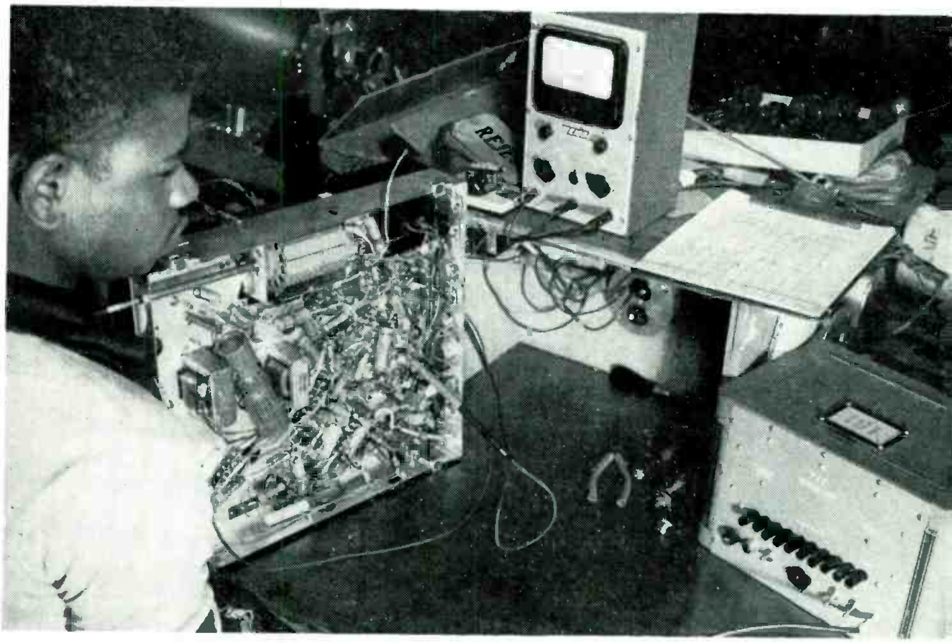


Fig. 3: View of i-f alignment station on main production line of Air King plant in Brooklyn, N. Y. Tel-Instrument type 1900 multi-frequency generator is used as signal source with an EICO VTVM being used as an alignment indicator. Generator, in furnishing 10 crystal controlled test signals, can be used to align stagger tuned i-f systems in TV receivers

down, over an interval of 1/120 second, at a 60 cycle rate. The sweep range is essentially linear over the used portion. Precise information is needed as to the location of specific points along this sweep band, so two accurate crystal - controlled marker points are provided in the instrument. These markers are created by applying a signal to a pair of crystals which generate a pulse signal as the frequency of the sweep goes through the channel spectrum. This pulse is amplified and fed back to the sweep oscillator grids with a sufficient negative amplitude to cause the oscillator tube to momentarily stop oscillating and thus creating two markers by instantaneously reducing the output signal to zero. A keying signal is derived from the 60 cycle power supply by means of a 991 gaseous tube that creates a 60 cycle square wave which is also applied to the grids of the oscillator tube thus causing it to stop oscillating when the keying signal polarity is negative. This keying signal generates a reference base line.

Amplifier Conditions

Since the r-f output is zero over the return for a 1/120 second at the end of each sweep excursion, the oscillographic indication gives a complete picture of the amplifier conditions: the r-f pass band of the stages with the video and sound carrier points marked by distinct lines, and with the zero base line drawn in by the oscillograph during the no-signal intervals. (See Fig. 1 Test A connections). Gain conditions are shown by relative amplitudes as for example those at the known marker points. It is to be noted that the receiver oscillator plays no part in this test.

For checking antenna network characteristics, the same signal at any channel is applied at a selected known level. This signal is also monitored by a self contained shunting rectifier circuit giving a signal that can be applied to an oscillograph directly, which reflects the effects of impedance variations (with respect to frequency) directly onto the oscillogram.

The third test involves correct setting of the oscillators, noting the position on the tuning range where this takes place. For this check (see Test Circuit B, Fig. 1) the output of the tuner is connected to a high quality i-f amplifier of known characteristics to avoid variations inherent in the i-f channels of the receivers. It has the same center frequency as the receiver i-f. An oscillograph is used as the indicator here also.

Since the output of the tuner produces a pattern on the scope that is independent of local oscillator conditions it is necessary to spot the effect of this oscillator frequency along the sweep. There are three methods in use. First, the "birdie" method where the superimposed oscillator frequency puts a birdie on the indicator, a second method utilizes a beat frequency obtained by the oscillator output and a fixed crystal; and in the third, a pulse generated by a crystal is used to key the oscillator output.

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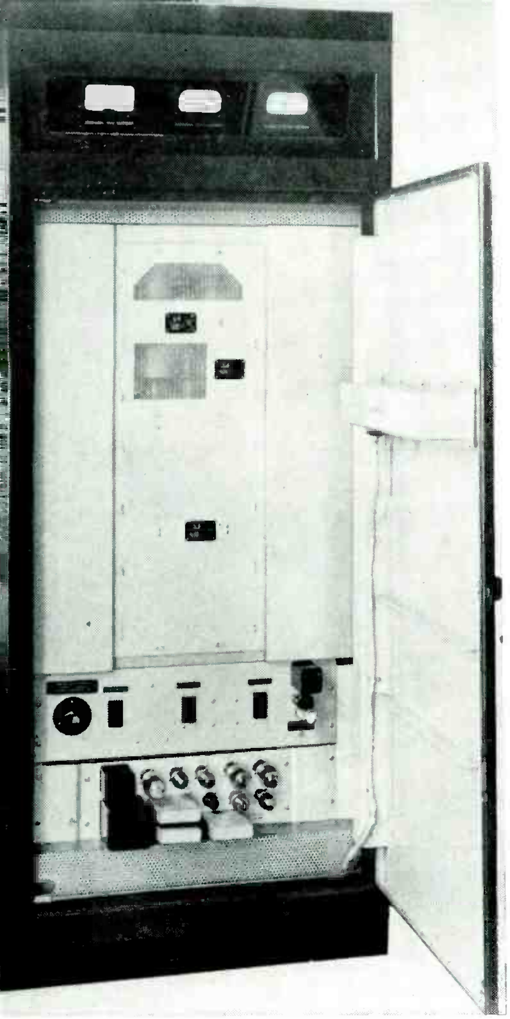
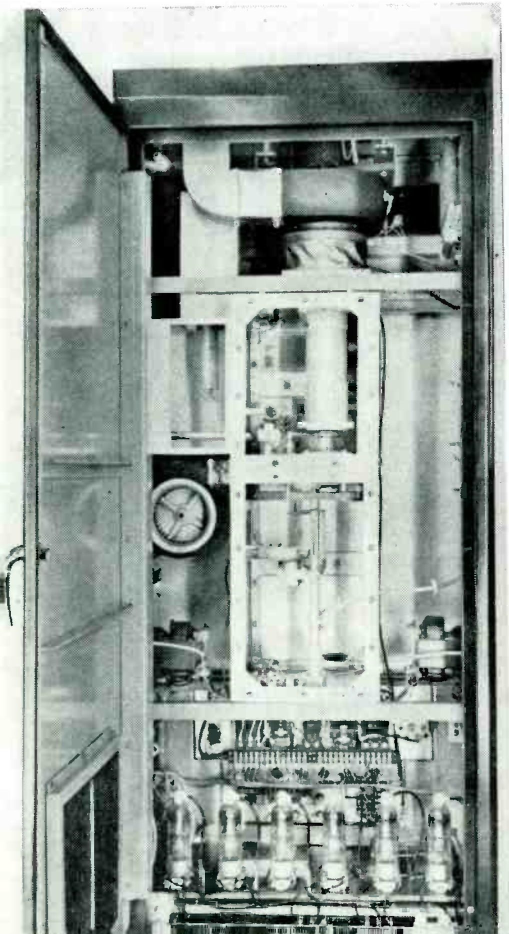


Fig. 1: Front view of the 5 kw amplifier. This may be compared with the rear view

Fig. 2: Rear of amplifier stage. Note the self contained rectifier tubes for power supply.



New 5 kw TV

Air-cooled high-power transmitting of both video and audio carriers on

By PAUL BREEN, Project Engineer, Transmitter Div., Allen B. Du Mont Laboratories, Clifton, N. J.

IN designing these amplifiers the basic requirements were: to obtain 5 KW peak visual power and 2.5 KW aural power output stages, capable of being driven by existing 500 watt peak visual output and 250 watt aural output transmitters. They should preferably use forced air cooled tubes thus avoiding the complications and higher cost involved in using water cooled tubes; they must meet all the present and proposed FCC and RMA requirements.

Although there are several air cooled tubes having the required power capabilities, none had been used at high band television frequencies. The Eimac 3X2500A3 appeared most promising because of its comparatively low plate resistance and coaxial construction, and was found to meet the requirements.

The visual and aural amplifiers are identical, except for a few small details. The visual amplifier must deliver a maximum average power of 3.0 KW which occurs when transmitting a 5 KW peak black picture. This is not very different from the 2.5 KW power output required of the aural amplifier.

Circuit Arrangement

The amplifier consists of one stage with two 3X2500A3 tubes in a push-pull cathode driven circuit.

The plate tank circuit is tuned to quarter-wave resonance. The external plate circuit is formed by the shorting bar between tubes. At Channel 7, the shorting bar moves up about 3½ in. However, even with these short lengths, satisfactory coupling is obtained. Fig. 3 also shows the grid mounting plate, the neutralizing capacitors and the lower sideband notching filter, all of which are discussed later.

Fig. 4 shows the low band plate tank. The physical length is kept down to about 15½ in. at Channel 2 by using comparatively high surge impedance lines. Plate tuning is accomplished by a sliding grounded plate near the plates of the tubes. This varies the surge impedance of the plate tank circuit in the high band case and acts as a capacity variation at the low band frequencies.

In practice, a grounded grid amplifier is usually degenerative since an out of phase voltage component results at the cathode, due to the tube plate current flowing in the input circuit.

Fig. 6 shows the equivalent circuit of a grounded grid amplifier. Assuming that reactive currents through the plate cathode capacity of the tube have been neutralized, the expression for R_{in} shows a definite dependence upon load impedance R_L. This results in two conditions which would be undesirable in these amplifiers: the driving power requirements would be greater than is readily available; and since variations in load impedance result in variations in input impedance, it would be difficult to adjust the bandpass characteristics of the stage.

It has been shown[1] that a cathode driven amplifier may be operated with the grid not at ground potential, but with a specified impedance in the grid circuit. Fig. 7 shows the equivalent circuit used by Muller in his analysis. This is based on a push-pull cathode driven circuit having an impedance $2Z_g$ from grid to grid and cross neutralization. The expression for input impedance R_{in} now contains terms which include the inter-electrode capacities of the tubes and the neutralizing capacity. From Fig. 8, inspection of this equation for input impedance reveals that if the term $1 + \mu mp$ is made equal to zero, the entire term involving R_L becomes zero, making R_{in} independent of R_L. Since this term $1 + \mu mp$ is determined by the tube constants and C_N the neutralizing capacity, it then only remains necessary to solve for

[1] J. J. Muller, published in Electrical Communications, Volume 23, Number 3, September 1946.

Output Stage

tubes facilitate amplification all channels in the VHF band

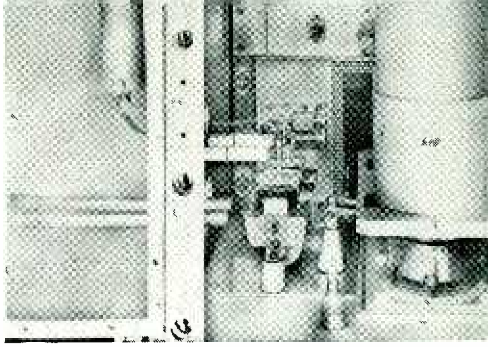


Fig. 3: High band plate tank circuit is tuned to λ/4 resonance on channel 13

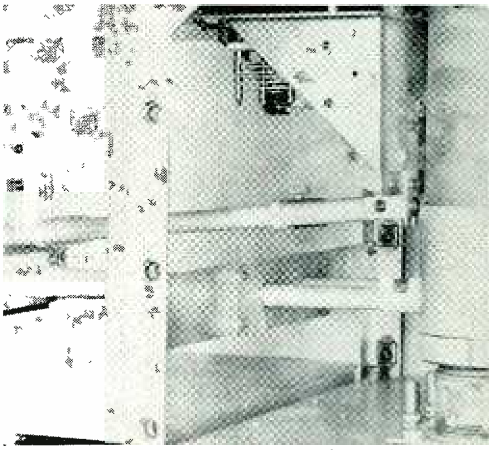


Fig. 4: High impedance low band plate tank

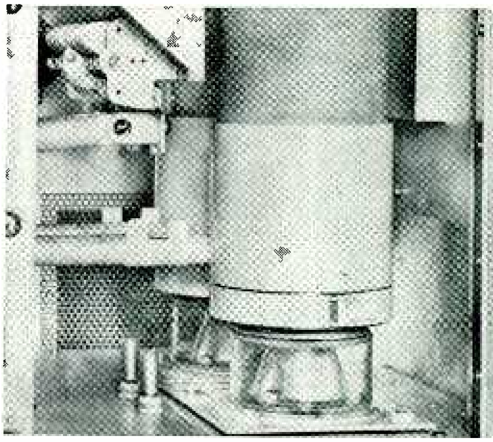


Fig. 5: Low band grid tuning inductance

C_N such that $1 + \mu mp = 0$ and no interaction will occur between input and output circuits. C_N comes out with a negative sign for this tube which indicates that an in-phase neutralizing voltage is required since the analysis is based on a cross neutralized circuit. C_N does not vary with frequency and the value for the 3X2500A3 tube is as shown.

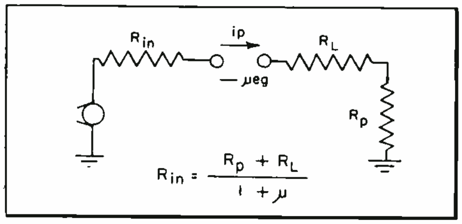
Z_g comes out with a positive sign which indicates an inductive reactance. Z_g varies with frequency. This is not too rapid a variation, however, and a single fixed value is satisfactory for all high band channels, while slightly different values are required for each low band channel.

This condition also makes the driving power requirements less than the grounded grid case for a comparable power output. This is because the cathode to ground voltage is less than the grounded grid case, but the current is the same. In other words, the stage is less degenerative.

The grid inductance is obtained in the high band by connecting the grid terminals of the tubes together with a metal plate about 5 in. wide. This may be seen in Fig. 4. Since the inductance of the internal grid leads of the tubes is almost the right value at these frequencies, the correct value of grid to grid inductance is obtained by varying the thickness of the mica between the grid mounting plate and ground. This varies the shunt capacity to this plate and, therefore, varies the effective inductance across it. At the low band frequencies, more inductance is required and this is obtained as shown in Fig. 5. Here each grid terminal is connected to a separate plate isolated from ground and an adjustable inductance is then connected between these plates as shown.

Tuning Cathode Circuit

The cathode circuit is tuned to three-quarter-wave resonance at high band frequencies and one-quarter-wave resonance at low band frequencies. At the high band frequencies, the physical length of the filament and grid within the tube plus the filament-grid capacity causes the first voltage node of the input circuit to appear at the tube terminals. In other words, the first quarter wave length of the input circuit is all inside the tube. This



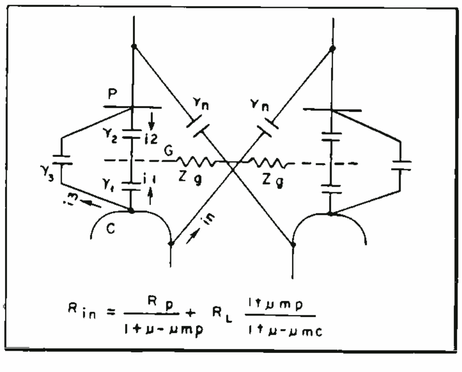


Fig. 6: (upper left) Equivalent circuit of grounded grid amplifier. Fig. 7: (lower left) Muller's equivalent circuit for cathode driven amplifier. Fig. 8. (right) Equations for C_n and Z_g. C_n is independent of frequency and negative for Eimac 3X2500 A3 used in this circuit

$$R_{in} = \frac{R_p}{1+\mu-\mu mp} + R_L \frac{1+\mu mp}{1+\mu-\mu mc}$$

where $mp = \frac{C_n - C_{cp}}{C_{cg}}$ (1)

$mc = \frac{C_n - C_{cp}}{C_{gp}}$

when $1 + \mu mp = 0$ (2)

$$R_{in} = \frac{R_p}{1+\mu-\mu mp}$$

and thus is independant of R_L from (1) and (2) above

$$mp = \frac{C_n - C_{cp}}{C_{cg}} = -\frac{1}{\mu}$$

$$C_n = C_{cp} - \frac{C_{cg}}{\mu}$$

for 3X2500A3 tube

$$C_n = 1.2 - \frac{48}{20} = -1.2\ \mu\mu f.$$

thus indicating in phase neutralizotion is required

$$Z_g = -\frac{Y_1 Y_2}{Y_1 + Y_2 + Y_3}$$

where $Y_1 = \frac{1}{j\omega C_{cg}}$ then $\frac{1}{Y_1} = j\omega C_{cg}$

$Y_2 = \frac{1}{j\omega C_{gp}}$ $\frac{1}{Y_2} = j\omega C_{gp}$

$Y_3' = \frac{1}{j\omega (C_{cp} - C_n)} = \frac{1}{j\omega C_{cp}}$

$$Z_g = \frac{1}{\frac{1}{Y_2} + \frac{1}{Y_1} + \frac{Y_3'}{Y_1 Y_2}} = -\frac{1}{j\omega [C_{cg} + C_{gp}(1+\mu)]}$$

for 3X2500A3 tube

Freq. (MC.)	Zg
216	+ 1.65 Ω
175	2.00 Ω
88	3.9 Ω
54	6.2 Ω

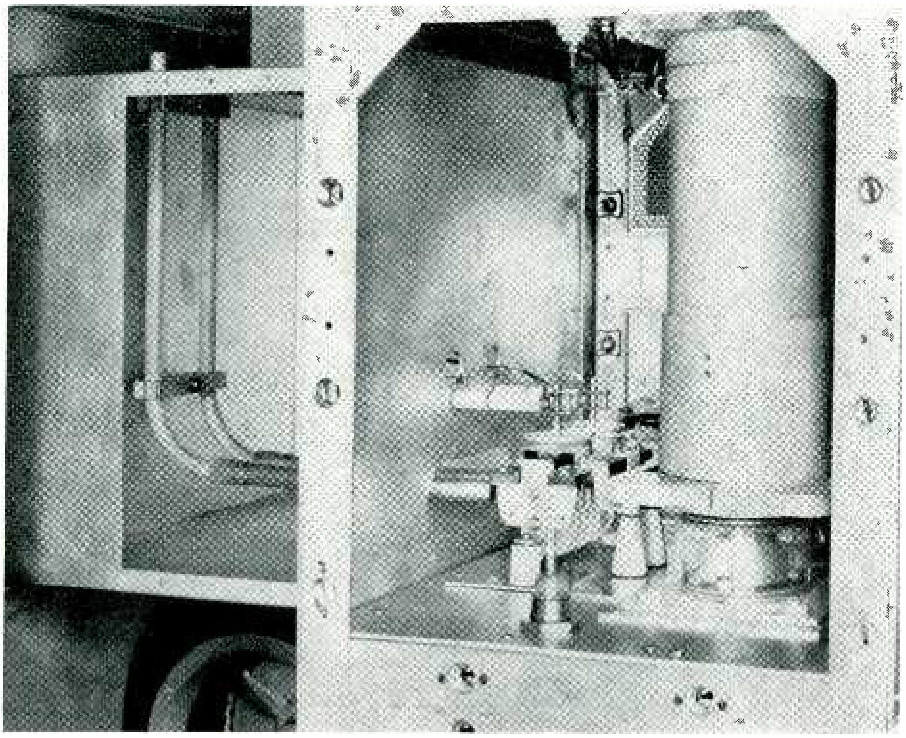


Fig. 9. Non-dissipative transmission line notching filter coupled to final.

has two important aspects: First the voltage maximum on the external cathode line is one half wave electrically from the cathode and therefore of opposite phase from the cathode voltage. Since in-phase neutralizing voltage is required, neutralizing leads one half wave long, giving the additional phase reversal required, are connected from the voltage maximum on the cathode lines to the posts near the plate circuit of the tubes. The capacity between these posts and the plate circuit is the neutralizing capacity. The second point involves the possibility of dissipating considerable r-f driving power in the filament structure of the tube. The active filament consists of a series of 12 hairpins of thoriated tungsten connected in parallel. Each tube filament and grid structure may be looked upon as a section of a coaxial circuit.

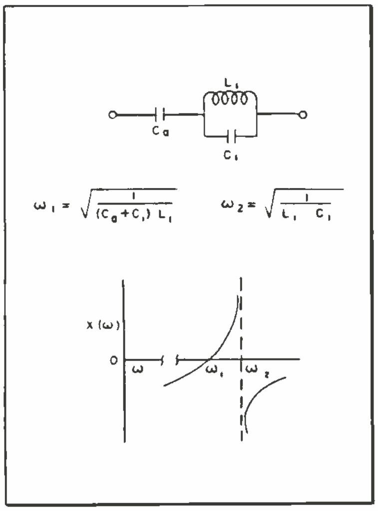
If the electrical length of the filament structure with its external leads is allowed to assume one half wave resonance, it will act like a half wave transmission line section shorted at one end by the active filament structure of the tube. Since it is quite easy to couple power into a half wave shorted section, considerable driving power will be dissipated in the filament. If the filament wiring is left to float, this circuit seems inclined to assume approximately one half wave resonance, therefore, it is tuned by means of its external circuit to one quarter wave resonance. Since it is impossible to couple to a one quarter wave section shorted at both ends, this prevents dissipation of driving power in the filament. Filament power is fed in between the outer conductor and an insulated wire up the center of the coaxial circuit inner conductor. The insulated wire and the r-f circuit inner conductor are connected together by means of a capacitor. This isolates the 60 cycle filament power from the r-f circuit and consequently allows the use of a shorting plug for tuning the filament.

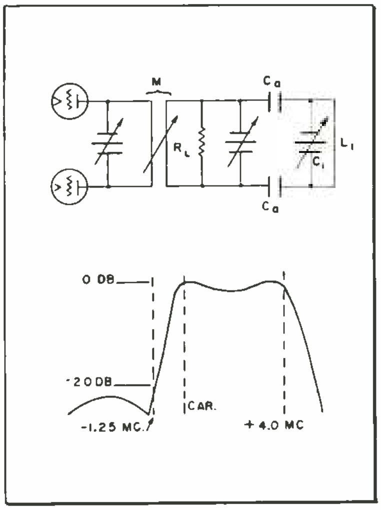
The visual amplifier provides single sideband transmission using overcoupled input and output circuits to obtain proper bandwidth. However, this is not down a minimum of 20 db at 1.25 MC below the carrier as FCC specifications require. It is, therefore, necessary to modify the response curve below the carrier without affecting the response in the desired pass band.

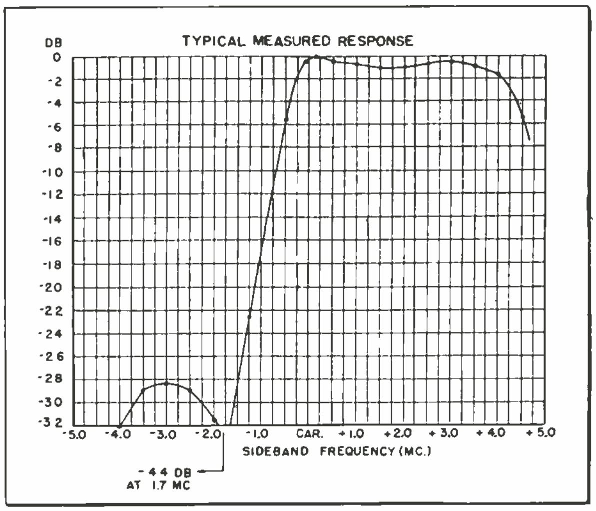
Fig. 10 shows a circuit having two resonant frequencies. At a frequency ω_2 L_1 and C_1 will have a parallel resonance and the impedance of the overall circuit will be high as shown. At a lower frequency ω_1 the net reactance of L_1 C_1 will be inductive and equal to the capacitive reactance of C_a. This will give a series resonance and a low impedance across the circuit. A circuit of this type is very loosely

(*Continued on page* 82)

Fig. 10. (left) Equivalent circuit of notching filter with two resonant frequencies. Fig. 11. (center) Notching filter coupled to output circuit parallel resonance occurs just below 1.25 MC lower cutoff frequency. Fig. 12 (right) Output band-pass is flat within 1.5 db to 4 MC







Vertical Antenna Characteristics

Tabulation of characteristics and performance of simpler quarter and half wave antennas provides convenient reference data

By NEWTON B. FOWLER, Consulting Engineer, 543 Barnett St., Atlanta, Ga.

To compare the characteristics and performance of simple quarter-wave and half-wave antennas, a table has been prepared showing certain fundamental and calculated characteristics (slide rule values), including transmission between similar types of antennas. Certain interesting relationships are brought out in this table and it is presented with the hope that it may clear up any misunderstandings existing because of the many formulas, using symbols having different meanings, that are available in the literature. For convenience, a partial list of references is included. These notes are intended to describe briefly the table and only a minimum number of formulas are therefore included.

For the purpose of calculating transmission losses between grounded antennas, a frequency of 5 megacycles (corresponding to a wave length of 60 meters) was selected. This frequency has the advantage of simple propagation laws over a perfectly conducting plane surface, such as approximated by sea water.[1,2] A path of 1 mile was chosen in view of the current practice of specifying the field of antennas at this distance. This is far enough to reduce the induction fields to negligible values and near enough to disregard attenuation losses and sky-wave effects at this frequency.

Although the calculations involve a frequency of 5 megacycles, it is not intended to imply that some of the relationships are not applicable to other frequencies. However, propagation effects at other frequencies and over other surfaces may require additional consideration, even at distances as short as 1 mile. For the purpose of comparisons, one antenna is considered at a frequency of 2.5 megacycles (120 meter wave length) and an isotropic antenna in free space is included for theoretical purposes.

It is well known that the radiated field intensity of a simple short straight wire antenna carrying uniform current is measured in volts per meter, and this field varies directly as a constant times the length of the wire, the frequency, the current, the sine of the angle that the radiated ray makes with the wire axis and inversely as the distance from the antenna to the point of measurement.[3] As the antenna wire is made longer, up to one-half wave length, a correction factor called the "effective length," is applied to account for the non-uniform distribution of current (greater lengths require the consideration of phase difference also).

Free-Space Field

A characteristic of any antenna is its so-called "free-space field" at unit distance and designated E_o volts per meter. For vertical antennas located over a perfectly reflecting surface, the resultant received field strength (consisting of the sum of the direct and reflected components) is designated E volts per meter and is equal to 2 E_o[1,2,3] (Image Effect).

The characteristic impedance (or intrinsic impedance) of space to transverse electromagnetic waves is 120π or 377 ohms. The average rate of power flow through a unit area of surface on the wave front and perpendicular to the direction of propagation is called the "power intensity" of the wave and equals $E^2/120\pi$ watts per square meter. The power intensity of a given antenna in a specified direction divided by the power intensity of an isotropic antenna radiating equal power is the "gain" (g) of the given antenna over a point source in that direction.[4,5,6] Usually the direction giving maximum gain is most important. Gains based upon radiated powers are called directive gains, and gains based upon powers supplied the antennas are called power gains. For antennas having no losses, these two gains are equal. The maximum directive gain is called the "directivity" of the antenna and may be expressed in decibels and designated G. Since the impedance of free space is constant, antenna gain may also be expressed in terms of the ratio of the free-space field strengths squared (i.e., E_{o1}^2/E_{o2}^2) for equal radiated power, and is a measure of the free-space field pattern.

The effective voltage generated in a receiving antenna is the product of the received field intensity in volts per meter and the effective length in meters.[3] An antenna absorbs power from the passing wave and this ability is designated as its "effective area,"[4,5,6] which equals $g\lambda^2/4\pi$. The effective area multiplied by the received power intensity gives the available power output into a matched load. Thus, the effective area of an isotropic antenna, and the effective area of any antenna averaged over all directions is $\lambda^2/4\pi$.[6] This is the area of a circle having a circumference of 1 wave length or $\pi(\lambda/2\pi)^2$. As stated by the Reciprocity Theorem, the characteristics of an antenna such as effective length, radiation resistance, power gain, effective area, etc., are the same whether the antenna be used for transmitting or receiving.[7]

Assumptions

The assumptions made in the table are as follows: very thin straight wire vertical antennas, smooth plane surface of nearly perfect conductivity, velocity of propagation on antenna of 99% of the speed of light, ideal antennas having no losses and effective lengths of $2/\pi$ times antenna lengths. The quarter-wave and half-wave antennas are mounted with their bases close to the surface of the conducting plane (except for the half-wave and isotropic antennas in free space) and all antennas fed at the current loop. Current distribution is assumed sinusoidal along the antenna. A frequency of 5 MC (60 meters) is used (with one exception) and the transmission path is 1 mile (1.609 kilometers) over sea water. A vertically polarized uniform plane electromagnetic wave is assumed at the receiving antenna. For antennas at the ground, only the surface-wave need be considered at this frequency and distance.[1] Only direct-wave transmission is considered for half-wave antennas in free space.[8]

All antennas are similarly polarized and transmission calculations assume they are perpendicular to the plane which passes through their current loops in the equatorial region, so the field intensities, received powers, gains and effective areas are a maximum. Two cases of interest from an engineering standpoint are considered for all practical antennas, first, when transmitting equal currents of 1 amp. and, second, when radiating equal powers of 1 watt. Calculations prepared for other currents or powers can be readily substituted in the table. Also, the performance expected at other frequencies (see Column g) may be readily approximated, subject to the restrictions indicated by the basic assumptions and propagation effects previously mentioned.

Explanation of Table

The table is divided into two parts. Case 1 deals with 1 amp. of current in the transmitting antennas and Case 2 with 1 watt radiated by the transmitting antennas. Columns a to h consider the characteristics and performance of one simple basic antenna type, both for transmission and reception. Transmission is between the same types of antenna separated by 1 mile.

The various lines refer to the characteristic or performance designated and are self explanatory. Line 12, the unattenuated field intensity at 1 mile in millivolts per meter, is based upon the antenna currents on Line 9, or the radiated powers on Line 10, calculated by standard field strength formulas. Line 15 is the maximum gain factor g (directivity) of the antenna referred to a point source. Since a perfect antenna having no losses is assumed, this is both the power gain and the directive gain. A half-wave antenna in free space has a power gain g of 1.64 and a G of 2.15 db over an isotropic radiator.[6,8]

Line 17, the area factor, $g/4\pi$, when multiplied by the wave-length squared, gives the effective area.

Receiving Conditions

The assumption is made that an identical antenna one mile away is used to receive from the transmitting antenna under consideration.

Line 18 is the product of the effective length (Line 7) times the received field strength at one mile (Line 12).

Line 19 is the power absorbed from the passing wave and delivered to the matched receiver (no losses were assumed) expressed in microwatts. (An equal amount of power is reradiated under this condition). The received power in watts may be calculated as the available power based upon Line 18 (in volts) squared divided by four times the radiation resistance (Line 8) in ohms.

As a check for the received power, the power intensity (Line 14) may be multiplied by the effective area (Line 16) and the product expressed in microwatts.

Line 21 shows the transmission loss between the two antennas expressed in db, and is equal to 10 $\text{Log}_{10} P_2/P_1$.

As a means of comparing the performance of half-wave antennas in free space with the theoretical point source radiator, column h, covering an isotropic antenna, is included. Since the area varies as a factor times the wave-length squared, Column g was included for antenna No. 4 operated on 2.5 megacycles. It will be noted from Columns e and g (Antennas Nos. 2 and 4) the lengths of the wires are 2 to 1 (also the wave-length ratio is 2 to 1). This results in double wire lengths, effective lengths and received voltages. However, the effective area of the longer wire (antenna No. 4) is four times the effective area of the shorter wire (antenna No. 2) and consequently antenna No. 4 receives four times as much power (when the received field intensities are equal) and the transmission loss between like antennas is therefore 6 db less at 2.5 megacycles over the 1 mile sea-water path. It will also be noted that antennas No. 3 and No. 4 have the same lengths but operate at different frequencies. This illustrates the convenience of tabulating antenna data for approximating results of different types and at different frequencies, although as already pointed out, propagation effects may entirely change the end results expected.

QUARTER-WAVE AND HALF-WAVE ANTENNA DATA
TRANSMISSION BETWEEN SIMILAR ANTENNAS 1 MILE APART
VERTICAL POLARIZATION OVER SEA WATER AND IN FREE SPACE

	Case 1 (1 amp.)			Case 2 (1 Watt)				
TRANSMITTING	a	b	c	d	e	f	g	h
1. Antenna No.	1	2	3	1	2	3	4	5
2. ¼ or ½ Wave	½	¼	½	½	¼	½	¼	ISO.
3. At Ground or in Space	S	G	G	S	G	G	G	S
4. Frequency (MC)	5	5	5	5	5	5	2.5	5
5. Wave Length (Meters)	60	60	60	60	60	60	120	60
6. Wire Length (Meters)	29.7	14.9	29.7	29.7	14.9	29.7	29.7	..
7. *Effective Length (M)	19.10	9.55	19.10	19.10	9.55	19.10	19.10	..
8. *Radiation Res. (Ohms)	73.2	36.6	100.	73.2	36.6	100.	36.6	..
9. *Ant. Current (Amp)	1.0	1.0	1.0	.117	.165	.100	.165	..
10. Rad. Power (Watts)	73.2	36.6	100.	1.0	1.0	1.0	1.0	1.0
FIELD AT 1 MILE								
11. Free-Space Eo—mv/m	37.30	18.65	37.30	4.36	3.08	3.73	3.08	3.40
12. Total Field E—mv/m	37.30	37.30	74.60	4.36	6.16	7.46	6.16	3.40
13. Field—db above 1μv/m	91.5	91.5	97.5	72.8	75.8	77.5	75.8	70.7
14. Power Intensity μ Watts/Meter²	3.69	3.69	14.76	.0503	.1006	.1476	.1006	.0307
15. Gain Factor (g)	1.64	.82	1.20	1.64	.82	1.20	.82	1.00
16. Effective Area (M²)	470	235	344	470.	235	344	940	287
17. Area Factor ($g/4\pi$)	.1305	.0653	.0955	.1305	.0653	.0955	.0653	.0796
RECEIVING (Use same radiation resistance, effective length, gain, 1 mile field and effective area as above)								
18. *Rec. Volts (Millivolts)	712	356	1424	83.3	58.8	142.4	117.6	..
19. Rec. Power (μ Watts)	1732	866	5080	23.7	23.7	50.8	94.8	8.82
20. Rec. Power (db Below 1W)	27.6	30.6	22.9	46.3	46.3	42.9	40.3	50.6
21. Trans. Loss (db)	46.3	46.3	42.9	46.3	46.3	42.9	40.3	50.6

(*Referred to a current loop)

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Engineers Inspect UHF-TV Station

RCA-NBC Bridgeport, Conn. experiment evaluated in light of operating experience and field strength measurements

By FRANKLIN LOOMIS

TO obtain a first-hand view of how UHF television is working in the only city where such a scheduled broadcast service is in operation, some 80 consulting engineers and lawyers journeyed to Bridgeport, Conn. at the invitation of NBC-RCA on June 28.

We were shown the well-planned transmitter building perched on the side of Success Hill, some 300 ft. above Bridgeport. This installation has been described in TELE-TECH on page 25 of the February issue and referred to on page 48 of the March issue, so only the bare specifications are given. Antenna height 330 ft.; slotted antenna has a gain of 17; 1 KW RCA TV transmitter, ERP 11.5 KW on the channel 529-535 MC; transmitter broadcasts TV programs received from WNBT over 2000 MC microwave link.

The automotive equipment which was drawn up in front of the transmitter, presented a novel appearance. A 5-ton truck, with stake body, carried a dural extension ladder which when lowered rested on the cab. The ladder could be quickly raised, in steps, to 48 ft. where it could be supported rigidly by two tubular braces, permitting measurements while underway down treeless streets, such as the Merritt Parkway (special police permission obtained). Towed by a short link, behind the truck, was a Pontiac station wagon which carried the measuring equipment. Mounted on the roof of this station wagon, at a height of 10 ft. was a TV receiving antenna, a scaled-down counterpart of the Super-turnstile antenna, having a circular pattern, hence requiring no rotation. A similar antenna was used at the top of the extension ladder. On roads where it was feasible, simultaneous measurements of signal strength could be made at two heights while the cavalcade was in motion. Beside the two Esterline Argus recorders, connected to receivers fed by the two antennas, the station wagon carried a signal generator and a standard TV set. The gas-driven generator for 120 v. a-c was located in the truck.

Bridgeport, a relatively easy city to cover with UHF, receives good service. Usable pictures have been received at 22 miles, under normal home conditions. Line-of-sight transmission, however, is even more desirable than in the VHF band. Satisfactory reception could not be obtained at distances of 12 miles in locations where ridges or hills intervened.

Survey records have not yet been analyzed. When this has been done NBC hopes to rationalize the results and arrive at simple rules for predicting transmission ranges and making home installations. At present the method the installer follows is to start with a simple bat-wing dipole and move it around the house to find the best location for good signals. If such a spot is not found then the next step is to use a larger, high-gain antenna. Where severe maxima and minima of signal strength are found moving the antenna only a few wavelengths, the stacked "V" antenna mentioned later is indicated.

Indoor antennas are satisfactory provided the receiver is on the side of the building which faces the transmitter, otherwise persons walking in the room cause picture fading.

Built into an RCA table model TV receiver was found a UHF tuning unit. This experimental model is described in an RCA report "An Experimental UHF Television Receiver", Dec. 1949. Only a brief description is given here. The circuit is a double super-heterodyne feeding into the i-f of the standard TV receiver; tuning range 500-700 MC; 75 ohm co-ax from antenna feeds into a printed-circuit high-pass filter to reduce spurious response; a tuned r-f amplifier and mixer follows. The noise factor is 14 db at 500 MC and the gain of the tuner is 49 db at 500 MC.

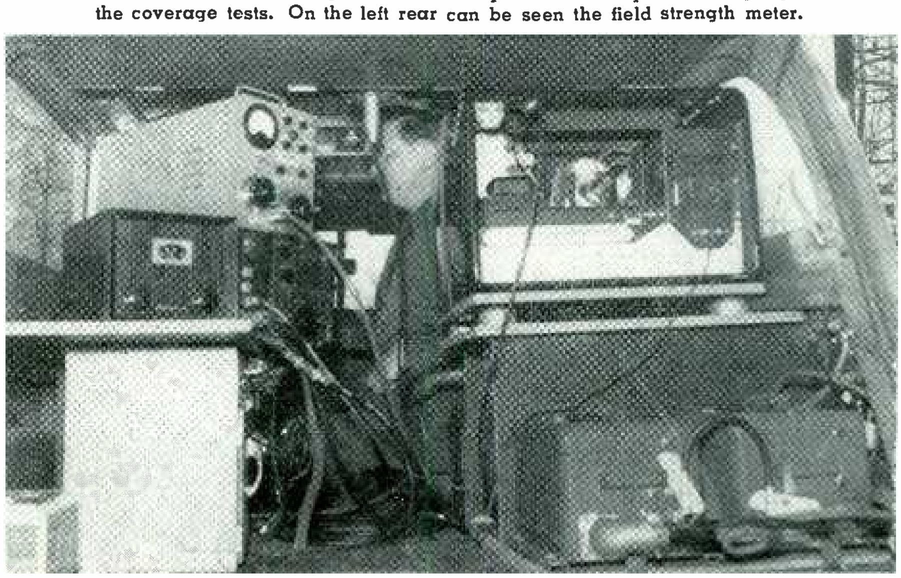
A converter, consisting of 5 tubes plus a crystal detector, with a noise factor of about 22 db was also shown. There are 88 receivers, some of the converter type, installed in Bridgeport homes.

Receiving Antennas

Within 5 miles of the transmitter a simple bat-wing dipole is used. The next higher gain antenna employed is the stacked "V" made by forming a "V" in the horizontal plane by mounting two antenna rods at an angle of 45° and stacking a second such "V" above the first. By

(*Continued on page* 75)

Interior of the Pontiac station wagon used to carry field intensity measuring equipment for the coverage tests. On the left rear can be seen the field strength meter.



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

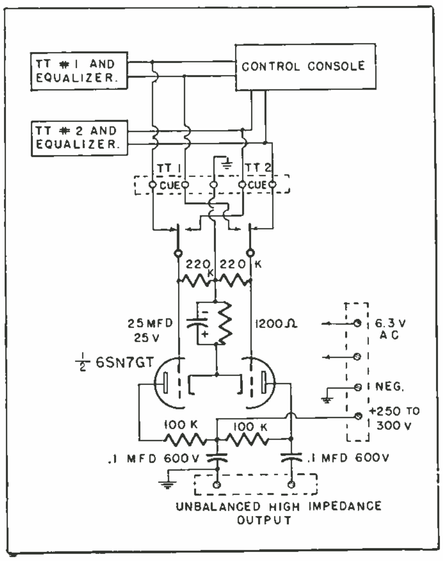
Simple Cueing Amplifier Bridging-Coupling Circuit

EDWIN W. HILL, Chief Engineer, WDHL, Bradenton, Fla.

A separate cueing amplifier and speaker system, entirely independent of the control console, is a much appreciated addition to the turntable circuits of a broadcast station. Although almost any type of small audio power amplifier can be used for record cueing purposes, the objection is that practically all the common amplifiers which might be used have high-impedance unbalanced input requirements, whereas the low-impedance balanced circuit is universal in broadcast record reproduction. Suitable bridging transformers can be used but they are somewhat expensive.

The coupling circuit illustrated transforms the balanced low impedance of the turntable lines into an unbalanced high impedance quite effectively and very inexpensively. It may be bridged across the low impedance line between the turntable equalizer and the control console and will have no effect on the normal operation of these circuits. A DPDT key switch allows either one of two turntables to be fed to an unbalanced high-impedance cueing amplifier for auditioning.

The parts required are one tube and its socket (a pair of 6J5's may be used if they happen to be more plentiful around the station than the tube specified), 5 resistors, 3 condensers, a key switch and some terminal boards. The unit should be shielded, of course, and the lines from it to the turntable circuits should be well-shielded pair. The modest heater and plate power requirements may be furnished by the console power supply, or they may be obtained from the particular cueing amplifier used.



Bridged cueing amplifier coupling circuit

$$$ 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.

Catenary Support for Co-Axial Cable

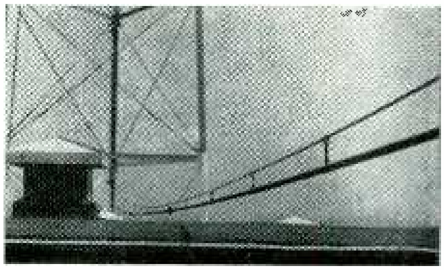
WILLIAM MARON, General Manager, WPOE, Elizabeth, N. J.

Whenever co-axial cable has to traverse a roof with obstructions, or varying height levels of roof the problem of supporting the cable arises. This can be accomplished by supports of different heights in the form of saw-horses. Unfortunately, this method has several drawbacks, including problems of cable expansion, security in storms, and maintaining roof watertight.

At WPOE the co-ax cable traverses 80 feet of roof from the point of emergence over the transmitter room to the tower. A messenger cable was stretched between a vertical steel support, placed just behind the point where the coax emerges from the roof, and the tower leg up which the coax is fastened on the way up to the antenna. By varying the length of the copper straps used to hand the coax to the messenger cable, the coax can be hung perfectly level.

After the messenger cable is strung and tightened with a turnbuckle, the coax is temporarily hung in place with rope. A large level is placed on the coax and the supporting straps are adjusted until the coax is level. Straps are placed about four feet apart. The straps are tightly clamped to the co-ax and allowed to remain loose on the messenger cable. This permits the coax to move during a wind, or when there is a temperature change without wearing the coax at points of support.

The size of the messenger cable will depend on the distance between



Catenary supports for long coaxial run

supports and size of coax cable. Here a ⅜-inch galvanized multi-strand wire rope is used as a messenger for the ⅞-inch coax.

Harmonics Are Easy

J. H. FLEET, KSTL, St. Louis, Mo.

THE following quotation is an excerpt from the CP for KSTL, 690 KC, St. Louis, Mo.

"The authority granted herein is subject to the condition that adequate precautions are taken to insure that second harmonic radiations from the proposed operation will not interfere with the services of station KWK, St. Louis, Mo., on 1380 kilocycles."

When construction was started in April, 1948, considerable thought was given to this item. After installation a simple method of checking as well as eliminating even harmonic radiation, without requiring additional equipment was evolved.

The transmitter, Raytheon (RA 1000) uses a pair of 833A's in push-pull, in the final. By using the metal frames of the final tank coil as pick-up loops, and measuring the induced voltage it was possible to balance the final so that even harmonics were reduced almost to zero. The balancing was accomplished by moving the slider taps until each side of the tank had equal RF voltage. The modulation monitor used one of the end frames for a pick-up coil, so a second feed line to produce the same RF drop to the Modulation Monitor was made for the other frame. By the use of a double-pole double-throw switch, the engineer on duty can switch the modulation monitor from one end of the final tank to the other.

The carrier level meter, which is a tuned RF volt meter, gives a direct reading of the voltage ratio in each half of the push-pull tank. If either tube or tuning characteristics change, it is noted immediately and corrected by shifting the tank taps to compensate for the change.

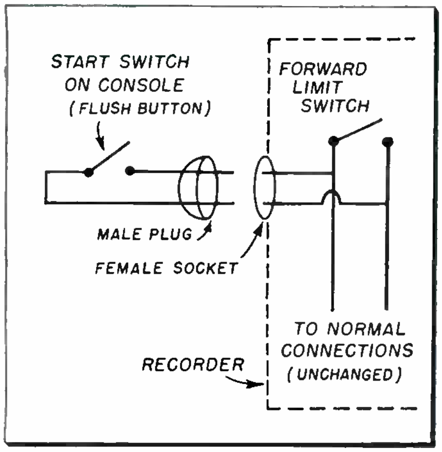
Using this method, station KWK on 1380 KC can be heard on KSTL's second harmonic on a portable radio directly under the tower, without objectional interference.

Remote Start Switch for Brush Recorder

ROBERT R. HILKER, Chief Engineer, WMAP, Monroe, N. C.

ACROSS the forward limit switch of a Model BK-403 Brush recorder is added a small polarized socket to the terminal section of the recorder connected to a small push button flush in a blank part of the console. By setting the recorder beforehand and by merely pushing the start button on the console when ready, a very close cue can be worked on tape recordings.

Since this button is right on the console, standing out by itself, there is no danger of pushing the wrong button. This idea also eliminates the necessity for two people worrying about starting a tape recording, and also it assures quieter operation when the announcer is in the control room—since the tape recorder is several feet from the mike. In other cases it could even be in another room.



Wiring remote start switch for Brush recorder

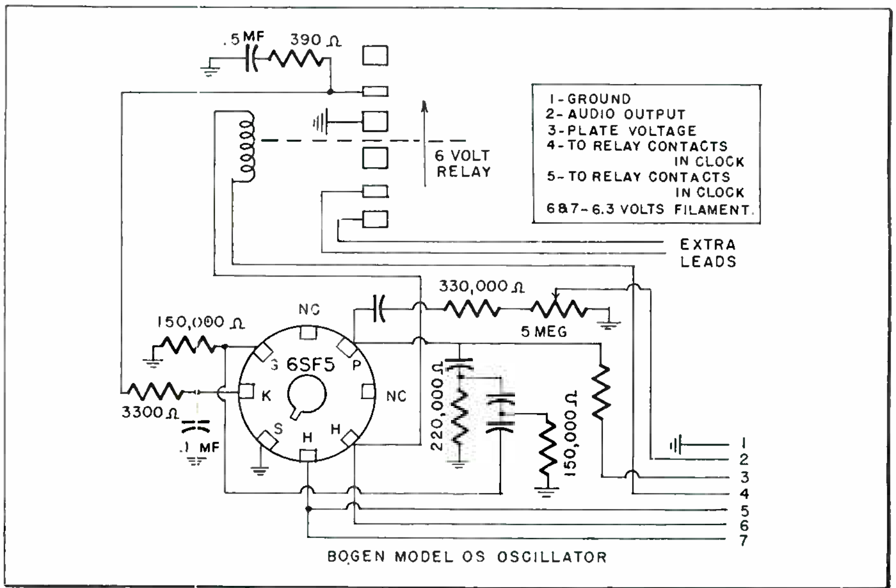
Time Signal Clock Synchronizer

H. F. STURM, Chief Engineer, WHTN—AM-FM, Huntington, W. Va.

THE self-winding clock furnished by the local Western Union Company is used in two studios, one on each side of the control room. Each clock is synchronized each hour on the hour by a DC impulse from the local W. U. office. The control room clock is equipped with a small relay, (furnished by W. U. upon request for a small monthly charge), whose contacts close for a duration of approximately 1.5 seconds each time the clock is synchronized, thereby closing the contacts of the oscillator relay.

The oscillator is a Bogen Model OS, of the type used in the Bogen School Intercommunicating System. This oscillator, in a box only 3 x 3½ x 5 inches takes up very little space and uses one 6SF5 tube. It comes complete with a 6 volt relay and approximately 4 feet of multi-colored seven wire cable. Plate and filament voltages are furnished by the console power supply and the oscillator signal is fed to the program amplifier. Originally the 6 volt relay broke the oscillator plate voltage which produced clicks as well as chirps. The circuit was modified to key the cathode and the 390 ohm resistor in series with a .5 mmf condenser connected across the contacts completely obliterated any clicks or chirps. To reduce the audio level and also to control same a 5 meg. volume control was installed in the audio output lead of the oscillator. There is little drain on the console power supply.

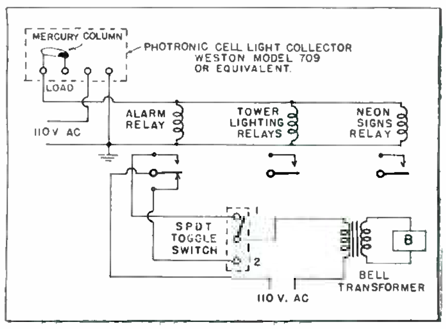
Clock synchronizer and timesignal controlled by Western Union hourly sync pulse



Tower Lighting Indicator

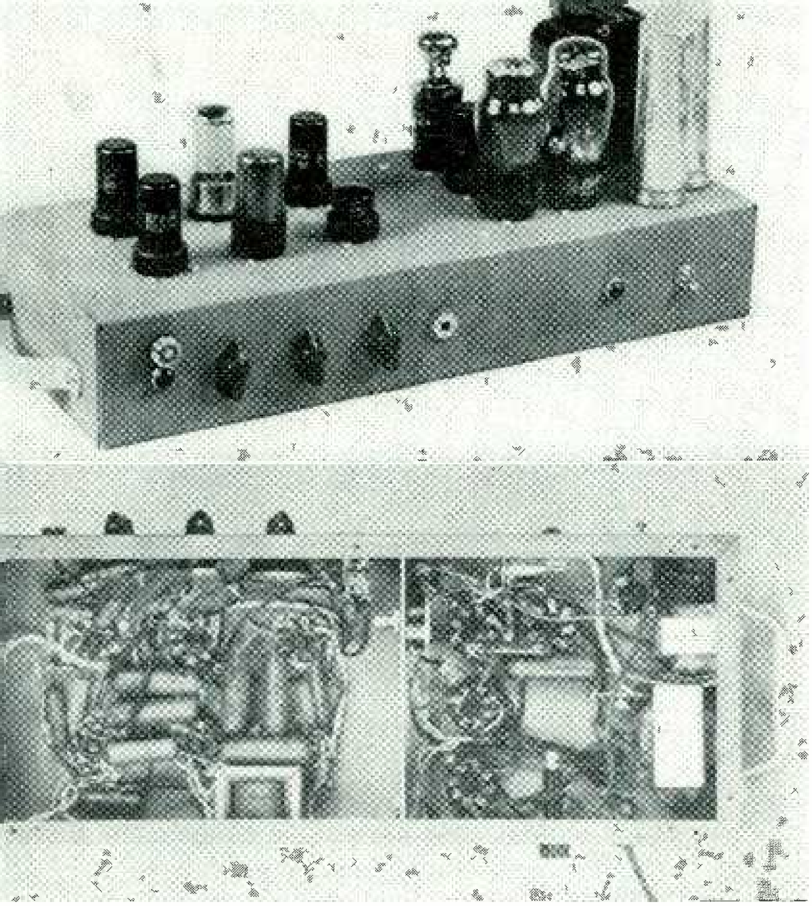
WILLIAM H. MEINERS, Chief Engineer, KRIO, McAllen, Texas

NUMEROUS stations use light collectors for automatically turning on and off the tower lights. According to CAA and FCC the lights must be checked and logged each night. Also, most stations have one or more neon signs to be turned on and off. The operator must remember to check the lights and the best time to do this is when they are first turned on. Also, one should know the exact time that the lights are turned on and off so that adjustments can be made if necessary.



Automatic tower light "in use" indicator

With the spdt switch in position No. 1 the bell does not ring until the mercury column shorts the contacts. The bell will then continue to ring until the spdt switch is turned to position No. 2. When the tower lights go off the bell will again ring until the spdt switch is put in position No. 1. The operator therefore is notified when the lights are turned on and off.



Physical appearance of top and underside of logarithmic amplifier chassis

An Amplifier

Equipment provides 0-100 db volt to 10 volt inputs over

By GLENN A. WALTERS, *Director of Research, Dalmo Victor Co., San Carlos, Calif.*

THE logarithmic amplifier is desirable in applications where large variations in input are involved. A logarithmic presentation has become common engineering practice as in recording antenna pat'erns and measuring band-pass characteristics of amplifiers. The device described in this paper was designed for use with automatic antenna pattern recording equipment and should prove to be equally useful in many other engineering applications.

A logarithmic response from an amplifier can be obtained readily through the use of remote cut-off tubes whose static transfer characteristics are inherently of a logarithmic nature. Such tubes can be used either in tandem or cascade. In a tandem circuit the several tubes are connected in parallel with the control grid of each tube biased at a different level. Each tube then works between cut-off and saturation with its "grid voltage-plate current" characteristics operating over a given portion of the logarithmic output range. By proper overlapping of the working characteristics of the parallel stages, a rather good logarithmic response is obtainable.

The cascade amplifier consists of several stages of amplification connected in series in the conventional manner. By applying a portion of the output of such an amplifier as negative bias voltage to its grids, it is possible to obtain a non-linear amplifier whose output is proportional to the logarithm of the input. An amplifier of this type is best adapted to the amplification of ac signals.

A maximum range of approximately 40 db per stage is obtainable for reasonably good response characteristics. The total range for a given amplifier is limited by the signal-to-noise ratio, maximum output level, and maximum allowable error in response. While somewhat greater ranges may be obtainable from the tandem circuit, it is less stable and more dependent upon individual tube characteristics than with the cascade circuit. The circuit described herein is of the latter type.

The circuit, Fig. 3, consists of a 100 db amplifier employing three 6SK7's followed by a 6J5 au'omatic volume control amplifier and a 6H6 dual rectifying circuit. One portion of the rectifying circuit supplies AVC voltage; the other drives the 6SN7 dc amplifier output stage.

Extended Cut-off Pentode

The 6SK7 is an extended cut-off pentode. Inspection of its "grid voltage-plate current" characteristics indicates that it is approximately logarithmic over a considerable range. In the preliminary development the three stage 6SK7 cascade amplifier was connected directly to the 6H6 rectifying circuit. AVC voltage was supplied from a separate source and manually controlled. The input to the amplifier was varied between the levels of 1 millivolt to 10 volts and the AVC voltage manually adjusted to that value producing a logarithmic varia'ion in the output voltage of the 6H6 rectifier. It was found that the AVC voltage required for logarithmic response was approximately 15 times greater than that obtainable from the last 6SK7 tube, so the 6J5 AVC amplifier was added. The latter has a constant gain somewhat greater than 15.

The AVC voltage is rectified in the first half of the 6H6 and fed back to the grids of the cascade stages. An AVC gain control which has been placed in this return circuit can be used for calibrating the amplifier. The second half of the 6H6 rectifies the output of the main amplifying section and applies the derived voltage to the grid of the

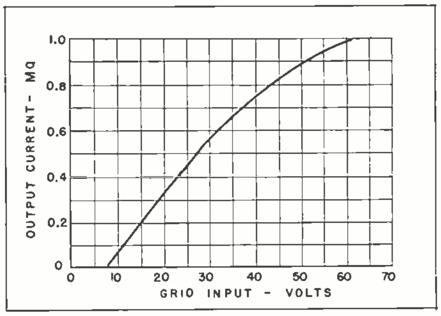


Fig. 1: 6SN7 output stage typical response

with Logarithmic Output

gain with 1 db accuracy for 1 milli-
frequency range of 300 to 10,000 cps

6SN7 dc output circuit. A balancing potentiometer has been placed in the cathode circuit of the 6SN7 to correct any unbalance caused by tube differences and the emission potential of the 6H6 circuit. As used in this specific application a 0-1 ma. graphic recording meter, having an internal impedance of approximately 1300 ohms, was directly driven by the difference in potential existing between the two cathodes of the 6SN7.

The greatest deviation from a logarithmic response (found at the maximum output level) was kept to a minimum by biasing the 6SN7 stage in such a way that its amplification leveled off toward the higher end of the scale. This tends to flatten out the opposing characteristic of the 6SK7 cascade amplifier, resulting in an improved logarithmic response over the entire range, Fig. 1. It should be noted that zero output does not correspond

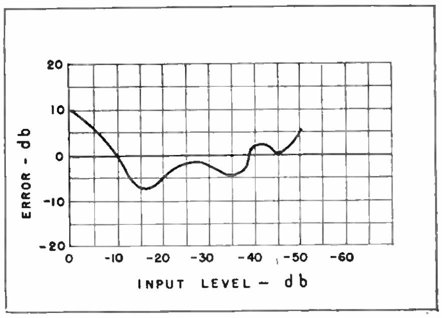


Fig. 2: Deviation from logarithmic response

to zero grid drive. This is brought about by the bias setting of the balance control when adjusting for minimum signal response.

Numerous other methods of bias control were tried but the system described here proved, above all, to be the simplest and gave the best response characteristics. A typical curve showing the deviation from the ideal logarithmic response is plotted as a function of input level in Fig. 2. By careful alignment of the balancing and AVC controls, deviation from the ideal logarithmic response can be made less than ½ db; however, with tube aging, etc., it has been found that deviation in the order of 1 db are to be expected.

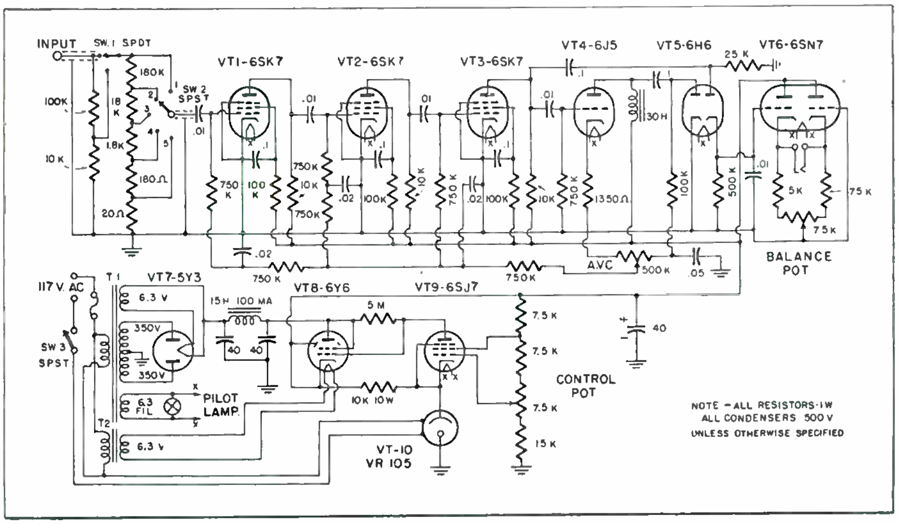


Fig. 3: Circuit diagram of the logarithmic amplifier which has a gain of 100 db

The only critical portion of the amplifier is in the wiring of the first stage of amplification, a relatively high-gain, broad-band amplifier. The usual troubles with noise and feed back are apt to be encountered. All grounds of the first stage of amplification, including those of the input jack and calibration switch, should be connected to the chassis at one point only and the normal precautions associated with the wiring of high gain amplifiers should be observed, throughout. Shielding of individual stages or particular components has not been found necessary. The noise level of this amplifier is below ½ millivolt.

Consistant Characteristics

Several of these amplifiers have been constructed and their characteristics found to be consistent. If the 6SN7 output stage is used for driving a load different from that for which it was designed, i.e., 1300 ohms, it has been found necessary to change the values of the cathode resistors. These resistors must be so chosen as to produce the required limiting characteristic previously mentioned. In addition, the magnitude of the resistor shown as 1350 ohms in the cathode circuit of the 6J5 automatic volume control stage is somewhat critical.

The exact value of the resistor is best found by substituting a 1500 ohm variable resistor in the circuit. The amplitude response characteristics of the amplifier are then noted at the check points of the calibrate switch and that value of cathode resistance producing minimum deviation from the ideal logarithmic output curve is chosen. Once the proper value has been found, tube replacement does not materially affect the value of this resistor. Further improvements in the amplifier's characteristics can also be obtained through proper choice of the operating range of the AVC voltage.

Best results are obtained from the amplifier with its input range between 0.001 and 10 volts. As used with automatic antenna recording equipment it was found that the standard amplifiers most used in the field were designed for a maximum output of 100 volts rms. For this reason a 10:1 voltage divider was placed in the input circuit of the amplifier. If this is not in agreement with the specific application desired it is suggested that this divider be changed such that a maximum signal of 10 volts be applied to the grid of the first 6SK7 at the 0 db level.

A calibration switch at the input, has five positions in steps of 20 db each. In practice the logarithmic amplifier can be calibrated in the

(*Continued on page 82*)

Front End

Circuit utilizes a matched tion. Subminiature tubes

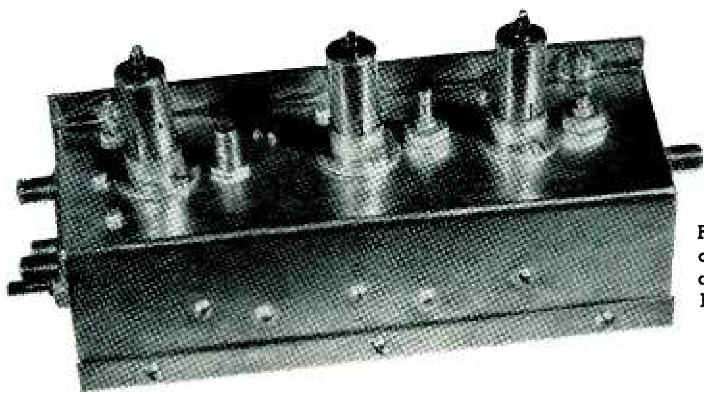


Fig. 1: Exterior view of unit whose overall dimensions are 1⅞ x 1⅞ x 5¼ inches

By VERNON H. ASKE, Sylvania Electric Products, Inc., Kew Gardens, N. Y.

THE range of frequencies between about 400 and 1000 MC has been labelled the "awkward" region because it is not suited to the application of wave-guide techniques nor to the usual lumped-constant circuit. While transmission lines are used successfully at those frequencies, they are often shunned because of their relatively large size and the inconvenience of coupling successive stages. The challenge offered by this sparsely-developed region has long been recognized, and "400 MC" has become a commonplace term in tube data and government contract specifications.

It was for the purpose of investigating the performance of conventional and developmental tubes in this frequency range that the receiver front end was designed. Fig. 1 is a photograph of this unit. The circuit utilizes a matched single-tuned input circuit of a new type construction*, a double-tuned radio-fequency interstage, and a pentode-type mixer working into a 30-MC intermediate-frequency stage. The i-f circuit is loaded with an impedance which simulates the input loading of the i-f tube. Three separate units of similar construction were built. The first two employed subminiature tubes, one using sockets, while the other utilized a "wired-in" construction. The third unit used tube types 6AK5, 6AS6, and 6J6 miniature tubes, but was quite similar in other respects.

The discussion will be centered around the unit using socketed subminiature developmental tube types. The r-f tube used in this unit is a type 5840, the mixer tube is a type 5636, and the local oscillator tube is a type 5718. The type 5636 has electrical characteristics similar to those of the type 6AS6. Electrical characteristics of the type 5718 are given in Appendix 1. The circuit diagram for this unit is shown in Fig. 2.

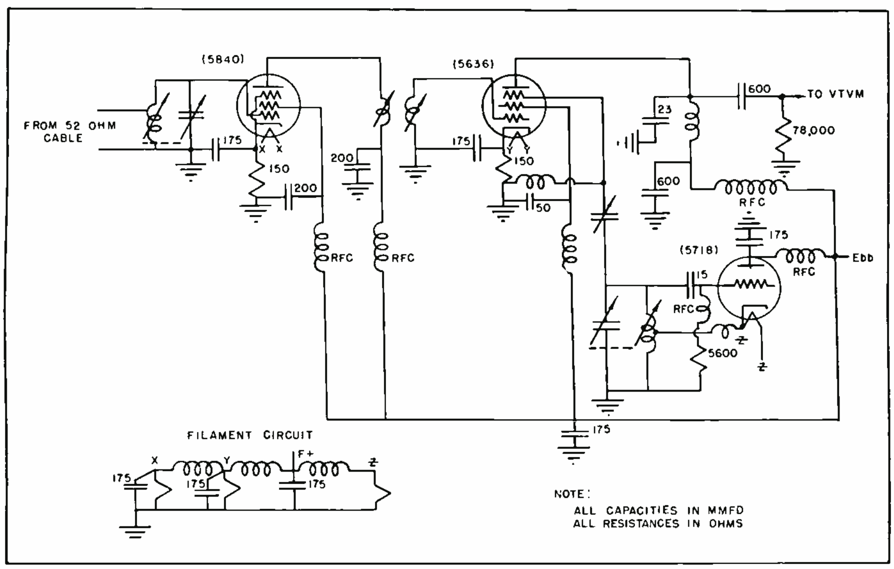
*Patent Applied for.

Design Considerations

The units were designed primarily for narrow-band communications. An i-f bandwidth of about 500 KC was desired. The choice of this bandwidth was somewhat arbitrary inasmuch as the design was not intended for any particular type of modulation or fidelity. The limits to which this bandwidth can be controlled may be seen from the design considerations and calculations which appear later. The i-f center frequency was chosen as 30 MC, primarily because it is a common value and amplifiers were available for this frequency.

The choice of a mixer circuit depends very much upon the desired characteristics of this stage. The primary characteristics desired in this receiver were narrow bandwidth, high conversion transconductance, and isolation between the oscillator and signal circuits. The first consideration excludes the triode mixer on account of its low plate resistance. The high conversion transconductance requires that the signal be applied to an inner grid of a multi-element tube. This is true since the conversion transconductance is proportional to the maximum signal-grid to plate mutual conductance, and the inner grid of a multi-element tube generally has the greatest mutual conductance. Placing the signal on an inner grid requires that the oscillator output be applied to an outer grid in order that the last requirement of isolation be fulfilled. The type 5636 tube was designed primarily for this type of application. Much effort was exerted during its design to obtain high conversion transconductance, to obtain isolation between input and local oscillator and to obtain an oscillator modulator grid which would require little driving power. These requirements were met to a marked extent with the pentode-type construction of the type 5636. The pentode-type mixer inherently has more noise than a triode. However, since greater gain may be obtained at narrow bandwidth, the signal-to-noise ratio may be as high

Fig. 2: Complete circuit diagram for the front end of the 400 MC receiver



WASHINGTON
News Letter

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

MILITARY RADIO $1.5 BILLION—Pentagon authorities now put total upcoming military radio-electronic demands at 1500 million dollars or more. As noted elsewhere, the Air Force will expend $500,000,000 on its new plane-building program, with another $300,000,000 for radio-radar air-raid warning network. The Navy will spend $500,000,000 on electronic modernization. And the Army Signal Corps, as recently disclosed by Maj. Gen. S. B. Akin, Chief Signal Officer, has an elaborate program of some 200 items of equipment.

MAY DUPLICATE WORLD WAR II—Principal radio items in large dollar-value procurement for "Signals" are 12-channel radio-relay equipment, fixed antennas to go with larger radio sets, lightweight field mine detectors, 500-watt amplitude modulated radio-teletype sets, radiosondes, HF radio-relay terminal units, vacuum tubes, meters, test equipment, and oscilloscopes of various types. The present programs of the three armed services are considered "just a starter", in the opinion of most observers, and the radio industry can be expected to be called upon for greatly increased loads of equipment production in the next year, building up to volumes like World War II possibly.

NEGOTIATED CONTRACTS NOW METHOD—Negotiated contracts with definite time limits of delivery, instead of the competitive-bid orders with no delivery limitations, is now the order of the military services's procurement. Larger companies getting orders will engage in extensive subcontracting as in World War II. In order to speed up specifications on newly improved equipment, development contracts are being awarded, with the present stepped-up volume from the Armed Services being generally divided between development and production orders. Big goal is to get new inventions out of the laboratory stage into production.

COLOR-TV DECISION IN EARLY FALL—Even though the international situation will in all probability block any implementation by the television industry of color video, the FCC pressed with lengthy meetings during August toward a decision on the controversial issue of determining the best color-TV system. The likelihood, too, is that the military procurement demands may force a continuation of the television "freeze", even though it is accepted that television is one of the most potent, if not now the most important, medium of mass communication, so vital in a national defense and civilian defense emergency. The FCC may continue its UHF allocations hearings during the latter part of September despite the situation, according to the present outlook. But the war emergency is felt to have engendered support for the allocation of 470-500 MC for the broadband mobile radio system proposed by the Bell Telephone Laboratories.

MOBILE RADIO TO CONTINUE—Civilian mobile radio is viewed as an equipment production line that would not be as much disturbed as television by the military procurement requirements. The safety radio services—police, fire, highway maintenance etc.—are essential for civil defense, and radio would be a most vital communications link in any A-bombing or other civilian defense crisis. The industrial radio services, so widely used by industries like petroleum, power and gas utilities and forest products, with their essential role in any war effort, are likewise slated for a "green light" by the military services so their operations will not be disturbed. In fact, the VHF mobile radio frequencies, particularly those above 150 MC, have such short range transmission characteristics that they are considered by the military as not presenting any security hazard or possible espionage usage. The 30-40 MC band, however, with its possible long-range transmission use, might well offer a security problem.

FREQUENCY STUDIES GO ON—With the establishment of a three-member Commissioner committee, which will maintain close relationships with the armed services and national defense program, the FCC has geared itself for its role in any developments of the present emergency. The FCC committee is composed of Chairman Wayne Coy and Commissioners E. M. Webster and George E. Sterling. There is no plan at present for the revival of the World War II Defense Communications Board or its successor, the Board of War Communications. One major task of the FCC committee will be to aid the armed services in any frequency requirements, and it might well occur with a greatly intensified emergency that the military services might require the taking over of more spectrum space.

PCBA MET AUG. 2-3—The President's Communications Policy Board, headed by President Irwin Stewart of West Virginia University, engaged in an intensive study, at its August 2-3 meeting, of frequency requirements and utilization, civilian and military, a subject brought to the forefront by the international situation.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

Design for a 400 MC Receiver

PART ONE OF TWO PARTS

single-tuned input that features new type construc- and new miniature tuned circuits employed throughout

as in the case of the triode.

A type 5718 tube was used for the oscillator. The circuit is a Hartley from outward appearances. However, due to the prominent part that the tube capitances play in determining the feedback voltages, it does not fall into a strict Hartley classification but rather is classified as a hybrid circuit.[1] A grounded plate was necessary since the shield-to-plate capacitance tends to reduce the plate-to-r-f ground potential. This type of circuit also enables one side of the variable-tuned circuit to be at ground and thus reduce the effects of hand capacitance when tuning. The local oscillator is to be tuned below the incoming signal. This is desirable for the reason that less coupling occurs between the oscillator and signal grids at the lower fequency and the transit time current[2] in the No. 1 grid of the mixer tube will be less.

R-F Interstage

The r-f interstage consists of a double-tuned circuit. The mutual inductance is made variable so that the output impedance of the type 5840 tube may be matched to the input impedance of the type 5636. The input circuit consists of a single-tuned circuit to which the input cable of 52-ohm characteristic impedance is tapped for matching purposes. The image rejection ratio is increased by making this input circuit and the secondary of the r-f interstage highly capacitive.

In order to calculate properly the receiver performance, the plate resistance and input resistance of these tubes must be known at the frequency of operation. It is well known that the input resistance varies inversely with the square of frequency. Measurements up to 100 MC have indicated good correlation with this theory. At frequencies above 100 MC some investigators have obtained results which indicate a fall of input resistance that varies inversely with frequency to a power greater than two. This apparent decrease in input resistance was noted when measuring the voltage gain of amplifiers. That is, if one measures the gain (from a known impedance) through a matched transformer to a tuned grid circuit, one can calculate the input resistance, since the voltage step-up is proportional to the square root of the ratio of impedances. The most convenient method of measuring this input gain is to measure the over-all gain and then divide it by the grid-to-output gain. Calculations based on the measured input gain resulted in a computed value of input resistance much less than theory predicted. However, the voltage gain measured from grid to output was higher than that value predicted by calculations. This phenomenon was studied further by use of a crystal probe. Investigations with this small probe revealed an appreciable voltage rise between the point of measurement and the actual tube elements. Re-calculation of the input resistance after applying rough corrections resulted in a resistance much more in agreement with the theory. Likewise, the resulting grid-to-output gain was more in agreement. Thus, we can deduce that the resistance at the grid circuit is transformed into a lower resistance at the point of measurement. This is due to a combination of the lead inductance and inter-electrode capacitance of the tube. By this reasoning it is realized that the value of input resistance is a function of the step-down between the tube elements and the point of measurement and will be dependent upon the input circuit as well as the point of measurement. Further investigation of this step-down was carried on in a more precise manner by Mr. I. Fenichel of this laboratory whose results substantiated the above reasoning. In the last analysis, the resistance to be matched is that which appears at the tube elements and which as now indicated can be calculated. For example, measure the input resistance at a lower frequency and then calculate the resistance at 400 MC. The input resistance of the type 5840 tube at 100 MC is approximately 7000 ohms. Its resistance at 400 MC will be:

$$\frac{R_{in}(400\ \text{MC})}{R_{in}(100\ \text{MC})} = \frac{100^2}{400^2} = \frac{1}{16}$$

$$R_{in}(400\ \text{MC}) = \frac{7000}{16} = 437\ \text{ohms}$$

This value of input resistance holds for both the type 5840 and the type 5636 tubes. The plate resistance of a tube at high frequency has not been as fully treated in the literature as input resistance. For purposes of this design, the dynamic resistance of the plate circuit of the r-f tube loaded with a tuned circuit was measured by the reactance variation method. The resulting resistance was approximately 5000 ohms at 400 MC.

(*Continued on page 88*)

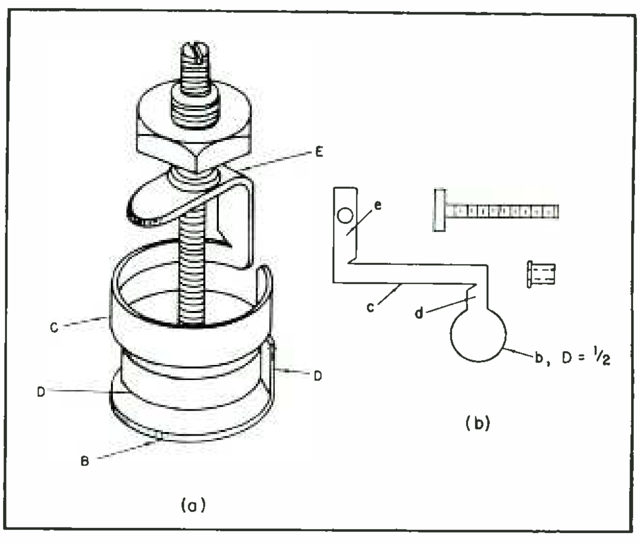


Fig. 3: Assembled tuner used in this receiver is shown at (a). Simplicity of parts and construction is indicated by the diagrams at (b)

...pment Specifications

...ble from manufacturers

r els	Type & Bandwidth of Transmitted Signals	Required Input to Receiver	Power Consumption (KVA)	Accessories Available or Provided	Remarks
	TV: 30 CPS—6 MC	125 µ V (a)	T&R—1.5	A—AME	Trans. & Rec. Xtal-Controlled; Picture, power & freq. monitoring provided in Xmitter
	FC, VC, TG, TP, TM, CN†	6.4x10⁻⁹ Watts	T&R—1.9 ■	P—CE, RL, ML; A—DC, RS, PE, TQ, AC	■ Incl. FTL—28A multiplexing equip.; † Each channel 300—3400 CPS, DC path (0—50 CPS), program channel optional
	0.5µsec. pulses†	6.4x10⁻⁹ Watts	T&R—0.37	P—RL, ML; A—RS, PE, AC, DC, CE, TQ	FTL—29A is UHF head for FTL—10B; †200,000 PPS, 10% duty cycle ▲ with 6 ft. PB
	0.5µsec. pulses†	3x10⁻¹¹ Watts*		P—RL, ML; A—RS, PE, AC, DC, CE, TQ	FTL—43A is VHF head for FTL—10B: †200,000 PPS, 10% duty cycle * for 50 db S/N
	6 MC	125 µV (a)	1500	A—RS, ML, PE, SD, AC; P—RL, TQ	Trans. & Rec. Xtal Controlled; ▲ with 6 ft. PB
	VC: 50—15000 CPS	*	T&R—0.55	P—RL; A—CE, AC, TQ	* 12 db noise factor
	VC: 300—34000 CPS†	*	T&R—0.55	A—CE, ML, RS; P—RL	† plus ringing supervision signaling etc., FC, TG, TP, TM, CN; * 12 db noise factor
	VC: 300—3000 CPS	100 db (b)	T&R—1.2		Trans. & Rec. Xtal Controlled; Uses 2C39A
	VC, TG, TP, TM, SG, CN	30 µV	T&R—0.6	A—CE, A—AC	Uses 4X150-A shf tetrode in transmitter output
VC	FC, VC, TG, TP, TM, CN	115 db (b)	T&R—0.6	P—TQ, CE, RL; A—CE, AC	Uses 5976 or 2K26 Klystron; ● Input to sub-carrier
SC	FC, VC, TG, TP, TM, CN	116 db (b)	T&R—0.32	P—TQ, CE, RL; A—CE, AC	Uses one Klystron for both receiving & X-mitting into one antenna
	TV: 302CPS—5 MC	—30 dbm	1	P—RL, FG; A—ML, RS, PE	▲ with 8 ft. PB; Uses SAC—19 Klystron; Video Channel can be dropped or injected at repeater stations
VC	VC: 300—3300 CPS†	—50 dbm	0.7	P—ML, RL, FG; A—CE, PE	▲ with 4 ft. PB; † Can be multiplied for 32 VC or FC, 512 TG, TP, TM, CN Channels
	VC: 300—2800 CPS†		1.2	A—CE	† Also accommodates TG, TP, TM, CN
	VC: 300—2800 CPS†		0.7	A—CE	† Also accommodates TG, TP, TM, CN
	VC:—4000 CPS†	—97 dbw*	T&R—0.39	A—CE, PA	● per channel; † Also accommodates FC, TG, TP, TM, CN; * S/N 60 db
	VC:—4000 CPS†	—99 dbw*	T&R—0.39	A—CE, PA	● per channel; † Also accommodates FC, TG, TP, TM, CN; * S/N 60 db
	VC:—4000 CPS†	—99 dbw*	T&R—0.39	A—CE, PA	● per channel; † Also accommodates FC, TG, TP, TM, CN; * S/N 60 db
	VC:—4000 CPS†	—99 dbw*	T&R—0.39	A—CE, PA	● per channel; † Also accommodates FC, TG, TP, TM, CN; * S/N 60 db
	VC:—4000 CPS†	—97 dbw*	T&R—0.39	A—CE	● per channel; ▲ with 5.5 ft. PB † Also accommodates FC, TG, TP, TM, CN; * S/N 60 db
	VC:—4000 CPS†	—97 dbw*	T&R—0.39	A—CE	● per channel; ▲ with 5.5 ft. PB † Also accommodates FC, TG, TP, TM, CN; * S/N 60 db
	VC:—4000 CPS†	—97 dbw*	T&R—0.39	A—CE	● per channel; ▲ with 5.5 ft. PB † Also accommodates FC, TG, TP, TM, CN; * S/N 60 db
	50—15000 CPS	—100 dbw*	T&R—0.48		▲ with 5.5 ft. PB; * S/N 60 db
	50—15000 CPS	—105 dbw*	T&R—0.4	A—PR	▲ with 5.5 ft. PB; * S/N 60 db
	50—15000 CPS	—104 dbw*	T&R—0.43		
	TV: 30 CPS—4.25 MC	30x10⁻¹⁰ Watts*	T&R—1.5	P—WV, CB, CK; A—MR, AN	* for 40 db S/N; Uses QK-174A Magnetron
	VC: 200—30000 CPS		750		Provides 15 FC, TG, TP, TM Channels;
	VC: 280—2800 CPS†	10 µV	0.5	A—CE, PR, AN	Provides 105 TG, TP, TM, CN Channels; † FC: 280—2800 CPS; Trans. & Receiver Xtal Controlled

RS—Reversing Switch
RY—Relays
SC—Subcarriers
SD—Sound Diplexer
SR—Selenium Rectifiers
SW—Coaxial Selector Switches
TG—Telegraph
TL—Transmission Lines
TM—Telemetering
TP—Teletype
TQ—Test Equipment
TV—Television
TW—Towers
UT—Utilities
VC—Voice
VR—Vibrator Converters
VT—Vacuum Tubes
WV—Wavemeter
WF—Waveguide Fittings
AME—Audio Multiplexing Equipment
SCR—Stacked Corner Reflector
STL—Studio Transmitter Link
PPS—Pulse per second
PTM—Pulse Time Mod.
PWM—Pulse Width Mod.
1—7.OMC Swing
2— ± 400 KC Swing
3—10 MC Swing
4— ± 200 KC Swing
5—12 MC Swing
6—6 MC Swing
7— ± 120 KC Swing
8— ± 100 KC Swing
9— ± 22.5 KC Swing
10— ± 75 KC Swing
11— ± 3 MC Swing
12—300 KC Swing
13—35 KC Swing
(a) for 20 db quieting
(b) Below 1 Watt

...cessory Manufacturers

Lingo & Son, John E., 2814 Buren Ave., Camden 5, N. J.—TW
Link Radio Corp., 125 W. 17 St., New York 11, N. Y.—TW
Measurements Corp., Boonton, N. J.—TQ
Mesker Steel Corp., George L., Evansville 8, Ind.—TW
Microwave Equipment Co., Box 470, Caldwell, N. J.—WF, TQ, AR, PE
Mitchell Industries, Inc., Mineral Wells, Texas—FL
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.—VT, AN, MX
NRK Mfg. & Eng'g Co., 5644 N. Western Ave., Chicago, Ill.—WF
Polytechnic Research & Development Co., Inc., 202 Tillary St., B'klyn 1, N.Y.—TQ
Premier Instrument Corp., 52 W. Houston St., New York, N. Y.—WF, AR, FL
Product Development Co., 526 Elm St., Arlington, N. J.—TW
Radio Corp. of America, RCA-Victor Div., Camden, N. J.—TW
Raytheon Mfg. Co., 138 River St., Waltham, Mass.—TW
Rostan Corp., 202 E. 44 St., New York 17, N. Y.—TW
Selectar Industries, Inc., 401 E. 138 St., New York 54, N. Y.—TQ, AN, WF, TL
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.—TQ
Skyline Tower Co., 5900 S. Ashland Ave., Chicago 36, Ill.—TW
Sola Electric Co., 4633 W. 16 St., Chicago 50, Ill.—PF
Sperry Gyroscope Co., Great Neck, L. I., N.Y.—VT, TQ, WF, AR
Stainless, Inc., 3rd St., N. Wales, Pa.—TW
Stoddard Aircraft Radio Co., 6644 Santa Monica Blvd., Hollywood 38, Calif.—AR
Sylvania Electric Products, 1740 Broadway, New York 19, N. Y.—VT, CY
Technicraft Laboratories, P. O. Box 1908, Waterbury, Conn.—WF
L. H. Terpening Co., 16 West 61 St., New York 23, N. Y.—WF, MX
Tower Construction Co., 402 Commerce Bldg., Sioux City 9, Iowa—TW
Trio Mfg. Co., Griggsville, Ill.—TW
Upright Scaffolds Div., Up-Right Inc., 1013 Pardee St., Berkeley 10, Calif.—TW
Varian Associates, 99 Washington St., San Carlos, Calif.—WF, TQ, VT, AR
Vesto Co., Parkville, Mo.—TW
Weymouth Instrument Co., 1440 Commercial St., E. Weymouth 89, Mass.—TQ, AN, WF
Wincharger Corp., 7th & Division Sts., Sioux City, Iowa—TW
Wind Turbine Co., E. Market St. & Penna. RR., West Chester, Pa.—TW
Workshop Associates, 135 Crescent Rd., Needham Heights 94, Mass.—AN, DI

FOR EVERY MICROWAVE APPLICATION
...NEW COMMUNICATION NEEDS
...EXPANSION OF EXISTING SERVICE
...REPLACING WIRE AND CABLE LINES

Wherever microwave radio can serve — whether across a city or across a nation—a Federal Microwave System offers proved assurance of dependable communications at lowest cost.

FEDERAL PTM (Pulse-Time-Multiplex)

Performance records made in the field are proving the unique superiority of Federal PTM and its pulse-type operation.

• SYSTEM CAPACITY

Up to 23 voice channels on a single carrier, or as many as 115 voice channels with combined systems.

• FREQUENCY RANGE

1700-2200 megacycles... inherent reliability and efficiency proved in field operation.

• VERSATILITY OF OPERATION

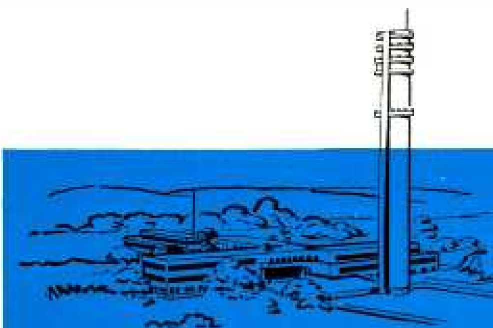
Telephone, telegraph, teleprinter, telemetering, supervisory remote control, DC signaling, dialing facilities.

• SIMPLE TRIODE RF TUBES • NO CRITICAL TUNING
• 60 DB CROSS TALK • EASY EXPANSION
• LOWEST COST TUBE COMPLEMENT

Federal is a central source of supply for complete systems and accessories, including... specially designed towers and buildings; ringing equipment; DC path equipment; drop channel equipment; dialing equipment; two-wire, four-wire terminations; carrier equipment employing frequency division multiplexing.

FEDERAL MICROWAVE TELEVISION LINKS

Federal Microwave relay and link systems for television, operating in the frequency range of 1990-2100 megacycles, provide economical, high-quality facilities for studio-transmitter links, inter-city relays and remote portable pickups.



RESEARCH

Federal Telecommunication Laboratories, Nutley, N. J.—research and development by more than 700 scientists and engineers.

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

Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

Microwave Relay Equ

Technical characteristics of systems and equipment now avai

Manufacturer's Name, Address & Equipment Model No. and/or Name	Type Service	Frequency Range (MC)	Transmitted R-F Band width (MC)	Type Modulation	Trans. Modulation Input	Trans. Power Output (Watts)	Effective Rad. Power (KW)	Size & Type Antenna (ft.)	Nu of C
Allen B. Dumont Labs. Inc. TA-149 1000 Main Ave., Clifton, N.J.	TV	1990—2110	12	FM—1	1—2.5 V. (75 Ω)	10	8	4, 6—PB	
Federal Telephone & Radio Corp. 100 Kingsland Road, Clifton, N.J. **Federal Telecommunication Labs., Inc.** 500 Washington Ave., Nutley, N.J. **Federal Electric Mfg. Co.** 9600 St. Lawrence Blvd., Montreal, Can. FTL—10B	PL, RR, UT, IN, GV	1700—2200	5.6	PTM	—20 dbm	4 Avg.—40 PK	3.2 Avg.—32 PK▲	4, 6, 10—PB	1 t
FTL—29A	PL, RR, UT, IN, GV	1700—2200	5.6	PTM	5 V. PP	4 Avg.—40 PK	3.2 Avg.—32 PK▲	4, 6, 10—PB	
FTL—43A	PL, RR, UT, IN, GV	150—250	5.6	PTM	5 V. PP	100 "—1000PK	1 Avg.—10 PK	SCR	
FTL—27A	TV—STL, GV	1750—2200	12	FM—5	1—2.5 V. (75 Ω)	10	8▲	4, 6, 10—PB	1
FTL—11A	BD—STL	940—952	0.5	FM—4	10 dbm	3	0.48	4, 6—PB	1
FTL—13A	PL, RR, UT, IN, GV	890—960	0.5	FM—4	0 dbm	3	0.48	4, 6, 10—PB	1 t
General Electric Cc. .....UA—1-A Electronics Park, Syracuse, N.Y.	PL, RR, UT	1850—1990	6	PWM	—10 dbm	2	2	6—PB	1 t
Link Radio Corp. ....2048—TR 125 West 17 St., N.Y. 11, N.Y.	PL, RR, UT, PS, IN	940—960	0.8	FM—2	0 dbm (600Ω)	10	4	6—PB	1 t
Motorola Inc. Communications & Electronics Div. 4545 Augusta Blvd., Chicago 51, Ill. FSTRM—30BR Series	PL, RR, UT, IN	6125—7425	10	FM—3	0 dbm ●	0.1	0.32	3.3—PB	1 t
MICROPLEX FSTRM—30BR Series	PL, RR, UT, IN	6125—7425	10	FM—3	0 dbm ●	0.1	0.32	3.3—PB	1 t
Philco Corp. ....TLR—2A	TV	5925—6425	20	FM—5	1 V. (75 Ω)	1	10▲	4, 6, 8, 10 PB	1
Tioga & C Streets, Phila. 34, Pa. CLR—6	RR, PL, UT, IN	5925—7425	10	FM—6	0 dbm (600 Ω)	1	2.5▲	4, 6, 8, 10 PB	1—
Radio Corp. of America CW—5A Front & Cooper Sts., Camden 2, N.J.	PL, RR, UT	952—960	0.5	FM	—20 dbm	2		4, 6 PB	8
CW—20A	PL, RR, UT	1850—2200	5	FM	—20 dbm	3		6 PB	24
Radio Engineering Labs., Inc. 751 36-40 37 St., Long Island City 1, N.Y.	PL, RR, UT	400—470	0.5	FM—7	—10 dbm ●	15	0.15	CR	
752	PL, RR, UT	450—470	0.36	FM—7	—20 dbm ●	15	0.15	CR	
752—B	PL, RR, UT	450—460	0.36	FM—8	—20 dbm ●	15	0.15	CR	
752—C	PL, RR, UT	450—460	0.2	FM—8	—20 dbm ●	15	0.15	CR	
757	PL, RR, UT	890—960	0.36	FM—7	—20 dbm ●	8	1.3▲	3.5, 5.5 PB	
757—B	PL, RR, UT	890—960	0.36	FM—7	—20 dbm ●	8	1.3▲	3.5, 5.5 PB	
757—C	PL, RR, UT	890—960	0.2	FM—8	—20 dbm ●	8	1.3▲	3.5, 5.5 PB	
707—B	BD—STL	890—960	0.2	FM—8	+10 dbm	8	1.3▲	3.5, 5.5 PB	1
695	BD, MB, STL	150—175	0.04	FM—9	+10 dbm	50	1▲	3x3, 6x4	1
761	BD, MB, STL	450—460	0.1	FM—10	+10 dbm	15	0.15	CR	1
Raytheon Manufacturing Co. RTR—1C Waltham 54, Mass.	TV	1990—2110	17	FM—11	1—2 (75 Ω)	50	50	8 PB	1
Telectro Industries ....TMR—2 35-16 37 St., Long Island City 1, N.Y.	PL, RR, UT	890—960	10	FM—12	—25 dbm	3	12.5	4 PB	5 V
Westinghouse Electric Corp. ....FB 2519 Wilkins Ave., Baltimore 3, Md.	PL, RR, UT	940—960	0.5	FM—13	0 dbm (600 Ω)	15	3	6 PB	1 to

A—Available
R—Receiver
T—Transmitter
P—Provided
AC—Automatic Changeover
AF—Audio Filters
AN—Antennas
AR—Attenuators
BD—Broadcast
CB—Cable
CE—Channelizing Equipment
CK—Cabinet Racks
CN—Control Signals
CR—Corner Reflector
CY—Crystals
DC—Drop Channel
DI—Deicing Equipment
FC—Facsimile
FG—Flexible Waveguides
FL—Filters
FM—Frequency Modulation
GV—Government
IN—Industrial
MB—Mobile
ML—Multiplexing Filter
MR—Monitor Receiver
MX—Mixers
OS—Oscillators
PA—Power Amp
PB—Parabola
PE—Pressurizing Equipment
PF—Power Transformers
PK—Peak
PL—Pipe Line
PP—Peak Pulse
PR—Power Supply
PS—Public Safety
PT—Preselectors
RL—RF Filter
RR—Railroad

Microwave Equipment

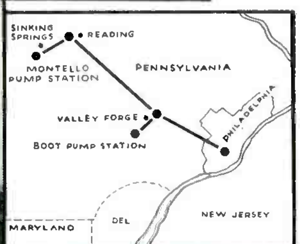
Airtron, Inc., 101 E. Elizabeth Ave., Linden, N. J.—WF
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.—TW
Alpar Mfg. Co., 466 St. Francis St., Redwood City, Calif.—TW
Aluminum Products Co., Box 56F, Mineral Wells, Texas—TW
American Bridge Co., 436 7th Ave., Pittsburgh 30, Pa.—TW
Andrew Corp., 363 E. 75 St., Chicago 19, Ill.—PE, TL, AN
ARF Products, Inc., 7627 Lake St., River Forest, Ill.—MX, OS, PT
Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill.—RY
Baker Mfg. Co., 133 Enterprise St., Evansville, Wisc.—TW
B.D.N. Steel Erecting Co., 82 W. Washington Blvd., Chicago 2, Ill.—TW
Berger Communications, 109-01 72nd Rd., Forest Hills, L. I., N.Y.—WF, AN
Bird Electronic Corp., 1800 E. 38 St., Cleveland 14, Ohio—TQ, SW
Blaw-Knox Co., Blawnox, Pa.—TW
Burnell & Co., 45 Warburton Ave., Yonkers, N. Y.—AF
Coil Winders, Inc, 61 Bergen St. Brooklyn, N. Y.—FL, AR
Cornell-Dubilier Electric Corp., 2900 Columbia Ave., Indianapolis, Ind.—VR
Easy-Up Tower Co., 3800 Kinzie Ave., Racine, Wisc.—TW
Eitel-McCullough, Inc., San Bruno, Calif.—VT
Elizabeth Iron Works, P. O. Box 360, Elizabeth, N. J.—TW
Emsco Derrick & Equip. Co., P. O. Box 2098 Terminal Annex, Los Angeles 54, Calif.—TW
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.—TW
Gates Radio Co., Quincy, Ill.—TW
General Electric Co., Electronics Dept., Syracuse, N. Y.—TW
General Radio Co., 275 Massachusetts Ave., Cambridge, Mass.—TQ
Grem Engineering Co., 206 8th Ave., Brooklyn, N. Y.—AR, TQ, WF
Gulton Mfg. Corp., Metuchen, N. J. —TL
Heintz & Kaufman Div., Robert Dollar Co., 947 Broadway, Redwood City, Calif.—VT
Hewlett Packard Co., 395 Page Mill Rd., Palo Alto, Calif.—TQ
International Derrick & Equip Co., 875 Michigan Ave., Columbus 8, Ohio—TW
International Rectifier Corp., 6809 S. Victoria Ave., Los Angeles 43, Calif.—SR
Kings Microwave Inc., 811 Lexington Ave., Brooklyn, N. Y.—WF
La-Pointe Plascamold Corp., Unionville, Conn.—TW
Lehigh Structural Steel Co., Allentown, Pa.—TW
Lewis & Kaufman, Inc., P. O. Box 337, Los Gatos, Calif.—VT

Federal MIC

COMMUNICAT

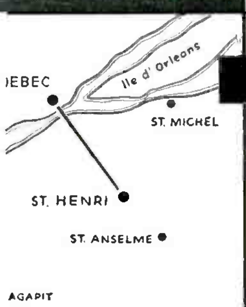
PROVIDING ULTRA-MODERN SERVICE THR
PERFORMANCE-PROVED IN T

PIPE LINE



KEYSTONE PIPE LINE COMPANY
Philadelphia to Montello, Pa.

The first pipe line installation of microwave radio for communications. Two unattended repeater stations; three terminals, one using drop-channel equipment.

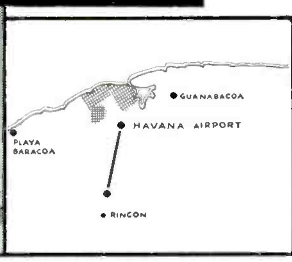


TELEPHONE

BELL TELEPHONE COMPANY OF CANADA
Quebec to St. Henri De Levis, P.Q.

For expansion of existing wire line toll facilities. A 23-channel PTM system is being initially equipped for operation on 15 channels.

AVIATION



RADIO AERONAUTICA DE CUBA
Remote Station to Havana Airport

Outputs of remote fixed frequency HF receivers are transmitted to the airport control tower by PTM. Twenty of the system's 23 voice channel capacity are used to provide voice, hand-keyed CW and teleprinter facilities.

A record of dependable, e
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This record of proved per
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Federal's microwave insta
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public utilities and telephone
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In every installation, routi
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For complete details on any app
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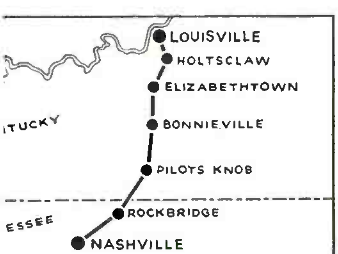

STATION WSM-TV, NASHVILLE, TENNESSEE
Inter-City Relay: Louisville, Ky., to Nashville

TELEV

The World's Longest Station-Owned Microwave Television Link System

Spanning 164 miles in two states, the Federal Television Link for WSM-TV will utilize five unattended repeater stations in relaying network television from the coaxial cable at Louisville to the WSM-TV transmitter at Nashville. This new system will feature sound diplexed into the video channel.

Federal Telephone ar

An Associate of International Tele

CROWAVE

ION SYSTEMS

)UGH OUTSTANDING DESIGN AND QUALITY
IOUSANDS OF CHANNEL-MILES

ent and economical communica-
;, rivers, swamps and mountains—
Microwave Radio Communication

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operation of Federal equipment is
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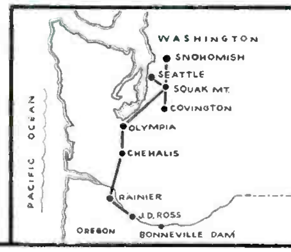
ation of Federal Microwave, write
dio Transmission Systems Division.

POWER UTILITY

BONNEVILLE POWER ADMINISTRATION

Covering 200 Miles of Power Lines in Washington and Oregon

The first microwave system specified by a power utility. Provides telephone, telemetering, supervisory control and power line fault locator transmission.



MUNICIPAL

DEPARTMENT OF WATER AND POWER, CITY OF LOS ANGELES

Los Angeles to Seal Beach, Calif.

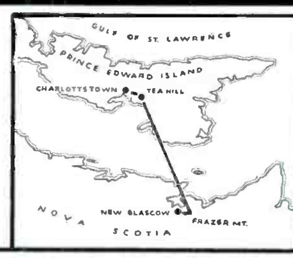
Initially equipped for eight-channel communication and telemetering service to connect downtown offices with an outlying steam generating plant.

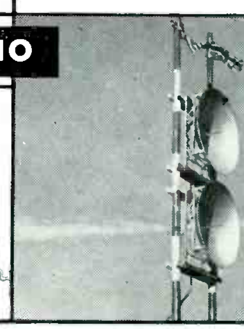
TELEPHONE-RADIO

MARITIME TELEPHONE AND TELEGRAPH COMPANY

New Glasgow, N.S. to Charlottetown, P.E.I.

The first commercial microwave link in North America. Includes special channel for high-fidelity radio program transmission.





SION

STATION WKZO-TV, KALAMAZOO, MICHIGAN
Inter-City Relay: Detroit-Toledo to Kalamazoo

A 130-mile Federal Microwave Relay System, supplying WKZO-TV with network television from program sources in Detroit and Toledo. The first commercial link to utilize channeling equipment for diplexing sound into the video channel. The reflector-type system terminates at Manchester, Mich., with an unattended repeater station at Elbion.

The World's First Television Link Providing Sound and Video on the Same Channel

d Radio Corporation

phone and Telegraph Corporation

FEDERAL TELEPHONE & RADIO FTR

Microwave Reflector Gain Chart

By J. F. SODERO,
*Project Engineer, Electronics Dept.
Hughes Aircraft Co., Culver City, Calif.*

Number 9

THE gain produced by the concentration of microwave radiation into a beam by a reflector with rectangular aperture as compared to omnidirectional transmission is given by:

$$\text{Gain} = 4\pi f(ab/\lambda^2) \quad \text{.........(1)}$$

where a and b are the aperture dimensions, λ is the radiation wavelength and f is a utilization or efficiency factor. For a circular aperture of diameter, d, eq. (1) is modified and becomes:

$$\text{Gain} = (\pi d/\lambda)^2 f \quad \text{.........(2)}$$

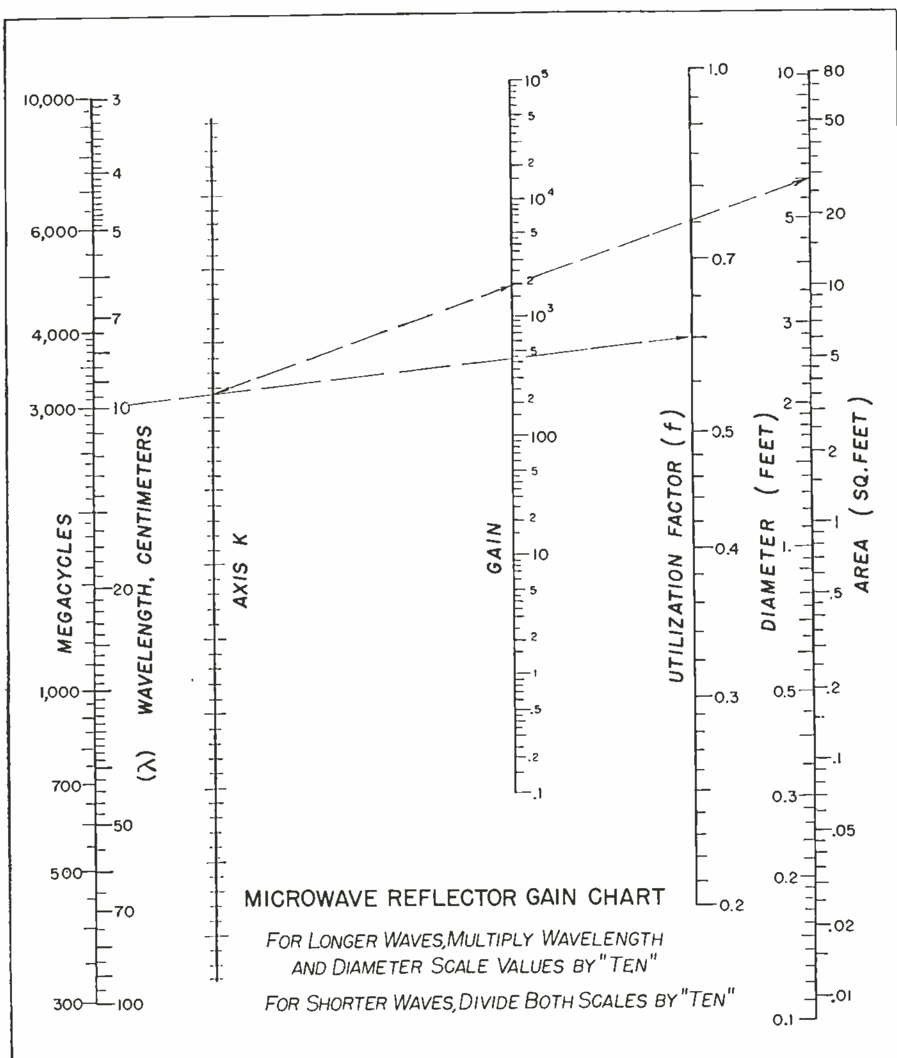
The application of these equations is restricted to apertures of dimensions which are large compared to the wavelength and which have constant phase distribution over the area. The calculated gain is applicable to that portion of the feed power which is incident upon the reflector and does not account for spill-over effects. The utilization factor, f, is unity for uniform field distribution over the aperture, but since this type of illumination produces excessive minor lobes for many applications the distribution is generally tapered toward the edges to minimize discontinuity effects. A compromise between minor lobe suppression and maximum gain generally results in values of f between 0.5 and 0.7.

In the design of a microwave reflector it is generally necessary to inspect the relation between aperture area and gain which requires repetitious solutions of eq. (1) or (2). The design chart has been prepared to reduce the labor of examining the variation between gain and dish area for a given wavelength and reflector efficiency. A conversion factor has been applied to permit diameters scaled in feet to be used.

The chart is used by constructing a straight line between the system wavelength (in cms) on the λ scale and the utilization factor on the f scale. The intersection of this line and the K scale determines a turning point, and a straight line from the turning point to the assumed area, axb, or diameter, d, on the extreme right-hand scale shows the gain at the point of intersection with the gain scale.

Example: Determine the gain of a paraboloid 6 feet in diameter at 10 centimeters with an illumination efficiency of 0.6.

From 10 on the λ scale draw a straight line to 0.6 on the f scale, and establish a turning point on axis K. From the turning point construct a straight line to 6 on the d scale and find 2000 on the gain scale.



BEHIND FEDERAL MICROWAVE LEADERSHIP —WORLD-WIDE PIONEERING, RESEARCH AND DESIGN; MANUFACTURING AND OPERATING EXPERIENCE OF IT&T

The vast experience of International Telephone and Telegraph Corporation in every phase of communications has contributed to the microwave radio systems manufactured in Federal's plant at Clifton, N. J. From these world-wide facilities, Federal has a background that includes....

PIONEERING ....

IT&T scientists through the years have pioneered in the development and improvement of new techniques in the art of communication

RESEARCH ......

Microwave was born in 1931 when IT&T engineers demonstrated the world's first microwave communication system. Operating between Dover, England, and Calais, France, this installation became the first commercial microwave radio system in 1933

DESIGN ....

IT&T research laboratories in the United States, England, and France, working independently and together, are making significant advances in microwave technique

PRODUCTION....

Through its manufacturing associates in 21 countries, IT&T has produced and installed microwave and other communication systems that are serving today in a wide field of application throughout the world

OPERATION .....

IT&T, as a world leader in international communications, operates intercontinental cables, land lines, radio telephone and telegraph circuits or telephone systems in practically every country.

100 KINGSLAND ROAD,
CLIFTON, NEW JERSEY

PRODUCTION

Federal Telephone and Radio Corporation, Clifton, N. J.—one million square feet devoted to production of communications equipment.

Microwave's Multi-Million Dollar Market

UNTIL about eighteen months ago the use of microwaves for communication purposes had been confined mainly to multiple channel circuits, such as telephone and telegraph. With the exception, of course, of television and FM relaying between studios and transmitters, remote pickups, and military use, there was not much apparent interest.

A recent upsurge in microwave activity finds equipment being used by a rapidly increasing number of organizations to replace wire connections, and to supplement them. Among these industries are railroads — the Chicago, Rock Island and Pacific has almost completed installation of over one hundred miles of microwave links designed to replace trackside wires which require expensive maintenance and replacement; oil and pipeline utilities which use repeater stations set up along the route of the pipe to relay communications from end to end, and to provide telemetering service at pumping and filtering stations; point to point communication services for transportation organizations: the cross country network linking New York and Chicago has been duplicated by a complete microwave circuit; electric, gas and other utilities are also finding the freedom from propagation vagaries and tropospheric effects very useful in maintaining watch over long transmission lines.

One of the major advantages of microwave transmission not generally achieved by use of lower frequencies in the VHF or even, to a lesser extent, the UHF bands, is that of secrecy and long distance coverage with low power. The optical characteristics of microwave transmission make it comparatively simple to control and focus the transmitted signal so that very narrow beams can be obtained with tremendous power gains being possible in the design of the receiving and transmitting antennas. The distance between repeater or relay stations depends on the terrain. In any case, use of radio in this form relieves the user of the responsibility of acquiring rights of way from landowners over whose land the circuit is to pass and erecting and maintaining landlines. So far as is known at present no one has yet made a charge of trespassing by the passage of a microwave beam over his land succeed in court. But an interesting point does arise in wondering what would happen if someone erected a building between two of the relay towers of a microwave system such as the A. T. & T. circuit to Chicago. Presumably, the operating company, if they could not persuade the owner to build in a slightly different position, would have no recourse at law, and would have to erect a passive reflector to bypass the offending structure, or perhaps lease space on it for a repeater reflector system.

As a general rule the propagation characteristics of microwave frequencies follow line of sight paths; for that reason permanent, or portable, installations are the rule rather than mobile equipment. The wide bandwidth available in the SHF portions of the spectrum is such that multiplexing and multiple channel operation is not only possible, but almost mandatory, if full advantage is to be taken of microwaves.

The great reliability of modern equipment is a strong factor in its increasing popularity. This coupled with its imperviousness to weather of almost all kinds which often disrupts normal wire communications is making more and more radio users turn to it.

Television has long used microwaves, first 7000 MC and more recently 1900 MC, and of the 107 TV stations in the country only about nine do not use at least one microwave remote pickup unit. At an average price of about $10,000 per set and with some stations using three or four sets this represents quite an investment in a very small part of the microwave field.

Microwave Use Table—excluding aeronautical and amateur services

BAND MC.	SERVICE	CLASS OF STATION
1700-1850	Gov't.	
1850-1990-	Fixed	a) International control b) Operational fixed
1990-2110	a) Fixed b) Mobile	a) Television pickup b) Television STL
2110-2200	Fixed	a) International control b) Operational fixed
2200-2300	Gov't.	
2450-2500	a) Fixed b) Mobile	Also industrial, scientific and medical equipment
2500-2700	Fixed	a) International control b) Operational fixed
3500-3700	Mobile	a) Land b) Mobile except TV pickup
3700-4200	Fixed	Common carrier fixed
4400-5000	Gov't.	
5925-6425	Fixed	Common carrier fixed
6425-6575	Mobile	a) Land b) Mobile, except TV pickup
6575-6875	Fixed	a) International control b) Operational fixed
6875-7125	a) Fixed b) Mobile	a) TV pickup b) TV-STL
7125-8500	Gov't.	
9800-9900	Fixed	Fixed
9900-10,000	Gov't.	
10,700-11,700	Fixed	Common carrier fixed
11,700-12,200	Mobile	a) Land b) Mobile except TV pickup
12,200-12,700	Fixed	a) International control b) Operational fixed
12,700-13,200	a) Fixed b) Mobile	a) TV pickup b) TV STL
13,200-16,000	Gov't.	
16,000-18,000	a) Fixed b) Mobile	Also, industrial scientific and medical
18,000-21,000	Gov't.	
22,000-26,000	Gov't.	
26,000-30,000	a) Fixed b) Mobile	
Above 30,000	Experimental	

PHILCO
Microwave Communications Systems

WHAT AN ELECTRONICS ENGINEER WANTS TO KNOW ABOUT PERFORMANCE, RELIABILITY, COST

What kind of service will a Philco microwave relay system provide?

Voice channels or a combination of voice, telegraph, printer, facsimile, telemeter, control and alarm facilities can be provided as through trunks or on a party line basis. Wide band facsimile and program channels can also be provided.

Can it be expanded to meet future needs?

Expansion of a Philco Microwave System in length or in number of channels can be accomplished readily without causing obsolescence of original equipment. A system may be expanded in blocks of four channels up to twenty-four or more channels. Each voice channel may be subdivided to handle up to twenty telegraph and printer circuits.

For what bands is the equipment designed?

Philco equipment is available in the 5925 to 7425 megacycle band which includes common carriers, industrials, railroads, petroleum industries and government agencies.

What about propagation?

Philco Microwave Systems are designed with a minimum fading margin of 30 db. Propagation tests show that over a 40 mile path this fading margin will provide reliability closely approaching 100%.

What kind of multiplexing is used?

Either frequency-division or time-division multiplexing may be used to modulate the FM carrier of a Philco Microwave System. For a large number of channels, Philco PAM time-division multiplex equipment is both versatile and low in cost.

What about cost?

A typical Philco Microwave Communications System costs less than $500 per mile, the exact figure depending upon length, terrain, number of dropouts and operational complexity.

Are all microwave systems similar?

No. There are fundamental differences which make the Philco Microwave Communications Systems better. For example, only Philco has the feed-back repeater designed specifically for long haul relay service. This repeater utilizes a single long-life microwave oscillator tube for transmission and reception in each direction—resulting in lower maintenance costs. Only Philco PAM Multiplex Terminals successfully combine performance efficiency and economy. Philco, the leader in military microwave radar, now offers the most advanced design microwave relay systems.

For further information please address inquiries to:

PHILCO CORPORATION

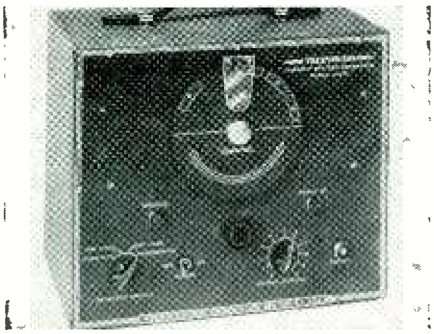
INDUSTRIAL DIVISION, PHILADELPHIA 34, PA.

NEW EQUIPMENT for Designers and Engineers

To be displayed at the 6th Annual Pacific Electronic Exhibit, September 13-15, Long Beach, Calif.

TV Pattern Generator

Model A-370 provides assistance in the proper adjustment and installation of television receivers, when no station pattern is on



the air. Many tests can be performed with this new TV linearity pattern generator that would otherwise be impossible unless a station pattern is available. Three different types of signals are provided: horizontal lines; vertical lines; cross hatch, 3-4 aspect ratio. With these signals it is possible to adjust the deflection yoke, horizontal and vertical hold controls, sweep width, linearity, and ion trap. Power consumption is approximately 25 watts. There is a selection of 8 or 9 horizontal lines or 12 vertical lines.—**Approved Electronic Instrument Corp., 142 Liberty St., New York 6, N. Y.**—TELE-TECH

Ruggedized Resistors

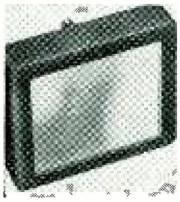
A self-contained rubber shock mount for panel instruments has been incorporated in the new Marion line of hermetically sealed meters. The rubber compound used is of 45 durometer molded directly to the interior of the case with the floating anchor disc and three-point mounting stud assembly molded in the center of the rubber block in sandwich form. This mount has proven highly satisfactory particularly in the attenuation of high amplitude, low frequency shock forces. —**Marion Electrical Instrument Co., Stark Street Gate, Manchester, N. H.**—TELE-TECH

Selenium Rectifiers

Designed especially for power and bias supplies in television, the 5S1 and 8Y1 are recent additions to the Seletron line. The 5S1 is rated at 500 Mils and the 8Y1 which measures only ½ in. square, is rated at 20 Mils, 130 v. Maximum peak inverse voltage of both models is 380.—**Radio Receptor Co., Inc., 251 West 19th St., New York 11, N. Y.**—TELE-TECH

Photoelectric Cell

A hermetically sealed selenium photoelectric cell has been developed which has an average current sensitivity of 600 μamps. at an illu-



mination of 100 ft.-candles with a 100 ohm external circuit resistance. The assembly features an extruded brass case using a glass-to-metal sealing alley to secure perfect hermetic sealing. The space utilization factor of the unit is high as the case is square. The active cell area is approximately 2.25 sq. in. and the positive contact is made by a center lug and the negative terminal lug is located ¾ in. away from the positive one.—**International Rectifier Corp., 6809 South Victoria Ave., Los Angeles 43, Calif.**—TELE-TECH

Crystal Oven

JAN approved all-moulded material is used in the Tiny Temp JKO2 crystal temperature control oven. Crystal units are completely surrounded by the heating elements, and the thermostat is located in a position to afford easy adjustment. Temperature stabilization at 75° C ±2 is provided for one or two CR-7 type crystal units in ambients from -55° to +70° C. It has a standard octal base and an overall width of 1.28 in.—**James Knights Co., Sandwich, Ill.**—TELE-TECH

Signal Generator

The EICO model 315 deluxe RF-TV-FM signal generator is now available in kit form. Known as the 315-K, it is claimed to have all the accuracy and stability features for the

most exacting alignment of TV, FM, and AM receivers. Featuring an accuracy better than 1% on all six separate calibrated ranges, it has a stable, boosted range oscillator circuit that covers the full range of 75 KC to 150 MC. Highest precision tuning of any bandwidth is accomplished by band-spread vernier tuning. Accuracy is independent of line voltage fluctuations from 105 to 130 v. The 4-step shielded r-f output attenuator is designed for constant output impedance.—**Electric Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.**—TELE-TECH

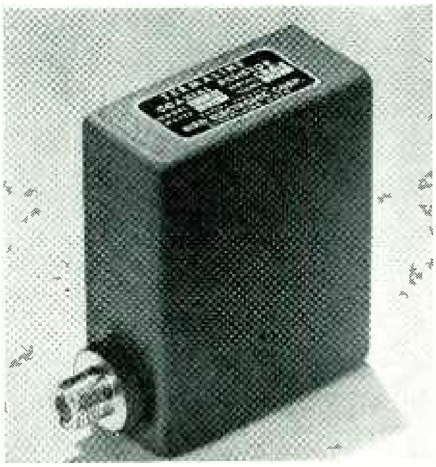
Radiation Monitor

Radio active contamination of laboratory benches, accessories, and hands can be quickly determined by a new radiation monitor, known

as model K-900. Geiger tube detecting element permits differentiation between beta and gamma radiation. The Geiger tube probe is connected to the main cabinet by a self-retracting cord. When not in use, the probe is mounted in the handle of the cabinet.—**Kelly-Koett Manufacturing Co., 12-T East 6th St., Covington Ky.**—TELE-TECH

Coaxial Load Resistor

The active power dissipation element of the Model 80A Termaline coaxial load resistor is the outer surface of a cylindrical film type



resistor, which forms the center conductor of a special self-terminated coaxial structure. Constant impedance properties depend upon shape of coaxial assembly and distribution of resistance along length of outer surface of resistor. Acting as an almost perfect termination for 50-52 ohm coaxial lines, the VSWR of the model 80A is less than 1.05 from d-c to 400 MC and less than 1.2 to 2000 MC.—**Bird Electronic Corp., 1800 East 38th St., Cleveland 14, Ohio**—TELE-TECH

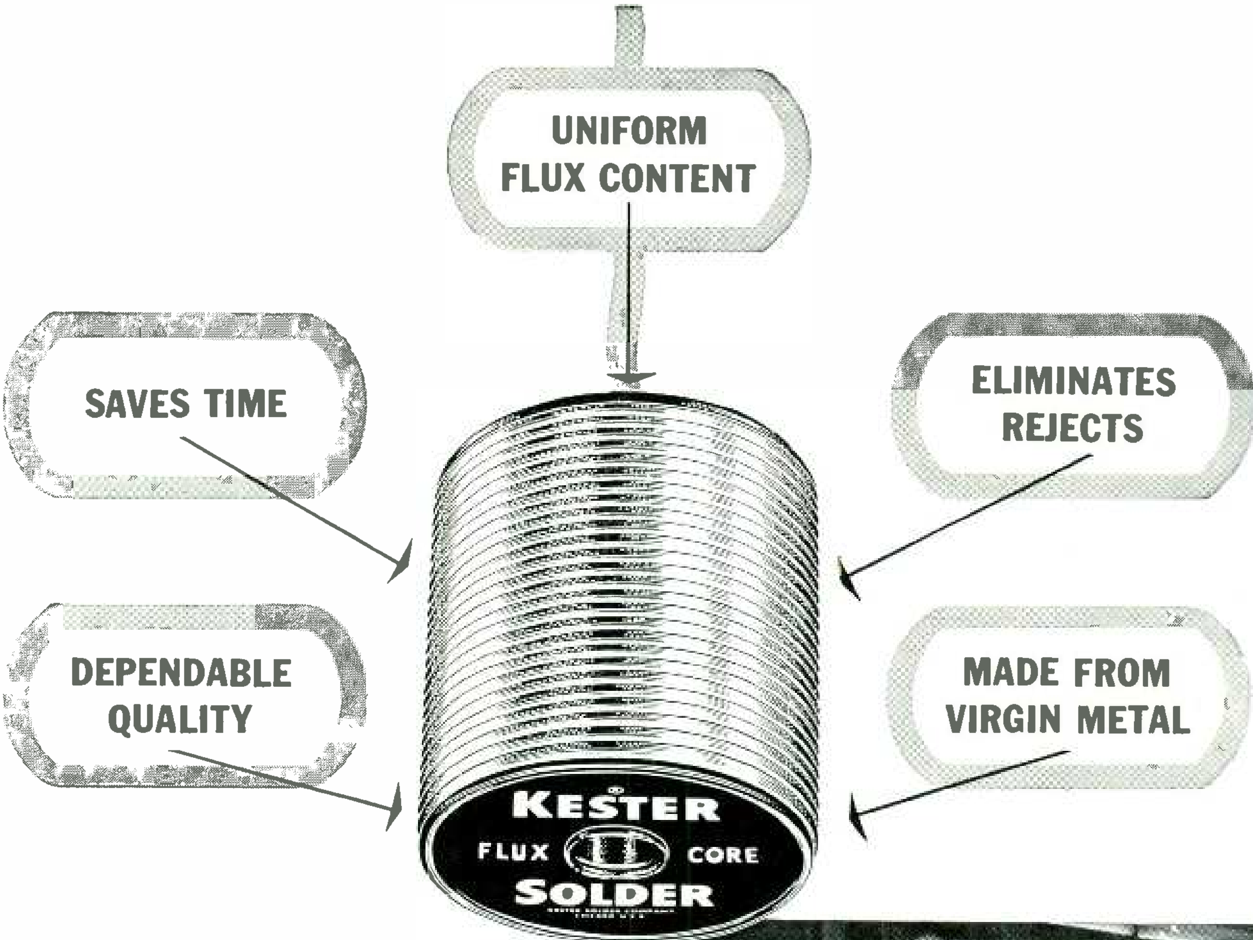
Servoscope

A new Servoscope has been developed for analyzing, testing or synthesizing servomechanisms, regulators, or automatic controls, by

observing or plotting the phase and amplitude responses with respect to various signal frequencies generated by the instrument. Means for displaying the test signal on a CR tube screen are provided by an electronic sweep, triggered by a commutator. Use of the oscilloscope also permits continuous inspection of the test signal wave shape for distortion caused by insertion or adjustment of any loop component. Relative amplitude measurement is made by comparing pattern height before and after the test signal is passed through the servo or control under test.—**Servo Corporation of America, 20-20 Jerico Turnpike, New Hyde Park, N. Y.**—TELE-TECH

Loudspeaker System

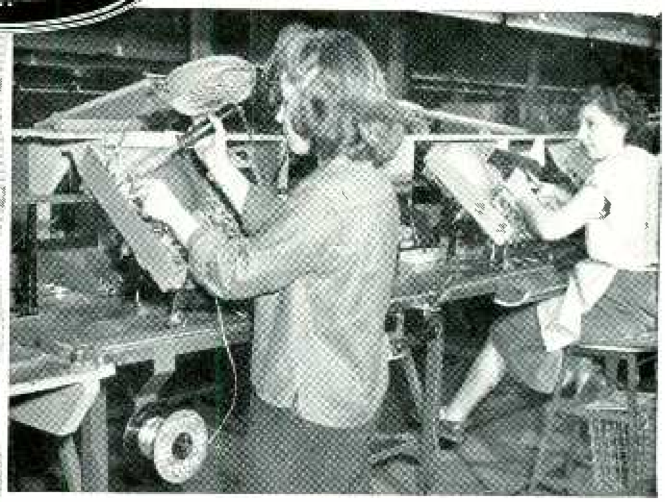
By using a 3-way crossover system, the mid guage section of the model 400 3-way loudspeaker is unmolested by lows and highs. Reproduction of complex wave forms is thereby simplified. The vented tube porting system is used for bass reinforcement. Cone resonance and cabinet resonance do not have predominant peaks, but are of such low magnitude and are so spaced that they function as true extensions of the bass response. Distortion is unusually low because the highly dampened cone is equivalent to several db of additional inverse feedback on an amplifier.—**Holt Radio Industries, P. O. Box 1230, Hollywood 28, Calif.**—TELE-TECH



KESTER

the Solder

that gets Speed into TV Production



Using Kester Flux-Core Solders, Plastic-Rosin and "Resin-Five" Core Solders, will keep your solderers satisfied. Kester flows better—handles easier—faster to use. Kester Solders are made only from newly mined grade A tin and virgin lead.

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Kester "Resin-Five" Core Solder and Plastic Rosin-Core Solder, which are available in the usual single-core type, can now also be had in a 3-core form.

KESTER SOLDER

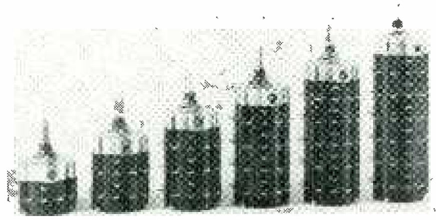
NEW EQUIPMENT — to be displayed at the National Electronics Conference, Chicago, Sept. 25-27

Micro-Miniature Capacitors

Type P837 capacitors are Hyvol K impregnated in humidity resistant molded thermoplastic cases and operate at temperatures from -15° C. to +85° C. without derating. Power factor is less than 1% when measured at or referred to a frequency of 1000 cps and an ambient temperature of 25° C. The use of Aerolite dielectric is a distinct departure from conventional foil paper and previous metal construction and facilitates the production of the smaller size: 3/16 in. diameter, 7/16 in. long; and ¼ in. diameter by 9/16 in. long.—**Aerovox Corp. New Bedford, Mass**—TELE-TECH

Selector Switch

Contact resistance is exceptionally low and life tests of ten million operations show that contact resistance changes less than 0.0005 ohms during the life of the type 31-3 rotary selector switch. This stability comes from the use of solid silver switch contacts and multiple leaf self-aligning brushes of silver alloy. Stray inductance is less than 0.03 µh., and capacitance between segments is less than 0.5 µµf. Switch body of molded mica-filled phenolic maintains high insulation resistance even after prolonged exposure to high humidity. Molded switch wafers fit together snugly in a totally enclosed construction that keeps out



dirt and dust, assures clean contact surfaces. Adjustable detent permits variation of switch torque. One, two three, four, five and six pole models are shown in photo (left to right).—**Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.**—TELE-TECH

Relays

Subminiature telephone type series MT relays are now available with one to four model 1SM1 microswitches. This provides an

assembly 1-7/16 x 1-15/16 x 11/16 in. with contacts up to 4 form C (4PDT) rated at 5 amps, 115 v. 60 cps resistive load, or 3 amps at 24 v. d-c. Maximum inrush is 12 amps for ½ sec. This relay is said to withstand better than 50 G. vibration. It is molded bakelite enclosed, thus protecting the contacts and springs from most environment conditions—**Potter & Brumfield, Princeton, Ind.**—TELE-TECH

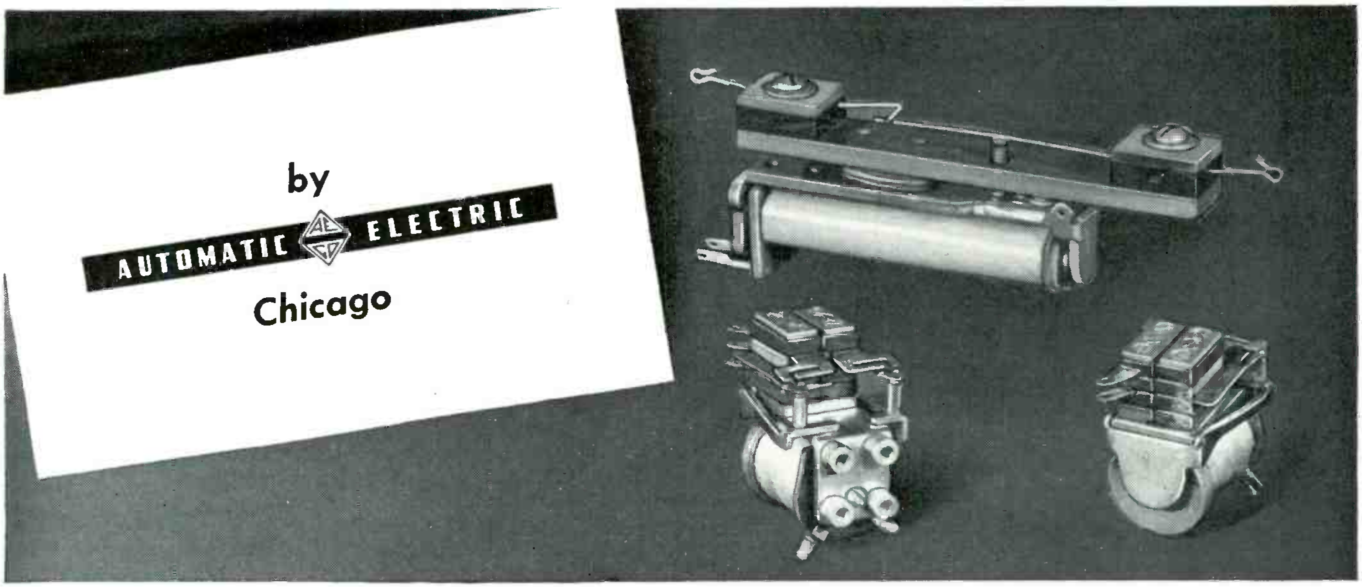
DC Millivoltmeter

Redesign of the the model MV-17b dc millivoltmeter has resulted in an instrument which gives improved performance and ac-

curacy with a variation in calibration of less than 1% for 20% line voltage change. The first stage of the carrier amplifier has an unusually high gain of over 1000 and is directly coupled to the second stage. Internal hum pickup and tube noise are reduced by heavy feedback of more than 1000:1. All tubes are under-heated, thus minimizing burnouts. Sensitivity is 1 mv full scale with 6 megohms input impedance and ranges up to 100 v. dc at 60 megohms. It may also be used as a micro-micro ammeter with a separate shunt box—**Millivac Instruments, P. O. Box 3027, New Haven, Conn.**—TELE TECH

to control high frequencies

USE LOW-CAPACITANCE RELAYS...



For smooth, chatter-free control of microwave circuits... switch them with Automatic Electric relays. Automatic Electric made its first low-capacitance relay more than ten years ago, and today offers two types, each providing exceptionally low capacitance between contact springs, and between springs and ground (frame, mounting, etc.)

In addition to these low-capacitance characteristics, Automatic Electric relays provide the dependability of "twin" contacts and the small size you need for compact mounting. The Class "C" relay (background above) is especially suitable for strip mounting; it is only 0.687" wide and 2$\frac{1}{8}$" high and is 5$\frac{15}{32}$" in over-all length. The Class "S" relay (two views in foreground) is 1" wide, 1$\frac{3}{8}$" high and 1$\frac{19}{32}$" long, over-all. Operating mechanisms are basically standard Automatic Electric designs, thus assuring the high operating efficiency for which Automatic Electric controls are famous.

To receive complete information, simply let us know your specific needs. Address AUTOMATIC ELECTRIC SALES CORPORATION, Chicago 7, Ill. In Canada: Automatic Electric (Canada) Ltd., Toronto. *Offices in Principal Cities.*

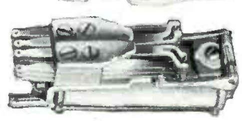
RELAYS **SWITCHES**

AUTOMATIC ELECTRIC

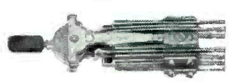
CHICAGO

OTHER AUTOMATIC ELECTRIC TELEPHONE-TYPE CONTROLS


Stepping Switches


Relays


Turn Keys


Lever Keys

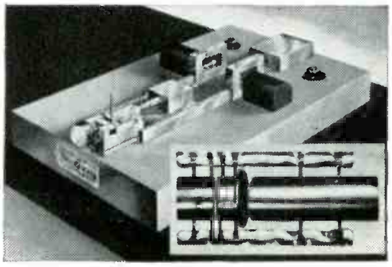
Efficient, dependable Automatic Electric controls are available also for many other uses. Lever, turn and push-type keys; telephone-type dials; stepping switches; lamp jacks and caps—as well as a complete range of telephone-type relays carrying the Automatic Electric name—are now in service in hundreds of industrial applications.

Audio Amplifier

Two new adaptations of the Sun Radio all-triode audio amplifier, designed by Consumers' Research of Washington, N. J., are now available. The new models incorporate Peerless transformers and are designated CR-10-P and CR-10-Q. Prices are slightly higher than the original CR-10. The CR-10-P includes a Peerless output transformer of special design for this amplifier. Increased quality of low tones increases the "presence effect." The CR-10-Q incorporates the Peerless S-240-Q output transformer which has a frequency response of ±1 db from 20 to 20,000 cps. There is less than 2% harmonic distortion at low output. Full power is delivered within 1 db from 40 cps to 10 KC. Output impedance is available for any load from 2 to 16 ohms. —**Sun Radio & Electronics Co., 122 Duane St., New York, N. Y.**—TELE-TECH

TV Glass Gun Fusing Machine

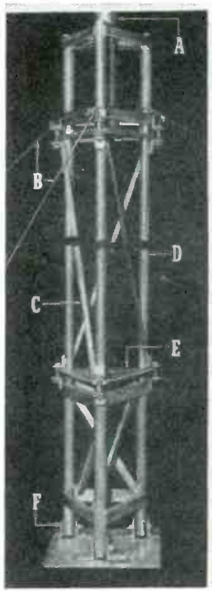
A complete unit for low-cost semi-automatic glass gun fusing has been developed which will turn out 150 to 200 guns per hour



and is adjustable to rods of various lengths. The only manual operation required is insertion of the gun parts and removal of the assembled gun from the spring collect. The unit is installed easily and requires only gas, oxygen and electrical connections to prepare it for production. Application of preheated glass rods is operated by remote control; positioning of glass rods for heating is a manual or hopper fed operation.—**Tri-Kris Co., Inc., Lansdale, Pa.**—TELE-TECH

Sectional Towers

The VEE-D-X tower is available in 10 and 20-ft. sections which are completely assembled and are diagonally laced with angle

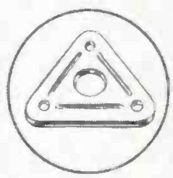


A. Standard Mount accommodates 2", 2¼" or 2½" O.D. tubing or pipe. Special mounts on request.

B. Guy Cables.

C. Diagonally laced with angle iron for maximum rigidity — no twisting.

D. Tower Sections 10' or 20' lengths. All welded construction.



E. Patented Plate spaced every 2' for rigidity.

F. Tower Base. Hinged feature allows tower to be raised or lowered mounted on ground or on flat or pitched roof.

iron for maximum rigidity. Simplified coupling methods make installation easier and faster. Patented triangular plates, spaced at 2-ft. intervals, prevent twisting and afford rigidity. The tower is self-supported up to a 20-ft. height and can be erected on the ground or on a flat or pitched roof. Packed tower assemblies are available from 10 to 100 ft., complete with all guy wires and fittings. For heights above 100 ft., additional sections may be ordered separately.—**LaPointe-Plascomold Corp., 37 Mill St., Unionville, Conn.**—TELE-TECH

Another successful start with DUMONT

WHBF-TV

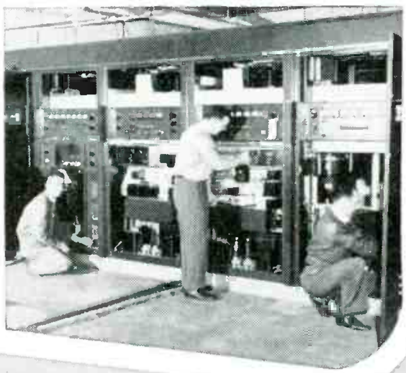
ROCK ISLAND, ILLINOIS

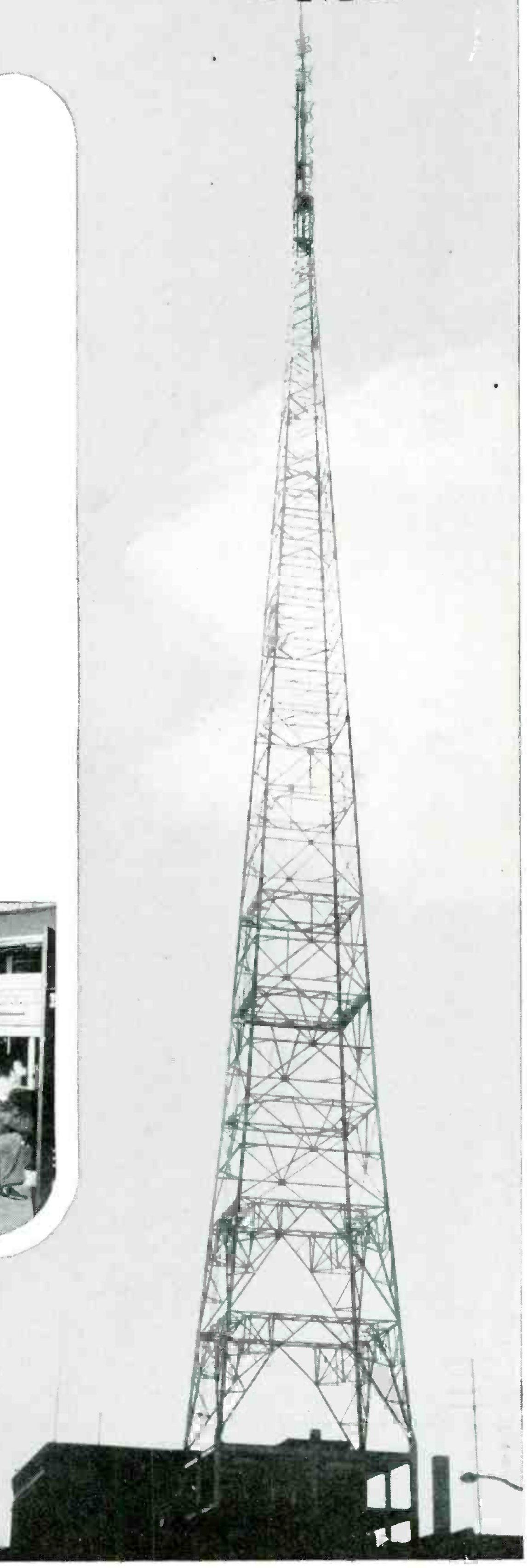
Channel 4

Another Television station with an eye to the future! WHBF-TV now goes on the air with Du Mont equipment assuring dependable, economical operation with all the advantages of the Du Mont "Grow As You Earn" system of equipment expansion. Air-cooled tubes, finest TV transmitter engineering and quality workmanship stand for low-operating expense characteristic of Du Mont TV transmitting equipment.

WHBF-TV operates on Channel 4 in Rock Island, Ill., covering the Quad Cities Area. We take this opportunity to congratulate WHBF-TV and welcome it to the ranks of the ever-increasing commercial TV stations of America.

> Remember, it's smart business to investigate Du Mont first — and then compare.





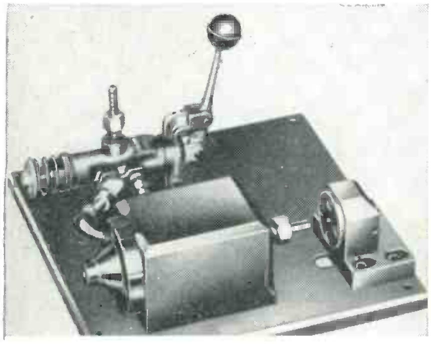
DUMONT

First with the Finest in Television

ALLEN B. DU MONT LABORATORIES, INC., TELEVISION TRANSMITTER DIVISION, CLIFTON, N. J.

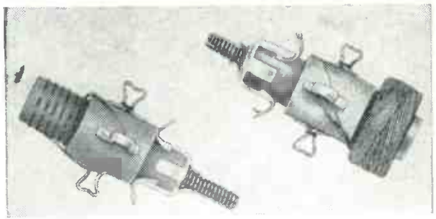
Wire Stripper for Coaxial Cable

When it is necessary to cut back the metal braid on coaxial cable to some point between the end and the point where the outer covering is removed, a new stripping machine can perform this operation at 600 cuts per hour. It leaves a square cut and a clean shoulder absolutely free from frayed ends and does not damage the inner polyvinyl tube. Most wire strippers which use knives or brushes cannot perform this operation and meet inspection requirements.—**Wire Stripper Co., 1722 Eastham Ave., E. Cleveland, Ohio**—TELE-TECH



Variable Inductances

Available singly or in complete sets, 14 variable inductance coils have been developed to cover the 0.25 microhenry to 10 millihenry range. The wire with which each coil is wound has been selected to represent "average" values of Q when used with capacities and frequencies normally associated with each range of inductance. Each coil is provided with a tap so that it may be used in Hartley or Electron Coupled oscillators. In the construction of wave filters, the adjustable inductance feature permits experimental determination of filter performance or the construction of a filter for a specific purpose without the time consuming labor of carefully selecting the capacitive elements on winding the coils to exact values.—**C. S. Linell Engineering Corp., Oak Park, Ill.**—TELE-TECH



Miniature Tubes

Two new miniature tubes (6S4 and 6AH6) have been developed for use in television and radio receivers. The 6S4 is a high perveance medium-mu triode, applicable as a vertical deflection amplifier in TV receivers which incorporate picture tubes having a deflection angle up to 70° and operating at anode voltages up to 14,000 v. Ratings include a dc plate voltage of 500 v.; a peak positive surge plate voltage of 2000 v.; and a plate dissipation of 7.5 watts. The 6AH6 is a sharp-cutoff amplifier pentode. Its high transconductance and low input and output capacitances adapt it to use as a wide-band amplifier and as a reactance tube for television and radio receivers. Under typical operating conditions it has a transconductance of 9000 micromhos and a plate current of 10 ma.—**General Electric Co., Syracuse, N. Y.**—TELE-TECH

Clipper-Filter

The SA-403-A is a device for clipping and filtering speech before modulation in a radiotelephone transmitter and which plugs into the octal socket normally filled by a tube in the speech amplifier circuit. No outboard wiring is required. The unit's highly-effective circuits use four triodes (two 6J6's). A control sets the peak level of amplitude modulation or frequency deviation as the case may be. A much higher average level of modulation is attainable with the SA-403-A. A narrow channel width is provided as unnecessary high and low audio frequencies are eliminated and all modulating power is concentrated to produce the most useful sideband frequencies. Intelligibility is further augmented by creating a more favorable consonant-to-vowel ratio.—**Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.**—TELE-TECH

Yes, TELEQUIP DOES THINGS RIGHT ... *always!*

CANADIAN GENERAL ELECTRIC COMPANY
LIMITED
HEAD OFFICE TORONTO, ONT

Royce Works,
830 Lansdowne Ave.,
Toronto, March 24, 1949.

Telequip Radio Company,
1901 South Washtenaw Ave.,
Chicago 8, Illinois,
U.S.A.

Gentlemen:

This will acknowledge receipt of equipment ordered from you recently your TSG-100A Television Synchronizing Generator and Monitoring Oscilloscope and TMG-100A Monoscope Picture Generator and Distribution Panel. We are pleased to inform you that the equipment is set up and operating satisfactorily.

It is amazing to us that such a complicated piece of equipment would withstand shipping and custome handling and still arrive here in good operating condition. We feel that your organization should be commended on the excellent job that was done.

Yours very truly,

G. Irwin

GJIrwin:HC

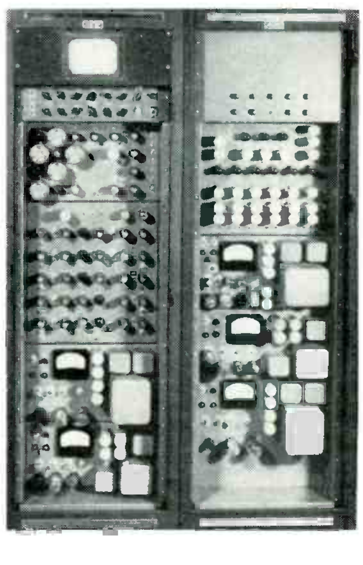
Assistant Manager,
Radio Receiver Division.

R3tory

Note this tribute to TELEQUIP from one of our foremost industrial organizations. You'll hear kind words from other users, too—your assurance of utmost satisfaction when you order

TELEQUIP SYNC GENERATOR AND MONOSCOPE with MONOSCOPE PICTURE GENERATORS and DISTRIBUTION PANEL

Telequip units produce regular pictures for TV test transmission and reception. Telequip gives synchronizing, driving and blanking signals for testing, research and development work, with monoscope controls and distribution signals for use at various points of testing.

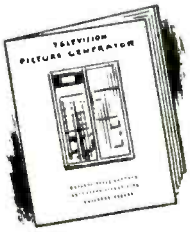


Invaluable to manufacturers of TV receivers and broadcasting units for checking faults not likely to be observed by other methods. Can be used at transmitting stations as auxiliary unit. Available either in combination or as separate units.

Picture tube manufacturers are finding this unit a valuable aid in speeding up production testing.

Now used by leading manufacturers and government agencies

ADMIRAL • MOTOROLA • CIVIL AERONAUTICS ADMINISTRATION STEWART-WARNER • ZENITH • NATIONAL VIDEO • GENERAL ELECTRIC • HAZELTINE • HALLICRAFTERS • SEARS ROEBUCK LABORATORIES • TRAVELER • BENDIX • MONTGOMERY WARD LABORATORIES • WELLS-GARDNER • TRANSVUE • FISHER RADIO SONORA • AIR KING • PACIFIC CABINET CO. • KINGSTON PRODUCTS



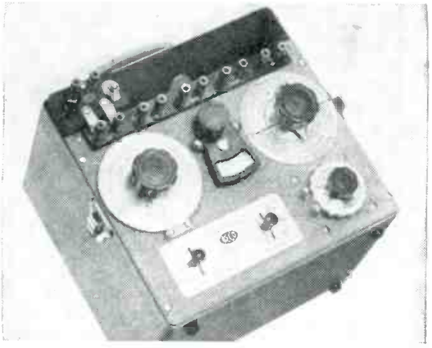
Send for this illustrated monograph completely describing the new Telequip Sync Generator and Monoscope.

TELEQUIP RADIO COMPANY

2559 West 21st Street
Chicago 8, Illinois

Universal Impedance Bridge

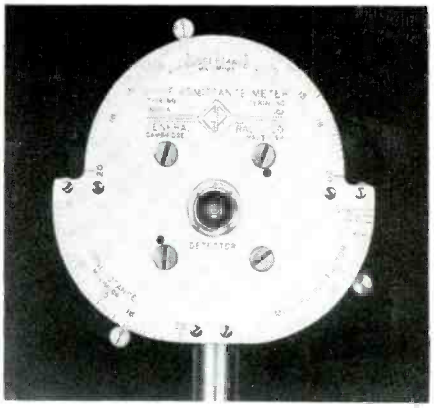
High accuracy is insured in the model 250-B universal impedance bridge by the use of wire wound resistors adjusted to a precision of ±0.05% in the bridge arms. A directly-calibrated slidewire consisting of a



0.05% precision decade with a coaxially-mounted single-turn rheostat for interpolating within the decade steps is used as the main LRC dial. Ranges are: resistance, 1 milliohm to 11 megohms; capacitance, 1 μμf to 1100 μf; inductance, 1 μh to 1100 henrys; storage factor of inductors (Q), 0.02 to 1000; dissipation factor of capacitors (D), .001 to 1.0. Included in the 8¾ x 10½ x 10½ in. aluminum cabinet are the precision reference standards, 1 KC tone generator, zero center suspension galvonometer, zero center suspension galvonometer with a deflection sensitivity of ½ μa/mm and four flashlight cells to power the bridge.—**Brown Electro-Measurement Corp., Dept. TT-1, 4635 S. E. Hawthorne Blvd., Portland 15, Ore.**—TELE-TECH

UHF Admittance Meter

Model 1602 UHF admittance meter is a null-type instrument, based on coaxial line technics, for making impedance measurements at ultra-high frequencies. It balances in the same manner as a low-frequency bridge and indicates susceptance and conductance on direct-reading scales, the calibrations of which are independent of frequency, and the null settings of both components are completely



independent. The admittance meter will measure conductances, and susceptances of either sign, from 1 millimho to 400 millimhos (1000 ohms to 2.5 ohms) over a frequency range from 70 to 1000 MC, thus covering the present and the proposed new UHF TV channels. Accuracy is ±5%. The admittance components can be easily converted to impedance, if desired, by using a Smith chart or Smith-chart slide rule. The 1602 can also be used as a comparator to indicate equality of one admittance to another, or degree of departure of one from the other.—**General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH

Television Booster

A high-gain, self-tuning television booster, known as the Tun-O-Matic, has been developed with all-channel broad band circuit

and four-stage amplification. Automatically tuned for all channels, 2 through 13, it supplies extra signal strength instantly and uniformly throughout any channel selected. Regulation of gain is made by tuning the receiver contrast control. There is no need to retune after the booster warmup period. Signal drift is eliminated.—**Electro-Voice, Inc., Buchanan, Mich.**—TELE-TECH

Deflection Yoke

A new core material and improved design on coil form has produced a 70° deflection yoke which the manufacturer claims to be

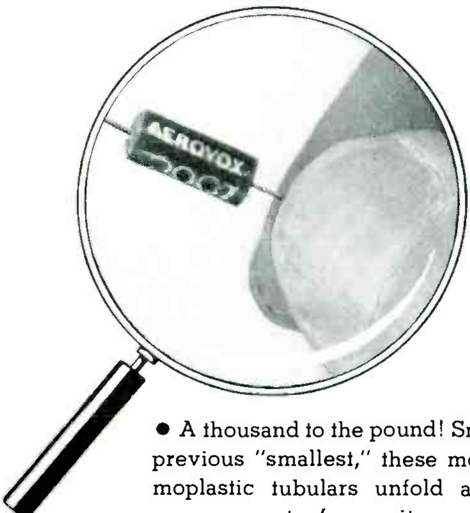
highly efficient in horizontal and vertical deflection. It can be supplied in several inductance values with or without customers' wiring network. Production tolerances on inductance, resistance, neck shadow, pincushioning, barreling and trapezoid are being held to close limits by means of improved tooling in the coil forming and assembly operations.—**Tel Rad Manufacturing Co., 1915 North Clybourn Ave., Chicago 14, Ill.**—TELE-TECH

Miniaturization Specialist Capacitors—

1000 to the Pound!

AEROVOX MICRO-MINIATURES

(TYPE P83Z AEROLITE* CAPACITORS)



● A thousand to the pound! Smaller than previous "smallest," these molded thermoplastic tubulars unfold an entirely new concept of capacitor construction. The smaller physical sizes are directly attributed to the latest metallized-paper technique which combines both dielectric and electrodes in a single winding strip. Unusually strong lead connections to capacitor section. Since capacitance is predetermined mechanically in the initial processing, it is no longer necessary to rely on the human element for capacitance control.

Type P83Z Micro-miniatures are particularly applicable to that portion of the electronic field where low capacitance paper capacitors and high-capacity disk capacitors are now being used.

*Trade-mark

Featuring . . .

Two sizes: 3/16" d. x 7/16" l.; 1/4" d. x 9/16" l.

200, 400 and 600 rated voltage; 300, 600 and 900 test voltage.

Hyvol K impregnated in humidity-resistant molded thermoplastic case.

Operating temperature from −15° C. to +85° C. without derating.

Power factor less than 1% when measured at or referred to frequency of 1000 cps and ambient temperature of 25° C.

Life test: 1000 hours at 1.25 times rated voltage in ambient temperature at 85° C.

Insulation resistance of 25,000 megohms or greater, measured at or referred to temperature of 25° C. Insulation resistance at 85° C., 500 megohms or greater.

● *Try Aerovox Micro-miniatures in your miniaturized assemblies. Write Dept. MM-83 for engineering data, samples, quotations and application-engineering aid.*

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

AEROVOX CORPORATION, NEW BEDFORD, MASS., U. S. A.

Sales Offices in All Principal Cities • Export: 41 E. 42nd St., New York 17, N. Y.

Cable: AEROCAP, N. Y. • In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

Plastic Insulation

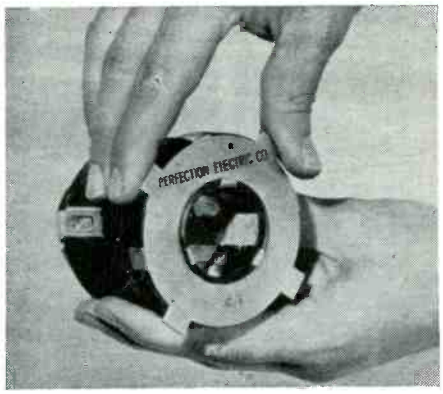
A high-quality plastic electrical insulation which will not support combustion is now available in commercial quantities and is being offered to the wire and cable and electrical industries as "Rulan" flame-retardant plastic. Flammability has been a characteristic disadvantage of plastics with good electrical properties but tests with "Rulan" have shown that it will not burn after the flame has been removed. Its electrical properties are comparable to, although not the equivalent of, those of polythene which is one of the best insulating materials known. "Rulan" has a power factor, over a wide range of frequencies, of 0.002, as compared with 0.0002 for polythene. It is non-tracking and retains its electrical properties after immersion in water for long periods at elevated temperatures—**E. I. Du Pont de Nemours & Co., Wilmington 98, Delaware**—TELE-TECH

Illuminated Control Panels

New control panels, made of pure plastic, are illuminated by small red-filtered lamps inserted in the clear plastic medium of the panel. The clear plastic is enclosed in a white coating with a coating of black bonded top of the white. Thus, a virtually solid, completely-closed block of clear plastic is produced which has high light distribution properties similar to those of quartz. The required letters or figures are processed into the black surface of the panel so that they appear dead white against the dense, non-reflecting black background. The light from the red-filtered lamps flows out through the panel surface where the white translucent undercoating is exposed, causing the letters to show clearly in the darkness.—**Universal Aviation Corp., 230 Park Ave., New York 17, N. Y.**—TELE-TECH

TV Centering Control

A control has been developed which cuts the time required to center TV pictures to three seconds (as compared with the 10 to 30 minutes usually needed to do the job). Known as the "Beamajuster," this new device eliminates the old style mechanical and electrical controls that necessitated numerous brackets, springs and connections for assembly. It consists of a pair of rotating aluminum plates (one plate holds a permanent magnet) and is installed by snapping on the back cover of the television tube yoke. It will fit any standard yoke and is suitable for any size tube. The picture is centered by rotating the outer plate with the fingers. Fine adjustments are made by moving the outer plate up or down or to either side. Once set, the picture will not drift.—**Perfection Electric Co., 829 South State St., Chicago 5, Ill.**—TELE-TECH



Single Magnet Ion Trap

A new single-magnet ion trap has been designed to occupy only 0.5 in. on the television tube neck. It is available in field strengths from 25 to 60 gauss. Easy to install and adjust, this new unit will not slip, maintaining its position without screw adjustment. It has high coercive force and its rounded edges prevent scratching or damage to the tube.—**Heppner Manufacturing Co., Round Lake, Ill.** TELE-TECH

NEW RMA PARTS CHAIRMAN

A. D. Plamondon, Jr., president of the Indiana Steel Products Co. (left), congratulates his successor, R. G. Zender, vice president of the Lenz Electric Manufacturing Co., upon his election as chairman of the RTMA Parts Div.

GE Develops Color Television System

General Electric has announced a new system of transmitting TV in color. Although full details are not yet available it is believed to be based on an investigation made by Bell Laboratory scientists in 1934, when it was discovered that the distribution of energy in a television carrier did not make full use of the frequency range available. At that time it was shown that approximately 46 percent of the useful spectrum is used in standard TV transmissions with the energy bunching around harmonics of the line scanning frequency.

The new system transmits green information up to the normal band width of 4 MC, red to 2 MC, and blue up to 0.2 MC. Green is transmitted normally, while red and blue are on subcarriers which fall in the spaces between the bunched line frequency harmonics.

Robert B. Dome, consultant for the Receiver Division, who conceived the new system explained that when the information reaches the color television receiver, (a three-picture tube set) much of it is separated by conventional filter circuits. However, all three of the tubes are affected to some extent by the green, red and blue information. But instead of an expensive and complicated wave filter to exclude the undesired frequencies, the human eye itself will do the rest of the filtering.

"Physiological filtering" is the name given by Dome to the persistence of vision which allows the viewer to "see" only the green information on the face of the green tube, only the red information on the red tube, and only the blue information on the blue tube. When these colors are combined on the face of the single color picture, a "high fidelity" picture would result since these colors can be mixed to produce all remaining colors and hues, he said.

Dr. W. R. G. Baker, vice-president of General Electric, said that in addition to the important advantage of having the precision equipment located at the transmitter, permitting relatively low-cost receivers, the system would be free from color fringing.

Because the system is simultaneous in operation, all colors are transmitted at the same time, thus avoiding color fringing. In the sequential systems color fringing is possible due to different arrival times of the colors and the consequent possibility of movement of objects before all the constituent colors have arrived. The G-E system is said to be compatible with existing monochrome systems, therefore it will fit in with present TV standards.

Industry Mobilization Committee Formed in Chicago

An electronics industry mobilization committee to plan coordinate and advise government agencies in war conversion and production was named in Chicago recently by James M. Blacklidge, chairman of the Association of Electronic Parts and Equipment Manufacturers. The committee will work with manufacturers, distributors and government agencies to expedite production of war material and to consider problems of allocation and procurement, Blacklidge said.

Empire State Building Extension Begun for 5 New York City TV Antennas

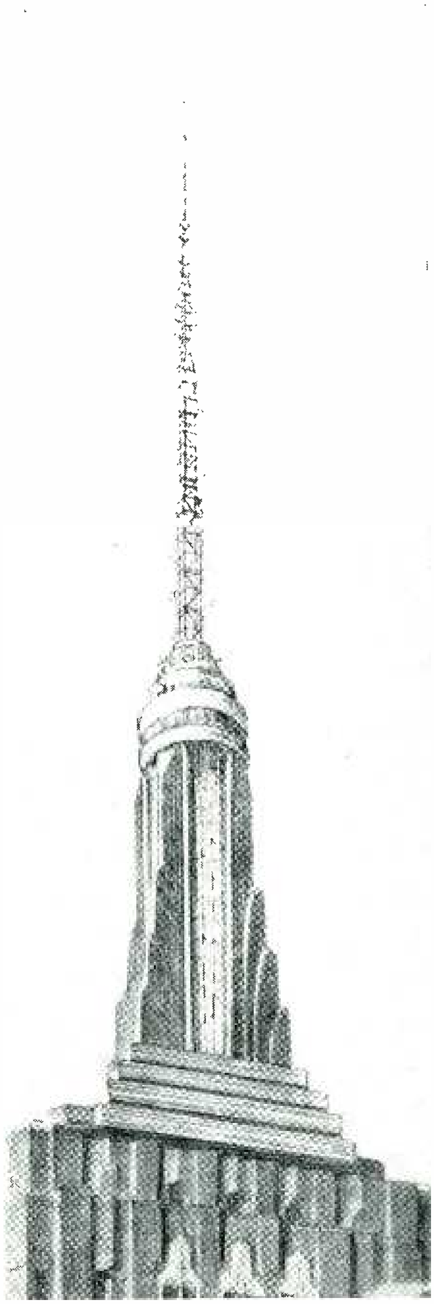
TELEVISION, following in the footsteps of the railroads, has initiated construction of the 200 foot superstructure on the Empire State Building with the driving of a golden rivet into the upper steelwork by Mayor O'Dwyer. Possibly *not* following the example of the railroad pioneers, the golden rivet could not be found after the ceremony — golden spikes are heavier for souvenir hunters to collect.

The architect's drawing of the tower as it will appear when completed in December of this year shows the multiplicity of antennas. Latest information is that WCBS-TV, WABD, WJZ-TV and WPIX will use the new RCA super gain antennas and WNBT-TV will use a special design of super turnstile.

Below these antennas, and visible in the sketch, are emergency dipoles proposed for use by any of the station tenants in the event of trouble with their main antennas. These are replacing the existing antennas installed by NBC during the time that it was sole occupant of the tower.

The prototype antenna is now under test at RCA Camden. Technical information concerning the installation is not yet available but some of the problems to be overcome are obvious. When the erection is completed there will be five TV and three FM stations. Each TV station has two carriers, so there will be a total of 13 carriers all on the air at the same time, plus any microwave transmissions which might be required for remote pick-up work. The carriers range from 54 MC to 204 MC. The possibilities of beat interference and internal as well as external modulation are almost infinite. Fortunately third harmonics are not generally very strong although channel 2 and 4 harmonics of this order could fall on channels 7 and 11.

One of the interesting features of this modification to the Empire State Building is that there do not appear to have been any squawks from the CAA on the score of height. This is presumably due to the fact that New York City is classified as a hazard already. However, one might expect that the addition of 200 feet to the highest point in the vicinity would produce *some* criticism. It goes to show that if sufficient backing is put behind a proposal it is possible to overcome red tape.



Artist's conception of completed tower

Tri-Color CR Tube

Dr. C. S. Szegho, author of the article entitled "Experimental Tri-Color Cathode Ray Tube" appearing in the July issue of TELE-TECH, calls attention to two mathematical misprints appearing on lines 45 and 49, column 4, page 35. The expression $O_1Q_3Q_1$ should read $O_1Q_3Q_2$ and the expression O_1P_2/Q_1Q_2 should read O_1P_2/O_1Q_2.

R. R. Batcher Named Chief Engineer RTMA

Ralph R. Batcher, who since 1943 has been consulting editor of Caldwell-Clements engineering magazines, has succeeded L. C. F. Horle as chief engineer of the Engineering Department of the Radio-Television Manufacturers Association and manager of the RTMA Data Bureau, in New York.

"Larry" Horle retired on July 31 after fifteen years service in the RTMA Engineering Department during which time he had an important role in the formulation or revision of numerous RTMA standards and other engineering activities. He was at one time president of IRE.

Mr. Batcher has had varied experience as a radio engineer, teacher and editor. During World War I he was a radio inspector for the U. S. Department of Commerce in New York and subsequently an instructor in radio theory at the Signal Corps Training School at the College of the City of New York.

From 1920 to 1943 Mr. Batcher was associated consecutively with the Western Electric Co. (now Bell) Laboratories, A. H. Grebe & Co., Stations WAHG, WBOQ, and WABC; and the Decatur Manufacturing Co. From 1931 to 1935 he was an electron-tube consultant and from 1935 to 1943 chief engineer of the Allen D. Cardwell Manufacturing Corp., where as chief engineer he developed military equipment and special types of variable capacitors.

Mr. Batcher joined Caldwell-Clements in 1943 as consulting editor of *Electronic Industries*, and for the last four years has been consulting editor of TELE-TECH.

He has been a member of the board of editors of the Institute of Radio Engineers Proceedings for 20 years. He is corresponding secretary of the Radio Club of America and a past president of the New York Section of the Instrument Society of America and a director of the Instrument Society of America.

Radio in Air and Marine Navigation

A joint meeting will be held in New York City September 19-21, on the common radio aspects of air, marine and land navigation. This meeting, at the Hotel Astor is jointly sponsored by the Institute of Navigation, the Radio Technical Commission for Aeronautics and the Radio Technical Commission for Marine Services.

PERSONNEL

Roger M. Daugherty has been elected Executive Vice President of J. H. Bunnell & Company, manufacturers of railroad and radio communication equipment. He was formerly manager of government sales and engineering and chief engineer of Sylvania Electric Products, Buffalo, N. Y.

Gegore D. Hulst, formerly in the General Patent Dept. of the research division of Allen B. Du Mont Laboratories, Inc., has been promoted to the post of manager of the special projects Laboratory of the Electronic Parts Division.

Walter F. Kram has joined the engineering staff of the Ballantine Laboratories, Inc. at Boonton, New Jersey as a senior engineer. He had specialized in instrument development work for the Standard Telephone & Cable Company of London and recently was engaged in C.A.A. Omnidirectional Range development work at Lavoie Laboratories.

Robert M. Beusman, who for the past fifteen years has been Western Division Manager for the Radio Condenser Company with headquarters in Chicago has resigned from this position, to join the management staff of Radio Industries, Inc., 5225 Ravenswood Ave.

Clyde E. Hallmark, formerly senior project engineer on TV with the Farnsworth Radio Corp., and television engineer with Emerson, has been appointed engineer-in-charge of advanced development of Magnavox, Inc., Fort Wayne, Ind.

Dr. Albert W. Hull, of the General Electric Research Laboratory, who has been credited with the invention of more types of electron tubes than any other man, has retired from his post as assistant director of the laboratory. He will be retained as consultant.

Gabriel V. Bureau has been named field engineer for the equipment sales department of the Radio Tube Division, Sylvania Electric Products, Inc., Emporium, Pa.

Kenneth C. Meinken, Jr., has been appointed to the post of Midwestern sales manager of tube sales to initial equipment manufacturers, of National Union Radio Corp., Orange, N. J.

Kings Microwave Organized

The Kings Electronics Co., Inc. of 811 Lexington Ave., Brooklyn 21, N. Y. has announced the formation and opening of its affiliate the Kings Microwave Co., Inc. at the same address, which will specialize in the production of microwave equipment. R. Harry Douglas, formerly of Bernard Rice's Sons Co. and the Signal Corps Electronics Laboratory has been named Electrical Engineer with Jules G. Simmonds formerly of Bernard Rice's Sons Co. and MIT Radiation Laboratories appointed Sales Manager. Catalogue listing equipment to be manufactured will be published shortly.

New Wide Range R-C Oscillator

A NEW R-C oscillator, developed by Peter G. Sulzer at the National Bureau of Standards, covers a frequency range from 20 cps to 2 MC in five steps. Combining simplicity and compactness with excellent frequency stability over this wide tuning range, it has several advantages over previous designs. In older models the top frequency is about 200 KC; in the new R-C oscillator, a single amplifier driving

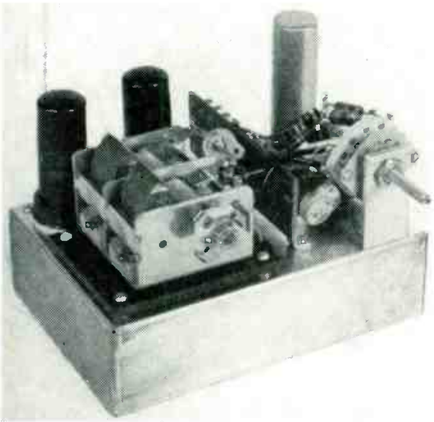
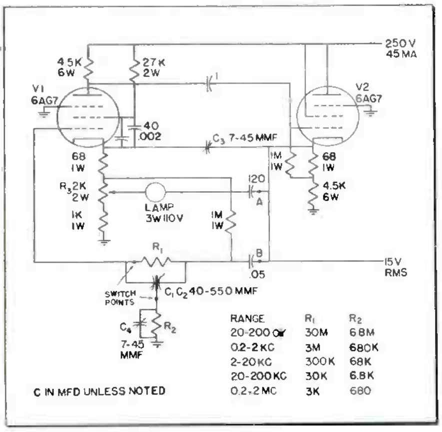


Fig. 1: New wide-range R-C oscillator



RANGE	R_1	R_2
20-200 ~	30M	6.8M
0.2-2 KC	3M	680K
2-20 KC	300K	68K
20-200 KC	30K	6.8K
0.2-2 MC	3K	680

Fig. 2: Detailed diagram of oscillator

a cathode follower provides wide-band operation with small phase shift, low output impedance, and constant output voltage.

The oscillator circuit has two feedback paths: a regenerative cathode-to-cathode loop, and a degenerative cathode-to-grid loop which includes a bridged-T network. Oscillation occurs at the frequency of minimum degeneration. The 15-volt output remains constant to within 1 db. at all frequencies, and the output waveform is essentially undistorted.

BOOKS

Microwave Electronics

By John C. Slater. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. A volume in the Bell Laboratories Series. 406 pages, published 1950. Price $6.00

This book presents a unified account of the principles of wartime and postwar research conducted at the Bell Telephone Laboratories and at the Radiation Laboratory of the Massachusetts Institute of Technology. In addition to overall coverage of the field of microwave electronics, fundamental theory is applied to the klystron, the linear accelerator, the cyclotron, the synchrotron, the traveling wave amplifier and the magnetron. While fundamental in approach, the subject matter is presented at a more mathematically complete level than has heretofore been available. An extensive bibliography at the end of the volume is well supplemented by more detailed references throughout the text. The book should prove an excellent reference work for theoretical physicists and engineers interested in radar or microwaves generally.

Television Components Handbook

By A. C. Matthews. Published by Technical Advertising Associates. Available through Accessory Division, Philco Corp., Tioga & "C" Streets, Phila., 34, Pa. 160 Pages. Price $2.50

Designed to bridge the gap between the formal text-book and the general engineering handbook, this volume fulfills a need as a practical reference source for engineers and technicians. The chapter dealing with the general design of TV receivers is extremely interesting because of the considerations given to the mechanical and material aspects of construction. The use of shock mounting, types of metal finishes employed, and Underwriters requirements are among the other topics discussed here. The numerous charts, diagrams, tables and curves displayed throughout the volume provide the means of quickly locating and understanding desired information. Additional subjects treated include: Antenna Systems and Transmission Lines, Transformers, Inductors and Reactors, Capacitors, Resistors, Switches, Insulating Materials and Vacuum Tubes. The text is non-mathematical in its treatment but some familiarity with television circuits, components, systems, and construction methods is assumed.

BOOKS RECEIVED

Servicing TV Receivers

Published 1950 by Sylvania Electric Products Inc., 500 Fifth Ave., New York 18, N. Y. A series of test pattern pictures illustrating commonly encountered faults in TV receivers with the text indicating characteristics, cause, and remedy. 119 pages. Price $2.00

Public Address Guide

By Guy A. Cornish, Gernsback Library No. 41. Published June 1950 by Radcraft Publications, Inc., 25 West Broadway, New York 7, N. Y. A practical manual dealing with the planning, construction, installation and maintenance of public address equipment. 80 pages. Price $0.75

UHF at Bridgeport

(*Continued from page* 41)

connecting the two "Vs" in parallel an impedance of 300 ohms is obtained. If the rods are cut 52" in length good VHF reception is also obtained. A gain of about 12 db may be expected from such an antenna.

Models were shown of experimental helical, parabolic and rhombic antennas. Space does not permit their description.

Monthly figures are: Station power bill $270; tube costs $600; 340 hours of operation. There is only one operator on watch at a time, the sound and picture carriers are synchronized so their spacing is always constant and average deviation of carrier frequency is 1000 cps. The cost of the entire installation, previously quoted at $170,000, is now given as $135,000. The maximum transmitter output now is 5 KW but in a few years an effective radiated power of 200 KW is expected. At 870 MC about 600 watts is obtained, but better tubes will increase the output at the higher frequencies.

Reception in the Field

We were taken by bus to a country club several miles from the transmitter and shown a picture from New York City on Channel 4, then shown the picture transmitted via the UHF Bridgeport station, KC2XAK. The quality on UHF was satisfactory. The mechanical tuning in the UHF tuner, in the writer's opinion, was too sharp; only an engineer could adjust it properly. There is little doubt as far as the receiver is concerned that the performance and picture quality from UHF TV transmission, for line-of-sight operation, equal that obtained on present VHF.

Most of the guests, even those who made independent field surveys in Bridgeport, felt the trip was informative and well worthwhile. Many said, both publicly at the luncheon meeting and privately, that the industry should be cautious in going into this new band. For instance, we should have definite answers to such questions as: (a) What about reception at a distance? (b) Is 225 mile separation of transmitters on the same channel sufficient? (c) Bridgeport is easy to cover. How about Pittsburgh? (Recently surveyed by Westinghouse). (d) When are we going to be able to buy real high-power transmitters? (e) What are the new, unknown problems that face the service man and the installer?

Tetrode Power Oscillator

(*Continued from page 29*)

transverse diaphragm "D" by a suitable insulating medium such as Teflon or mica sheet.

Because the correct capacitance depends to some extent on the exact dimensions of the oscillator, Fig. 4 is intended solely as a guide, and it is usually desirable to vary "C" slightly in order to obtain maximum efficiency from the oscillator. This does not imply that "C" is critical, however; good results can be obtained with variations of some ±30% about the optimum value, and, conversely, the oscillator may be tuned over a comparable frequency range without any adjustment to "C".

Next, the open line on the control-grid should be tuned for approximate resonance, which will occur when the line is electrically an integral number of half wavelengths long. Because of the internal inductance and capacitance of the tube itself, the external line will be only about one inch long at 1200 MC.

The plunger "P" should then be adjusted until oscillation is obtained, and, finally, all the adjustments including the load coupling and screen-grid voltage should be optimized for best operation at the correct frequency.

The variation of output, efficiency, and anode current in a correctly adjusted oscillator when only the plunger "P" is moved can be seen in Fig. 5.

In general, the control-grid open line is not so critical in adjustment as the plunger "P", and it may be left fixed over a small frequency band without affecting the efficiency.

Performance

Fig. 6 shows the CW performance of the oscillator between 500 and 1000 MC, assuming the plate dissipation of the tube is held constant at 150 watts, which is conservative. The pulse performance is also shown; the power output is the peak power during the pulse, which is assumed to be not greater than 5 microseconds in length. The maximum duty-cycle, or on-off time ratio, using the 4X150G is assumed to be such that the average power ouput is held below 100 watts up to 1250 MC, and less at higher frequencies.

The oscillator in the form shown in Fig. 1 is particularly suited to pulse modulation of the anode and screen-grid voltages, since the capacitances in shunt with the applied modulating voltages are small compared with the resistive impedances presented. Because of this, together with the flexibility of the feed-back system which allows optimum adjustment, the shape of the r-f pulses generated closely follows that of the modulating pulses. Moreover, because at UHF the 4X150G draws only a small screen-grid current, the screen-grid voltage may be obtained from the anode supply via a potential divider, with only a small power loss in the resistors. The resulting bad regulation of the screen-grid voltage gives the oscillator a very desirable property, namely that quite large variations in output loading and tuning can be tolerated without damage to the tube due to excessive screen-grid or control-grid current. This is of special interest in the case of a CW oscillator for industrial heating.

With the circuit described, oscillators can be designed around coaxial UHF tetrodes in such a way that the upper frequency limit is set solely by electron transit time in the tube, which is a matter of internal geometry. The circuit is particularly suited to pulse modulation, is only slightly more difficult to adjust than a comparable triode design, and is suitable for use with a variable impedance load. Satisfactory operation has been demonstrated up to 1500 MC with an Eimac 4X150G tetrode (pulsed) but there is no upper frequency limit inherent in the circuit itself.

Test Equipment

(*Continued from page* 35)

The third method, used in the sweep generator shown in Fig. 2, is often preferred, giving greatest precision with a minimum of time. A small auxiliary signal is applied to the input of the wide band i-f amplifier from a crystal controlled oscillator having a frequency equal to either the receiver's sound or video i-f channel's frequency. Usually the former is used. This signal produces a pip on the oscillograph trace which is superimposed on the sound carrier marker signal (inherently produced in the signal generator) when the local oscillator is precisely adjusted.

What happens is as follows: assume Channel 2 is under test in a receiver having a sound i-f of 21.9 MC. The signal generator produces and applies a swept frequency in

Test Equipment

(*Continued from preceding page*)

this case, extending from around 51 to 64 MC, except for two narrow crevices in the output at 55.25 MC and 59.75 MC at which points the signal is reduced to zero by the marker circuit. A certain portion of the center of this range will be passed by the r-f amplifier under test, depending on its own selectivity and gain characteristics. The local oscillator, if correctly adjusted would produce a signal of (21.9 + 59.75) or 81.65 MC.

Now by injecting a signal of 21.9 MC into the system it will produce a beat note with the local oscillator frequency which should equal exactly 59.75 MC if it is correctly adjusted. Since 59.75 MC is one of the known marker points on the pattern their coincidence gives a clear indication of a correct setting. The same procedure, utilizing the same 21.9 MC crystal, is used on all channels.

After the r-f tuning head the next item in the receiver for testing is the i-f channel. There are several systems of i-f amplification in use in present day television receivers. When an intercarrier sound system is used, only a single channel needs checking, but the system requires a somewhat different setup, to take care of the position of the sound carrier. A somewhat different arrangement can be used if a ratio detector is employed instead of the limiter-discriminator system and the needs are still further modified if best adjustments to stagger tuned stages are to be made at this point.

The primary source of signal for these tests is also a signal generator such as the Tel-Instrument Type 1500A I.F. Wobbulator that produces two independent swept frequencies in the i-f range (basic values 4 to 50 MC), each frequency being swept through a selected range by a 60 cps driven capacitor modulator. Several (up to 5) crystal markers give selected crevice type of calibration points in the useful range. As in the r-f signal generator these pulses result from the fact that the carrier signal is cut to zero whenever the signal sweeps across one of these crystal controlled pulse spikes. By using properly selected crystal marker frequencies all adjustments can be made on the i-f stages during this test. Often it is found that the stages have been preadjusted to the desired frequencies in order to save time on the production line. In such cases checking whether some abnormal circuit component gives higher or lower gain in a stage is all that is necessary since such gain variations would cause an uneven overall gain.

Preadjustments on individual i-f stages can be made with a multi-frequency generator consisting of a group of fixed frequency tone-modulated oscillators each with crystal control. Ten individual frequency outputs are obtainable from the Type 1900 Tel-Instrument generator illustrated.

West Coast IRE Meet and Manufacturer Exhibit

The 6th annual Pacific Electronics Exhibit is scheduled for Sept. 13-15 at the Municipal Auditorium in Long Beach, Cal. Along with it, same dates and place, the coast IRE convention will be staged.

A year ago the exhibit used 106 display booths, but this year the number is upped to 148. A year ago 72 manufacturers used 76 booths. In 1950 there will be 93 manufacturers using 105.

A partial list of exhibitors follows:

Advance Electric & Relay Co., Los Angeles 26, Calif.; Air-Craft Marine Products, Inc., Harrisburg, Pa.; Allied Electric Products, Inc., Irvington 11, N. J.; American Microphone Co., Pasadena 2, Calif.; Amperex Electronic Corp., Brooklyn, N. Y.; Altec-Lansing Corp., Hollywood, Calif.; Approved Electronic Instrument Corp., New York, N. Y.; Audio Devices, Inc., New York 22, N. Y.; Automatic Electric Sales Corp., Chicago, Ill.; Ballantine Laboratories, Inc., Boonton, N. J.; Bird Electronic Corp., Cleveland, Ohio; Boonton Radio Corp., Boonton, N. J.; Brown Electro-Measurement Corp., Portland 15, Ore.; The Brush Development Co., Cleveland 14, Ohio; Burlington Instrument Co., Burlingtan, Ia.; Cannon Electric Development Co., Los Angeles, Calif.; Cornell-Dubilier Electric Corp., South Plainfield, N. J.; The Robert Dollar Co., Heintz & Kaufman, South San Francisco, Calif.; Allen B. Du Mont Laboratories, Inc., Clifton, N. J.; Eitel-McCullough, Inc., San Bruno, Calif.; Electrical Reactance Corp., Franklinville, N. Y.; Electro-Engineering Works, Chicago 44, Ill.; Electronic Instrument Co., Brooklyn, N. Y.; Electro-Voice, Inc., Buchanan, Mich.; John Fluke Engineering Co., Springdale, Conn.

General Electric Co., Schenectady, N. Y.; General Radio Co., Cambridge, Mass.; Gertsch Products, Inc., Los Angeles 46, Calif.; Girard-Hopkins, Oakland, Calif.; Helipot Corp., South Pasadena, Calif.; Hewlett-Packard Co., Palo Alto, Calif.; Hoffman Radio Corp., Los Angeles 7, Calif.; Holl Radio Industries, Hollywood 28, Calif.; Hytron Radio & Electronics Corp., Salem, Mass.; Insuline Corp. of America, Long Island City, N. Y.; International Rectifier Corp., Los Angeles, Calif.; Kelley-Koett Manufacturing Co., Instrument Div., Covington, Ky.; Kames Knight Corp., Sandwich, Ill.; James B. Lansing Sound, Inc., Venice, Calif.; Leach Relay Co., Los Angeles 34, Calif.; Lenkurt Electric Co., San Carlos, Calif.; Magna Electronics Corp., Los Angeles 15, Calif.; Magnecord, Inc., Chicago, Ill.; Marion Electrical Instrument Co., Manchester, N. H.; Merit Coil & Transformer Corp., Chicago, Ill.; McIntosh Engineering Laboratory, Inc., Silver Spring, Md.; National Company, Inc., Malden, Mass.; National Union Radio Corp., Orange, N. J.; Newcomb Audio Products Co., Hollywood 38, Calif.; J. M. Ney Co., Hartford, Conn.; Ohmite Manufacturing Co., Chicago 44, Ill.; Oxford Electric Corp., Chicago, Ill.;

Radio Corporation of America, RCA Victor Div., Camden, N. J.; Radio Receptor Co., New York, N. Y.; Raytheon Manufacturing Co., Waltham 54, Mass.; Remler Co., Ltd., San Francisco, Calif.; Sangamo Electric Co., Springfield, Ill.; Walter L. Schott, Beverly Hills, Calif.; Simpson Electric Co., Chicago, Ill.; Shallcross Manufacturing Co., Collingdale, Pa.; Sorenson & Co., Inc., Stamford, Conn.; Sperry Gyroscope Co., Great Neck, N. Y.; Standard Coil Products Co., Huntington Park, Calif.; Suprenant Manufacturing Co., Boston, Mass.; Sylvania Electric Products, Inc., Emporium. Pa.; Tektronix, Inc., Portland 14, Ore.; Triad Transformer Manufacturing Corp., Los Angeles 24, Calif.; Tung-Sol Lamp Works, Inc., Newark 4, N. J.; Ungar Electric Tools, Inc., Los Angeles 54, Calif.; U. S. Recording Co., Washington 5, D. C.; Varian Associates, San Carlos, Calif.

CONSULTING ENGINEERS INSPECT UHF-TELEVISION FACILITIES AT BRIDGEPORT

Consulting engineers and attornies specializing in broadcasting problems who attended a recent inspection trip to station K2XAC, the UHF-TV operation of NBC-RCA at Bridgeport, Conn. Behind them are the transmitter building and tower base. (See story page 41)

Skiatron Color Patents

Skiatron Corp. has announced the grant of several new patent's among them, one for electronic color television. The patent claims that color is introduced by varying the freqency of the supersonic cell so that neither mechanical nor optical filters are required to introduce color into the picture. Also the color is inserted at the point of *creation* of the picture, instead of after the picture is formed. In effect, the method of operation can be compared with an uncorrected color lens in which colors focus at different points. However, in this case, instead of the focus changing, the colors change while maintaining the same point of focus.

Coming Events

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

September 18-20—Instrument Society of America, Conference and Exhibit, Memorial Auditorium, Buffalo, N. Y.

September 19-21—Joint meeting of Institute of Navigation, The Radio Technical Commission for Aeronautics and the Radio Technical Commission for Marine Services, Hotel Astor, New York City.

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.

BULLETINS

Receiving Tubes

The RCA Tube Department has just brought out a revised edition of the quick-reference booklet "RCA Receiving Tubes for AM, FM, and Television Broadcast".

This new, 24-page booklet covers more than 450 RCA receiving tubes and picture tubes including more than 50 new types. It provides quick and easy reference to the characteristics and socket connections for each tube type, as well as a classification chart which groups the tubes according to their family class, their functions, and their filament or heater voltages.

It can be obtained from RCA Tube Distributors, or by sending 10 cents to Commercial Engineering, RCA Tube Department, Harrison, N. J.

Transformers

The seventh edition of the Stancor Television Catalog and Replacement Guide, Form 338, is now available from Standard Transformer Corporation, 3580 Elston Avenue, Chicago 18, Illinois, or from any of their distributors. This twenty-six page booklet lists complete specifications and list prices of all Stancor transformers and related components.

Colorimetry

Scientists and technicians concerned with color measurement will find much helpful information in a new booklet, recently published by the National Bureau of Standards and now available from the U. S. Government Printing Office. Circular C478, Colorimetry, by Deane B. Judd, 56 large double-column pages, illustrated, 30 cents a copy, is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Shielded Rooms

A discussion of performance standards in the design of shielded rooms for electronic research and a series of principles to be followed to secure the best possible attenuation practical under current knowledge are contained in a new report available from the Office of Technical Services of the U. S. Department of Commerce. PB 100 752, **Notes on the Design, Construction and Evaluation of Shielded Rooms**, 20 pages including diagrams, sells for 50 cents per copy. Orders should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. accompanied by check or money order payable to the Treasurer of the United States.

R-F Components

Selectar Industries, Inc., 401 East 138th St., New York 54, N. Y. has issued a condensed listing of its line of r-f components. Transmission lines, waveguide assemblies, microwave test equipment, coaxial cable connectors, adapters, and cable and cord assemblies are included.

Precision Castings

"New Horizons With Microcastings" is the title of a new 16-page booklet which includes many applications of precision castings, specifications, and a step-by-step explanation of the Microcast Process itself. Published by the Microcast Division of Austenal Laboratories, Inc., 715 East 69th Place, Chicago 37, Ill., it contains a description of the development of the "lost wax" process and its adaption to modern industrial precision casting.

Courses in Film for Television

The basic course in films for television initiated by TELE-TECH's associate editor, John H. Battison, at New York University last Spring proved so popular that he is continuing it in the Fall semester. As direct result of the interest aroused he is also presenting an advanced course in which actual production of sound films is demonstrated using professional Auricon equipment. The courses commence on September 29.

Logarithmic Amplifier

(*Continued from page* 45)

following manner: With the calibration switch at the 0 db position (position #1) and 10 volts applied to the grid of the first 6SK7, adjust the AVC potentiometer until a 1 ma. movement is noted on the output meter. Change the calibration switch to its lowest position (80 db down) and adjust the balance control such that a 0.2 ma. movement is noted on the output meter. Repeat this procedure until these two positions are in full agreement. Some cross-control is evident; however, a little practice will soon establish the correct adjustments. Once the proper adjustments have been accomplished, the intermediate positions should be in good agreement.

The amplifier can be used over a frequency range of 300-10,000 cps and has an accuracy of ± 1 db from 0-100 db. Because of the large filters placed in the AVC circuit, the logarithmic characteristic will not be reproduced for fast changes in the input voltage level. In most applications this will not be found to be a disadvantage resulting in merely limiting the maximum rate of change that can be noted.

Referring to Fig. 3, it is seen that this unit is supplied with a voltage regulated supply consisting of a 5Y3 rectifier, 6Y6 series tube, 6SJ7 amplifier, and VR-105 control tube. The voltage of this supply can be regulated for values between 200-250 volts and will maintain a given voltage for a change in ac line voltage from 90-135 volts. Its internal resistance is approximately 25 ohms. The power consumption of the amplifier is 62 watts. Best logarithmic results were obtained with 225 volts dc applied to the amplifier; however, acceptable results are obtainable from a non-regulated supply whose output voltage is between 200-250 volts dc.

5 KW Output Stage

(*Continued from page* 38)

coupled to the main output circuit as shown in Fig. 11. The low impedance series resonance is made to occur at a frequency slightly below the 1.25 MC lower sideband frequency. This modifies the shape of the response curve below the carrier without any appreciable effect on the response in the desired pass band.

The reactance of this circuit at frequencies below the series resonance ω is such as to give a slight increase in response as shown. The amplitude of this response is easily controlled by the amount of coupling between the main circuit and the notching filter. The latter is composed of a simple non-dissipative transmission line section, located next to the main output circuit in Fig. 9.

Overall transmitter response is flat within one and one half db out to 4 MC while the lower sideband is attenuated more than 20 db below 1.25 MC. This results in an amplitude vs. frequency response which is well within the FCC and RMA minimum requirements (Fig. 12).

Tuning of the broadband circuits is facilitated by means of an r-f wobbulator and oscilloscope built into the visual transmitter. A power gain of between 5 and 6 is obtained with a plate efficiency of about 50% at 3.0 KW average output.

Artificial Reverberation Generator

Tech Laboratories, Inc., Palisades Park, N. J., announces that it has taken over the exclusive manufacture and sales of the Artificial Reverberation Generator developed by Audio Facilities Corp., of New York.

Noise Generators

Appendices and errata for Noise Generators and Measuring Technics" by I. J. Melman which appeared in the May, June and July issues is presented below.

APPENDIX I

Derivation[12] 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 Fi_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:

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

where Δf_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 Δf_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 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 Δf_2, and for this general condition Δf_2 can be considered equal to Δf_1, or:

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

In the usual procedure the noise

(*Continued on following page*)

ERRATA

i_a^2

1. May p. 29, Fig. 7: Pilot lamp should be inserted in the filament circuit of power supply.

2. May p. 61, References 6 and 7—Title of E. W. Herold paper should be: "The Signal to Noise Ratio of Radio Receivers." The author of "Spontaneous Fluctuations in Various Conductors" is W. Shottky.

3. June, p. 28, Table I—Text reads: "relative lengths are illustrated in Fig. 7". Correct figure is 14.

4. July, p. 37, 13th line first column—Fig. reference is 9; not 11.

5. July, p. 64—Following references were omitted at end of Part Three:

10. John A. Bauer, "Special Applications of Ultra-High Frequency Wide Band Sweep Generators," RCA RCA Review, Sept., 1947. Generators," RCA Review, Sept., 1947.
11. Equation 8 is derived in Appendix II.

The author makes grateful acknowledgment to Dr. Harwick Johnson of the RCA Laboratories, Princeton, N. J. for the benefit derived from numerous discussions with him on the subjects of circuit noise and measuring technics.

Noise Generators

(*Continued from preceding page*)

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

$F = 20IR_a$

[12] H. Johnson, "A Coaxial-Line Diode Noise Source for U-H-F", RCA REVIEW, Vol 8, p. 169, March 1947.

APPENDIX II

Effect of a transmission line placed between a generator and a load, Fig. A, either or both of which may be mismatched.

The current i_L through the load Z_L is:

$$i_L = \frac{2iZ_aZ_o}{(Z_o+Z_L)(Z_o+Z_a)e^{rl} + (Z_o-Z_L)(Z_a-Z_o)e^{-rl}} \quad (1)$$

where i is the constant current output of the generator; r is the propagation constant $=\alpha+jB$; l is the length of the transmission line.

When $Z_a=Z_o$ and αl is neglected for short lengths of transmission line then:

$$i_L = iZ_o/(Z_o+Z_L)\ e^{jBl} \quad (2)$$

For this case therefore no matter how bad the match at the receiver, the magnitude of the current through the load Z_L is independent of the transmission line length.

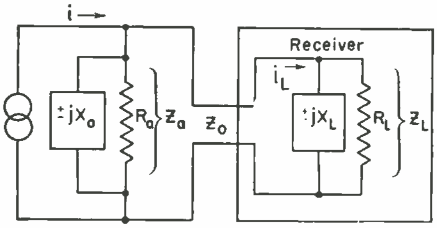


Fig. IIA

For a constant i_L at the receiver a mismatch at the generator will produce an error or difference in the required generator current i which equals:

$$m_v = (i/i') - 1 \quad (3)$$

where i' is the generator current when $Z_a=Z_o$; and i is the generator current when $Z_a \neq Z_o$

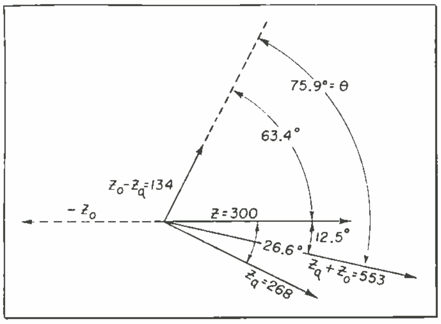


Fig. IIB

The error in the noise factor readings is a function of the power ratio and equals

$$m = m_p = \frac{(i)^2}{(i^1)} - 1$$

Form (1) and (2)

$$m = \left| \frac{(Z_o+Z_L)(Z_o+Z_a) + (Z_o-Z_L)(Z_a-Z_o)e^{-2jBl}}{2Z_a(Z_L-Z_o)} \right|^2 - 1 \quad (5)^{*}$$

* denominator should read: $2Z_a(Z_L + Z_o)$

When the receiver is badly mismatched, i.e. $Z_L >> Z_o$, then

$$m = \left| \frac{(Z_o+Z_a) + (Z_o-Z_a)e^{-2jBl}}{2Z_a} \right|^2 - 1 \quad (6)$$

When $Z_L << Z_o$, the variation of m with l is 180° out of phase with that shown in Eq. (6), but the maximum values are the same.

The error m is maximum positive when the line length is such as to rotate the vector (Z_o-Z_a) of (Eq. 6) in phase with the vector (Z_o+Z_a).

The shortest transmission line length for this condition is $Bl=\frac{1}{2}\theta$, where θ is the angle between the above two vectors for zero line length ($Bl=0°$).

A maximum negative m is obtained when the line length rotates the two vectors to an out of phase position, $Bl=\frac{1}{2}\theta+90°$.

A practical example will illustrate the effectiveness of this analysis. Let:

$R_a = 300$ ohms
$X_a = -j600$ ohms
$Z_o = 300$ ohms
$Z_L >> Z_o$

Then: $Z_a=240-j120=268\ \underline{/-26.6°}$

$Z_o+Z_a=300+240-j120=540-j120=553\ \underline{/-12.5°}$

$Z_o-Z_a=300-(240-j120)=60+j120=134\ \underline{/+63.4°}$

The angle between (Z_o+Z_a) and (Z_o-Z_a) is $12.5°+63.4=75.9°=\theta$

The above vector quantities are illustrated graphically in Fig. II B. Therefore when $Bl=\frac{1}{2}\theta=37.9°$, m is maximum positive. When $Bl=37.9°$, and the above values are substituted in Eq. (6), m=64% or 2.2 db.

When $B1 = 37.9° + 90° = 127.9°$, m = −39% or −2.2 db. Thus for varying line length a spread of 4.4 db may be obtained in the noise factor reading.

For the case where $X_a = 2000$ ohms, $R_a = 3000$ ohms, $Z_a = 300$ ohms and $Z_L >> Z_o$, the maximum error is ±0.35 db.

A difference in 10% between R_a and Z_o ($X_a = \infty$, $Z_L >> Z_o$) may effect a maximum variation of ±0.4 db.

The above discussion is generally applicable to any transmission line connection between a signal generator and other apparatus.

APPENDIX III

Two alternative definitions of noise factor are here used to derive the formula for the noise factor of a receiver or an amplifier. Since these examples are primarily intended to help give a clearer understanding of the concept of noise factor, the transit time loading at higher frequencies and feedback effects are not included in these derivations.

A. Definition:—Noise Factor:

$$F = \frac{\text{Total Noise Output of Receiver}}{\text{Total Noise Output of Ideal Receiver}}$$

An *ideal receiver* is one which does not have any noise sources of its own (Fig III A). All resistors, including the input resistance are considered noiseless. The bandwidth and gain of this Ideal Receiver are the same as the receiver with which it is being compared (Fig III B).

A = gain of receiver

R_{eq} = the equivalent noise resistance of the receiver (referred to the grid of the first stage)

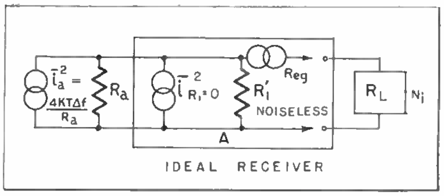


Fig. IIIA

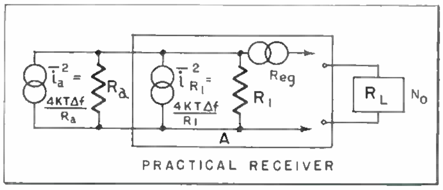


Fig. IIIB

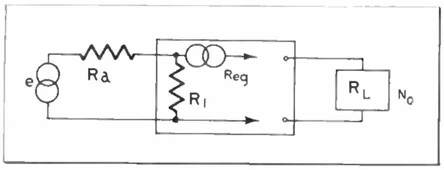


Fig. IIIC

R_a = antenna resistance referred to grid of first tube

i_a^2 = mean squared noise current generated by the antenna resistance

$i_{R_1}^2$ = mean squared noise current generated by the input resistance

N_o = Total noise output power of the practical receiver

N_i = Total noise output power of the ideal receiver

$$N_o = \left[(4KT\Delta f)\left(\frac{R_aR_1}{R_a+R_1}\right) + 4KT\Delta f R_{eq}\right]\frac{A^2}{R_L} \quad \ldots\ldots (2)$$

$$N_i = \left[(4KT\Delta f R_a)\left(\frac{R_1}{R_a+R_1}\right)^2\right]\frac{A^2}{R_L} \quad \ldots\ldots (3)$$

$$F = \frac{N_o}{N_i} = \left(\frac{R_aR_1}{R_a+R_1} + R_{eq}\right)\frac{(R_a+R_1)^2}{R_aR_1^2} =$$

$$\frac{R_a+R_1}{R_1} + \frac{R_{eq}}{R_a}\left(\frac{R_a+R_1}{R_1}\right)^2 \quad \ldots\ldots (4)$$

L Definition B, $F = (S_a/N_a)/(S_o/N_o)$ (5)

L With reference to Fig. IIIC

e = induced antenna voltage

S_a = Signal Power Input

S_o = Signal Power Output

N_a = Noise Power Input (The noise power input is that due to the antenna resistance alone. When calculating N_a, R_1 which is inside the receiver is merely part of a voltage divider network)

N_o = Noise Power Output

$$S_a = e^2\left(\frac{R_1}{R_a+R_1}\right)^2 \quad \ldots\ldots (6)$$

$$S_o = e^2\left(\frac{R_1}{R_a+R_1}\right)^2\frac{A^2}{R_L} \quad \ldots\ldots (7)$$

$$N_a = 4KT\Delta f R_a\left(\frac{R_1}{R_a+R_1}\right)^2 \quad \ldots\ldots (8)$$

$$N_o = 4KT\Delta f\left[\frac{R_aR_1}{R_a+R_1} + R_{eq}\right]\frac{A^2}{R_L} \quad \ldots\ldots (9)$$

Substituting in Eq. (5) for F

$$F = \frac{S_a/N_a}{S_o/N_o} = \frac{1}{R_a}\left(\frac{R_a+R_1}{R_a}\right)^2\left(\frac{R_a R_1}{R_a+R_1} + R_{eq}\right) =$$

$$\frac{R_a+R_1}{R_1} + \frac{R_{eq}}{R_a}\left(\frac{R_a+R_1}{R_1}\right)^2 \quad \ldots\ldots (10)$$

This result (eqs. 4 and 10) is identical to that derived by others[13] using the concept of "available signal".

[13] H. Goldberg "Some Notes on Noise Figures", Proc. IRE, vol. 36, pp. 1205-1214; October 1948

Latest WELLS Tube Price List

Many Types Are Now Scarce At These Low Prices. Check your requirements at once for your own protection. All tubes are standard brand, new in original cartons, and guaranteed by Wells. Order directly from this ad or through your local Parts Jobber.

TYPE.	PRICE EA.
OA4G	.95
EL-C1A	3.95
1A3	.60
1A5GT	.65
C1B/3C31	3.75
1B4P	1.05
1B21A/GL471A	2.55
1B22	3.40
1B23	7.50
1B27	7.75
1B32/532A	1.85
1B42	6.75
1B48	9.90
EL-1C	4.85
1C5GT	.65
1C6	.75
1C7G	.85
1D8GT	.90
1E7GT	.95
1G6	.65
1L4	.50
1LC6	.75
1LN5	.80
1P24	1.75
1Q5GT	.85
1R4	.55
1S5	.60
1T4	.65
2A7	.70
2B7	.70
2B22/GL559	1.75
2C22/7193	.35
2C26	.30
2C26A	.40
2C34	.40
2C40	5.25
2C44	1.25
2E22	1.10
2J21	10.45
2J21A	10.45
2J22	9.65
2J26	8.45
2J27	12.95
2J31	9.95
2J32	12.85
2J33	18.95
2J34	17.50
2J37	13.85
2J38	9.95
2J48	19.95
2J61	24.50
2K25/723A/B	14.95
2X2	.45
2Y3G	1.20
3-16 BALLAST	.45
3A4	.35
3A4/47	.45
3B7/1291	.40
3B22	2.35
3B24	1.75
3BP1	3.45
EL-3C	3.95
3C21	4.85
3C24/24G	.45
3C31/C1B	3.75
3CP1/S1	1.95
3D6/1299	.30
3D21A	.95
3DP1	3.75
3FP7	1.85
3FP7A	2.25
3GP1	4.95
3H-1-7 BALLAST	.45
3HP7	3.45
3Q5	.65
3Q5GT	.65
3S4	.60
GA4	2.00
REL-5	14.95
VT5/215A	.40

TYPE.	PRICE EA.
5AP1	3.75
EL-C5B	4.25
5BP1	2.45
5BP4	3.95
5CP1	2.45
5D21	22.50
5FP7	1.75
5GP1	2.95
5H-4 BALLAST	.45
5HP4	4.75
5J23	13.00
5J29	13.45
5U4G	.75
5W4	.76
6-4 BALLAST	.35
6-7 BALLAST	.35
6A3	.80
6A6	.65
6AB7/1853	.95
6AC7/1852	.90
6AF6G	1.10
6AG5	1.20
6AH6	1.00
6AK5	1.20
6AK6	.80
6AL5	.85
6AQ6	.65
6AU6	.65
6AV6	.65
6B4G	.90
6B7	.75
6B8	.65
6B8G	.75
6BA6	.65
6C4	.40
6C5	.55
6C6	.65
6C8G	.70
6C21	19.10
6D6	.50
6F5	.65
6F6	.60
6F6G	.60
6F8G	.85
6G6G	.85
6H6	.45
6H16 BALLAST	.45
6J5	.45
6J5GT	.45
6J6	.85
6J7	.65
6J8G	.95
6K6GT	.55
6K7	.65
6K7G	.65
6L6	1.10
6L7	.75
6N7	.85
6N7GT	.85
6Q7	.55
6R7	.75
6R7G	.75
6R7GT	.55
6S7G	.85
6SA7GT	.55
6SC7GT	.65
6SF5GT	.65
6SG7	.65
6SH7	.40
6SH7GT	.40
6SK7GT	.50
6SL7GT	.60
6SQ7	.55
6SR7GT	.55
6U7G	.55
6V6GT	.75
6X5GT	.73
7-7-11 BALLAST	.35
7A4/XXL	.55
7A7	.56

TYPE.	PRICE EA.
7B4	.55
7B8	.60
7C4/1203A	.35
7C5	.60
7C7	.60
7E5/1201	.60
7E6	.55
7F7	.60
7H7	.60
7L7	.65
7Y4	.50
9-3 BALLAST	.45
10	.50
10 ACORN	.55
10/VT25A	.53
10E/146	1.00
10T1 BALLAST	.50
10Y/VT25	.45
12A6	.25
12A6GT	.25
12AH7GT	1.10
12BD6	.65
12C8	.40
12F5GT	.55
12H6	.35
12J5GT	.35
12J7GT	.59
12K8	.59
12SA7GT	.62
12SF7	.50
12SG7	.55
12SH7	.40
12SJ7	.60
12SK7	.55
12SL7GT	.55
12SN7GT	.59
12SR7	.50
12X825 2A.TUNG	1.45
13-4 BALLAST	.35
14B6	.75
14Q7	.55
15E	1.40
15R	.70
16X879 2A.TUNG	1.35
FG17/967	3.25
19	.85
20-4 BALLAST	.45
REL-21	2.10
21-2 BALLAST	.45
23D4 BALLAST	45
RK24	1.55
24A	.40
VT25A/10	.45
25Z5	.65
25Z6GT	.52
26	.55
27	.55
28D7	.40
30/VT67	.58
30	.40
33	.70
34	.33
RK34/2C34	.35
35/51	.55
35W4	.45
35Y4	.50
36	.55
37	.35
38	.35
39/44	.30
43	.50
45SPEC.7V.FIL.	.28
46	.65
EF50	.45
50B5	.65
50L6GT	.54
VT52/45SPEC.	.28
56	.70
57	.45
58	.50

TYPE.	PRICE EA.
RK60/1641	.65
VT62 BRITISH	1.00
HY65	3.25
66B4	.90
VT67/30	.58
70L7	1.05
CEQ72	1.45
CRP72	.95
CYN72	1.65
RKR72	.90
RKR73	1.23
76	.40
77	.45
78	.45
VR78	.65
80	.45
FG81A	3.95
83V	.90
89	.42
89Y	.40
VR90	.95
VT90 BRITISH	2.55
VR92	.40
FG95/DG1295	9.95
VT98/REL5	14.95
100R	1.05
101/837	1.65
102F	3.55
FG105	9.75
VU111S	.45
114B	.80
121A	2.55
122A	2.65
VT127 BRITISH	.35
VT127A	2.95
VR150	.48
VT158	14.95
FG172	19.25
205B	1.35
211/VT4C	.40
215A/VT5	.28
221A	1.75
227A	2.90
231D	1.20
RX233A	1.95
257A	3.00
268A	2.95
274B	2.65
282B	5.25
287A/722A	9.50
304TH	3.70
304TL	1.95
307A/RK75	3.60
316A	.45
327A	2.50
350B	1.85
354C	14.95
356B	4.95
368AS/703A	3.75
371A	.80
371B	.80
388A	2.95
393A	3.60
394A	3.60
395A	4.85
MX408U BALLAST	.30
417A	14.25
434A	2.85
446A	1.15
446B	1.75
GL451	1.90
GL471A	2.75
SS501	3.00
527	12.85
WL530	2.75
WL531	1.75
WL532	1.65
532A/1B32	1.85
GL559	2.10
KU610	6.90

TYPE.	PRICE EA.
HY615	.35
WL632A	8.75
700	17.95
700B	17.95
700C	17.95
700D	17.95
701A	3.00
702A	2.60
703A/368AS	3.60
704A	1.05
705A/8021	1.00
706AY	17.50
707A	12.95
707B	14.45
708A	3.45
709A	4.75
710A/8011	1.25
713A	1.45
714AY	3.55
715B	6.55
717A	.60
721A	2.60
722A/287A	9.50
723AB	14.95
724A	3.85
724B	3.85
725A	6.85
726A	4.95
726B	13.50
730A	9.95
801	.40
801A	.65
803	3.40
804	6.90
805	5.75
808	1.65
809	2.65
811	2.35
812	2.95
813	8.95
814	2.60
815	2.35
826	.75
830B	3.95
832	6.50
832A	7.95
834	5.75
835/38111A	1.00
836	1.45
837	2.25
838	3.10
841	.40
842	2.75
843	.40
851	39.00
852	6.10
860	7.55
864	.40
865	1.85

TYPE.	PRICE EA.
866A	1.30
869	19.75
869B	27.25
872A	2.45
874	.90
876	.40
878	1.75
879/2X2	.45
902	3.75
931A	3.95
954	.30
955	.45
957	.35
958A	.35
967/FG17	3.75
991/NE16	.24
1005	.30
1007	4.50
CK1089	3.90
CK1090	2.65
1148	.35
1201	.45
1203	.45
1203A	.65
1236	1.75
1294/1R4	.55
DG1295	9.95
1299/3D6	.45
1299A	.60
1613	.55
1616	.75
1619	.35
1624	1.25
1625	.35
1626	.35
1629	.35
1630	2.75
1638	.65
1641/RK60	.65
1642	.55
1852/6AC7	.90
1853/6AB7	.95
1960	.85
1961/532A	1.85
1984	1.75
2051	.75
UX6653	1.20
7193	.35
8011	2.55
8012	2.75
8013	1.25
8020	2.10
8025	6.75
9001	.45
9002	.40
9003	.45
9004	.55
9006	30
38111A/835	1 00

PHOTO.TUBES.

917/CE11V-C.	$2.10
918/CE1C.	1.45
920/CE21D.	2.40
922/CE22C.	1.20
923/CE23C.	1.10
927/CE25.	1.25
930/CE30C.	1.20

SPECIAL TUBES.

4B24/CE224.	3.25
4B25/CE221.	7.85
4B26/CE226.	1.90
4B27/CE201A.	2.45
4B28/CE225.	2.40
4B35/CE212B.	7.65

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TELE-TECH

Advertisers September 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.

FRONT END DESIGN

(*Continued from page 47*)

The design of a tuned circuit of small dimensions and circuit adaptability was an imposing problem. Other attempts to construct tuned amplifiers were fruitless due to the difficulties presented by this situation. Small tuning range, matching problems, and low Q were some of the difficulties encountered with the tuned circuits available. Tuning a fixed inductance with commercially-available capacitors proved quite unsatisfactory due mainly to the inductance and distributed capacitance associated with them. Permeability tuning was attempted with little success. The desired tuning range could not be obtained and the resulting Q was extremely low because of the high losses in the core material at these frequencies.

An assembled tuned circuit which was used in this receiver and has found widespread use in experimental equipment within the laboratory is depicted in Fig. 3(a). This turner is only slightly larger than a T-3 (3/8-inch envelope) tube and thus takes advantage of the small size of these tubes.

Points d and e represent two high impedance points of the parallel resonant circuit. Loop, or turn, c represents the inductive component, while plate b and the face of the movable plunger a are surfaces which offer an effective capacitance between points d and e. When plunger a is moved within loop c, the inductance is decreased. This occurs because the circulating currents induced in this slug oppose the tendency to establish flux lines within this region. Possibly a more familiar explanation is found in the analogy with a transformer. Consider plunger a as being a short-circuited secondary, then an impedance $-(\omega M)^2/Z_s$ will be coupled into the primary. This coupled impedance can be considered a negative inductance. This means that the effective inductance of primary loop c is decreased as the mutual inductance between plunger a and loop c is increased. In this tuner the change of inductance results from this variation of the mutual inductance between plunger a and loop c. From the above analysis it is clear that both the inductance and capacitance increase as the plunger a is moved toward plate b. This type of construction provides a wide tuning range and tends toward a constant L/C ratio.

The make-up of these tuned circuits is shown in Fig. 3(b). The simplicity of construction is self-evident. Tuners have been constructed with 1, 1½, and 2 turns for the inductive portions of these units. The tuned circuit described above combines wide tuning range with simplicity of construction and good circuit adaptability. In this receiver, a single-turn type tuner was used for the input circuit, a 1½-turn tuner was used for the oscillator circuit and a modified tuner was used for the r-f interstage.

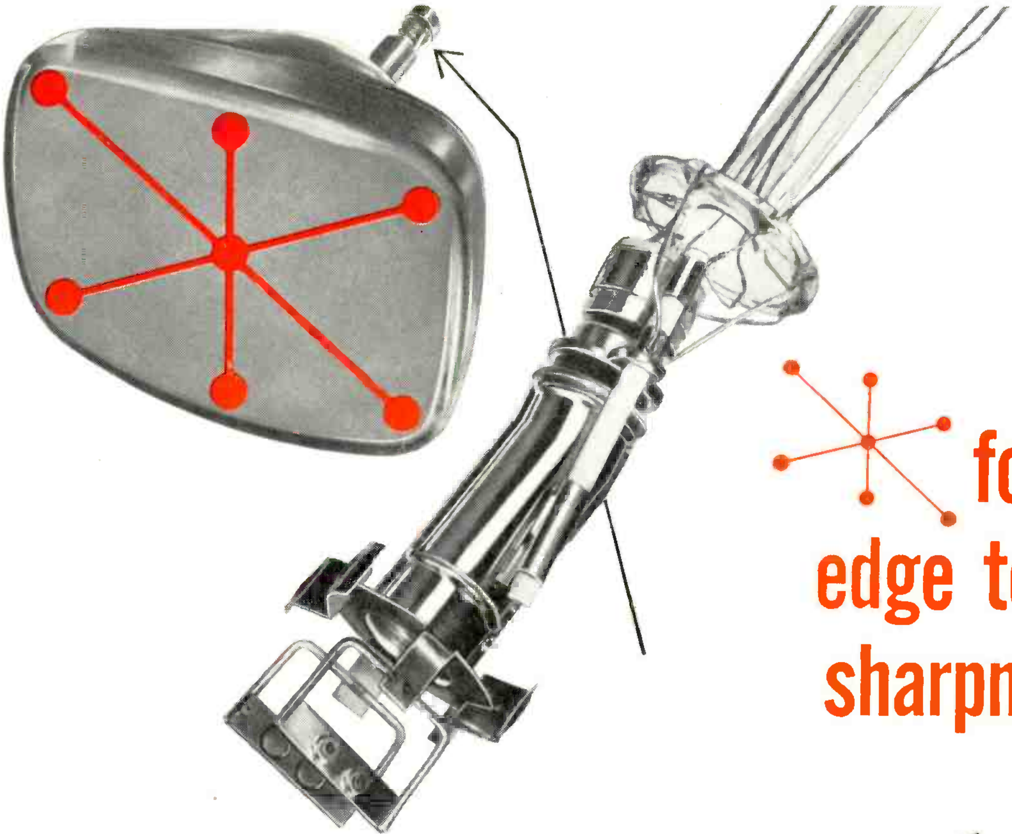
[1]N. B. Ritchey, "Citizen's Bond Oscillator", **Radio and Television News**, Dec. 1948; p. 44.

[2]E. W. Herold, "The operation of Frequency Converters and Mixers for Superheterodyne Reception", **Proc. of I.R.E.**, Feb., 1942; p. 99.

Part Two will appear in the October issue.

WPIX Transmitter Equipment

The latest television transmitter, antenna and accessories, representing an investment of $160,000, have been ordered by WPIX, The new York News station, from RCA for installation in the Empire State building, tallest structure in the world. WPIX is scheduled to begin transmission from the new location atop the Empire State within five months.



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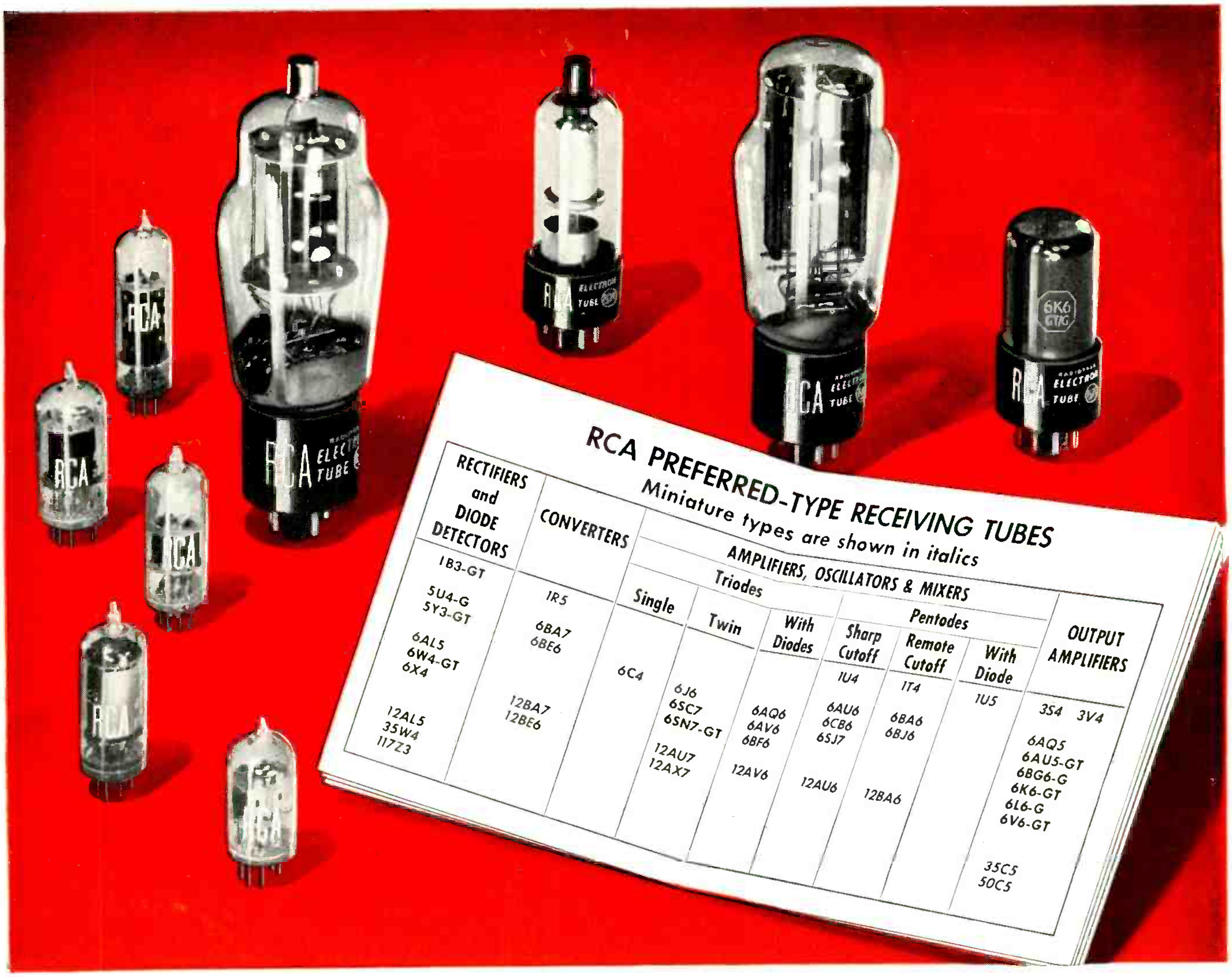

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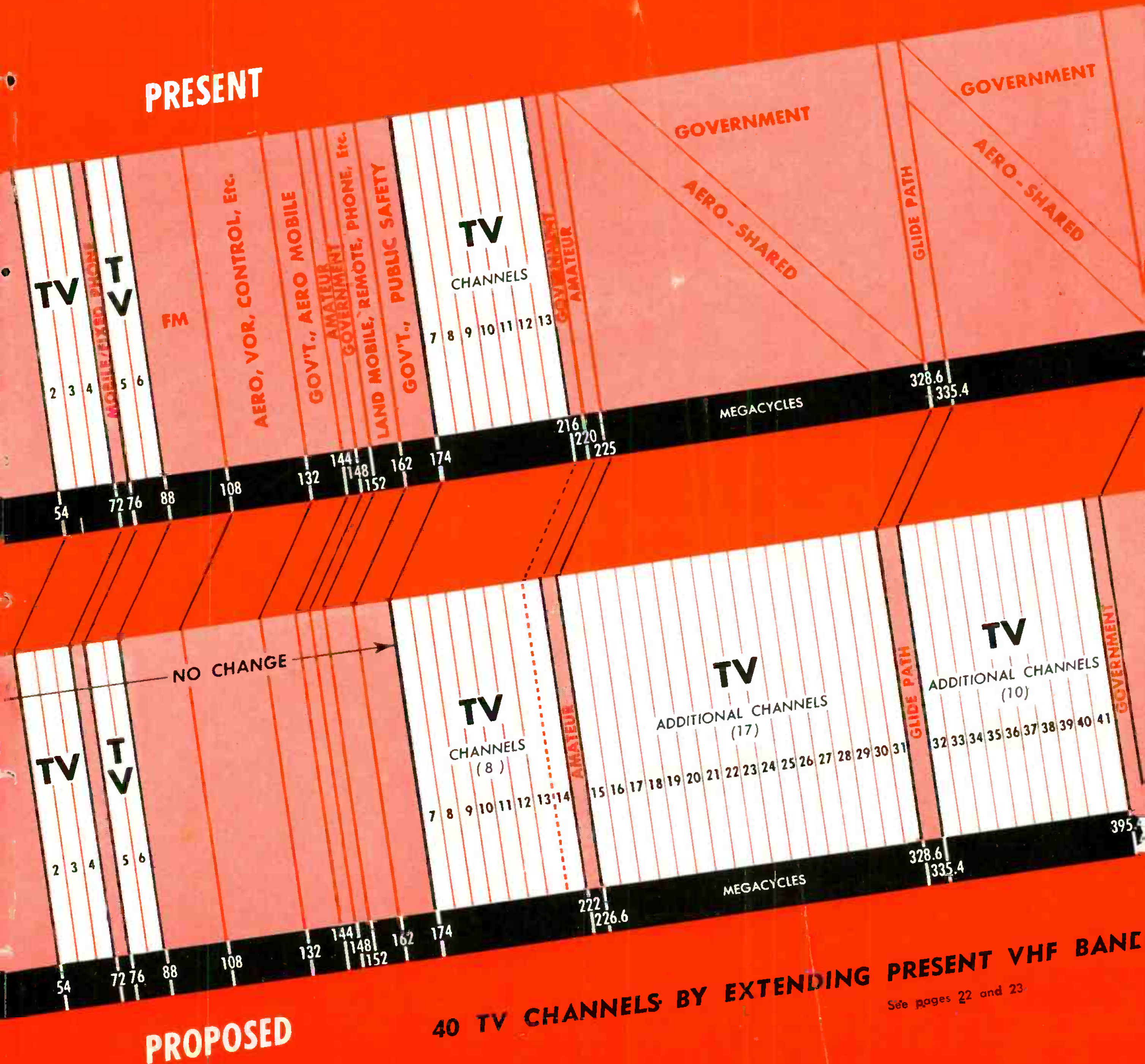

40 TV CHANNELS BY EXTENDING PRESENT VHF BAND

See pages 22 and 23

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