TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

June • 1948

CALDWELL-CLEMENTS, INC.

Photo: RCA radio tube inspection—See Page 1

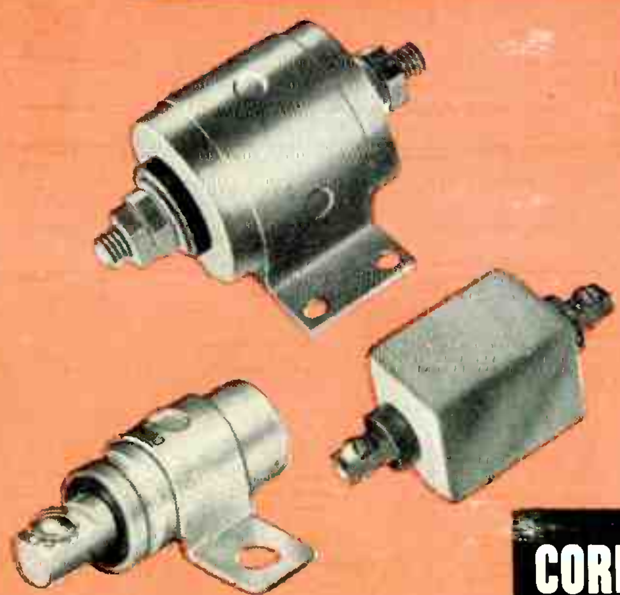
TV Pool Plan for Convention Coverage Page 22

Where to Sell to Uncle Sam Page 32

ENGINEERING TECHNICS — DESIGN — MANUFACTURING • OPERATION

quiet as a goldfish

with C-D *Quietones**



MICA · DYKANOL · PAPER · ELECTROLYTIC

A lot of electronic and electrical equipment is going to sea these days. But it won't stay there long—in fact, it won't even stay sold—unless it is Noise-Proofed against radio interference.

To you—the manufacturer—this means that your product should include C-D Quietones in its basic design. With safety at sea—as well as listening pleasure—at stake, your marine customers demand the kind of interference-free equipment operation C-D Quietones are designed to give. Of the hundreds of Quietone types available, there may be one which will fit your needs to a "T"; if not, our sleeves are rolled up and we're ready in our modern and complete Radio Noise-Proofing Laboratory—to design the specific filter you need. C-D Quietones will solve your radio noise and spark suppression problems speedily, permanently and effectively. Your inquiry is invited. Cornell-Dubilier Electric Corporation, Dept. J6-8, South Plainfield, New Jersey. Other large plants in New Bedford, Worcester, and Brookline, Massachusetts, and Providence, R. I.

Make Your Products More Saleable with C-D Quietone Radio Noise Filters and Spark Suppressors.

An Invitation from C-D

WORLD'S MOST ADVANCED RADIO "NOISE-PROOFING" LABORATORY IS AT YOUR SERVICE

without obligation

CORNELL-DUBILIER

WORLD'S LARGEST MANUFACTURER OF

CAPACITORS

* Reg. U.S. Pat. Off.

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

Formerly the TELE-communications TECH-nical Section of ELECTRONIC INDUSTRIES

JUNE, 1948

Editorial Contents

COVER: Tube filaments being inspected with aid of microscope at RCA tube plant at Lancaster, Pa., site of one of the largest tube producing centers.

CALDWELL-CLEMENTS, INC., Publication Office, Orange, Conn., Editorial and Executive Offices 480 Lexington Avenue, New York 17, N. Y., Tel. Plaza 3-1340

Publishers also of ELECTRONIC INDUSTRIES & INSTRUMENTATION and RADIO & TELEVISION RETAILING

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Tele-Tech*, June 1948, Vol. 7, No. 6. Regular price per copy 25 cents. Published Monthly by Caldwell-Clements, Inc., Publication Office Orange, Conn., Editorial, Advertising and Executive Offices 480 Lexington Ave., New York 17, N. Y. Direct all subscription inquiries to Orange, Conn., or to 480 Lexington Avenue, New York 17, N. Y. M. Clements, President; Orestes H. Caldwell, Treasurer. Subscription rates: United States and possessions, $3.00 for two years. Canada (Canadian Funds Accepted) $4.00 for two years. Pan American Countries $5.00 for two years. All other countries $7.50 for two years. Entered as second class matter June 9, 1947, at the Post Office at Orange, Conn., under the act of March 3, 1879. Printed in U.S.A. *Reg. U.S. Pat. Off.

How to power better television for more people

NOW YOU CAN design a television receiver that thousands instead of hundreds can afford to buy. You can improve electronic performance and make a longer lasting set—all at less cost.

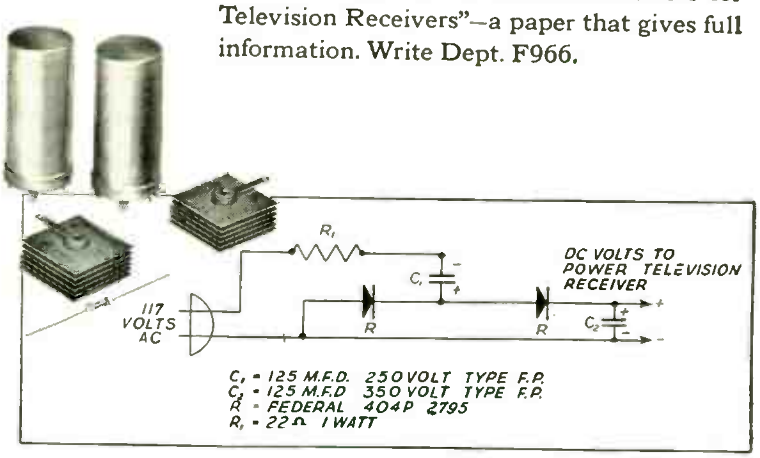
The answer is simple. Specify Selenium Rectifiers in the multiple power supply.

You eliminate power transformers, rectifier tubes and filter chokes. You cut the weight of power supply by as much as 90 per cent, because a complete Selenium unit weighs less than half a pound. Power supply parts can be mounted almost anywhere in the set for important space savings, too.

You get cooler operation for longer life of all components . . . electronic advantage of no interference to the cathode ray tube by stray magnetic fields . . . new design flexibility. *Lighter and more compact television receivers are now a reality!*

First manufacturer of Selenium Rectifiers in this country and pioneer of their many applications, Federal is *first*, too, in Selenium Rectifiers to power television receivers.

Write today for "Selenium Rectifiers for Television Receivers"—a paper that gives full information. Write Dept. F966.



FTR
An IT&T Associate

Federal Telephone and Radio Corporation

KEEPING FEDERAL YEARS AHEAD . . . is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

SELENIUM and INTELIN DIVISION, 900 Passaic Ave., East Newark, New Jersey

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors:—International Standard Electric Corp., 67 Broad St., N.Y.

2-way radio permits drivers to notify central office of completion of trip.

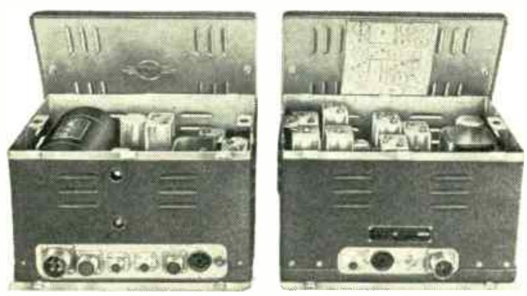
Link FM Sets . . . Sylvania Lock-In Tubes . . .

handle emergency calls rapidly and smoothly for Morro Limousine

Office can immediately advise driver of other calls in the same neighborhood.

WITH 10 of its 14 limousines equipped with 2-way Link FM, Morro Limousine Service is always ready—24 hours a day—to respond promptly to emergency calls for home-to-hospital transportation—anywhere in the entire Borough of Brooklyn. Cars are strategically located throughout the borough, to reach any point in the shortest possible time.

Since quick, *unfailing* service is the essence of Morro Limousine's business, Link Radio Corporation turns to Sylvania Lock-In Tubes to prevent communications interruptions. These tubes stay firmly in place in their sockets . . . have no soldered joints, few welded ones. Elements can't warp or weave. Connections are short and direct . . . getter located on top. Loss and leakage are reduced. See Sylvania Distributors or write Radio Tube Division, Emporium, Pa.



Transmitting and Receiving Units used by Morro Limousine Service, manufactured by Link Radio Corporation, New York.

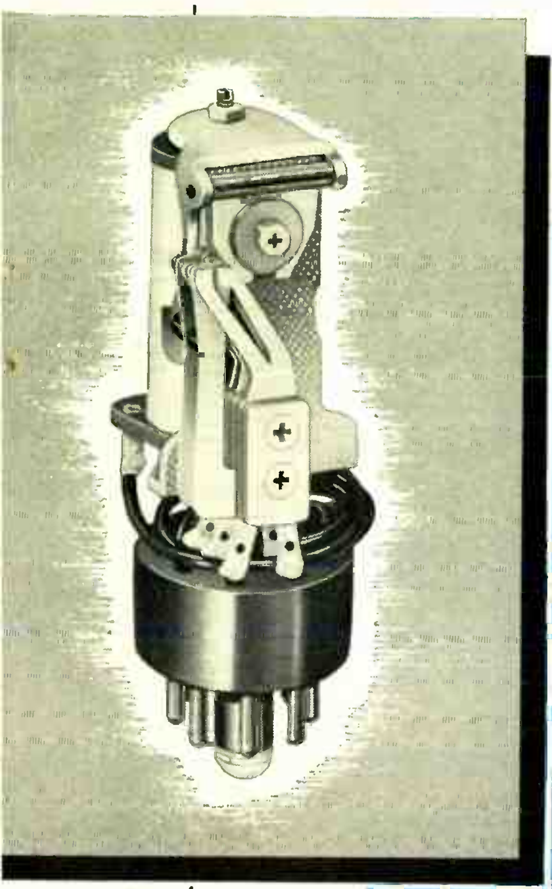
* * *

The famous Lock-In Tube's superiority makes it the ideal choice for equipment on the road, in the air, on the rails, marine radar, FM and television.

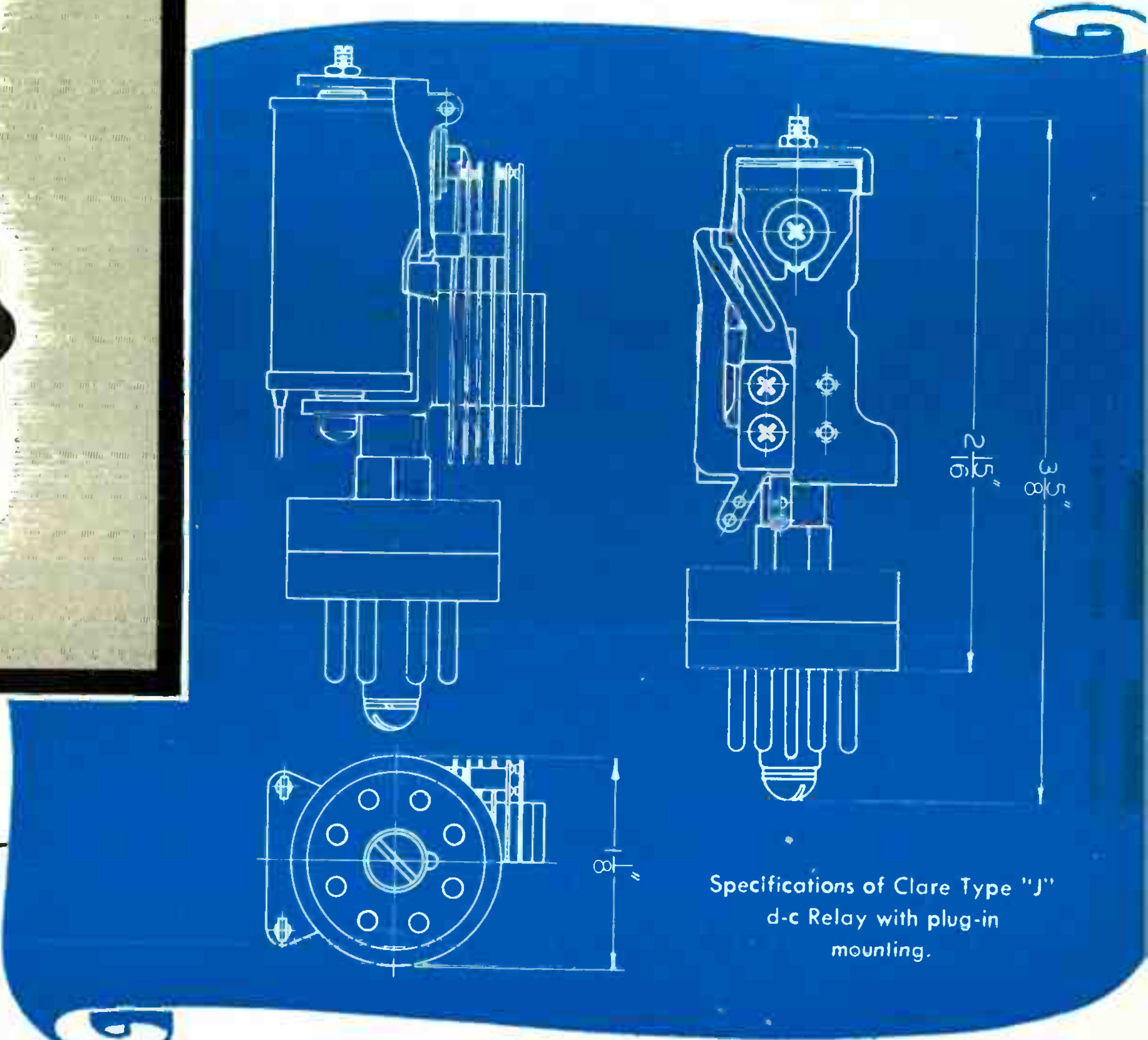
SYLVANIA ELECTRIC

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

NOW... The CLARE Type "J" Relay can be Mounted as Conveniently as a Radio Tube!



Famous Clare Type "J" d-c Relay now available in plug-in type where quick removal or replacement is desirable



Specifications of Clare Type "J" d-c Relay with plug-in mounting.

Clare Type "J" d-c Relays combine the best features of the conventional telephone type relay with the small size and light weight which modern compact design requires.

Check these outstanding features of Clare Type "J" design which provide hitherto unheard of performance by a small relay:

- ★ **Independent Twin Contacts**
- ★ **High Current-Carrying Capacity**
- ★ **Large Armature Bearing Area**
- ★ **Efficient Magnetic Structure**
- ★ **High Operating Speed**
- ★ **Large Contact Spring Pileups**

Clare sales engineers, with long experience in every type of relay problem, are located in principal cities. They will be glad to provide you with complete engineering data on the Clare Type "J" Relay, show you how it may be "custom-built" to meet your exact requirements.

Look for them under "Clare Relays" in your classified phone book . . . or write C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address CLARELAY.

CLARE RELAYS

First in the Industrial Field

HOW LONG IS HALF AN INCH?

EL-MENCO's answer is illustrated above — the new miniature CM15. That half inch of silver mica capacitor is miles long on performance . . . age-long on endurance . . . 2 to 500 mmf. long on range.

The CM15 is short on delivery time (unlimited production) . . . short on limitations (tolerances: ± 20% to 1%) . . . short on guess work (6-color coded to Joint Army-Navy Standard Specifications JAN-C-5 for fixed mica dielectric capacitors).

The long and short of it is this: EL-MENCO's new miniature CM15 possesses the value inherent in all EL-MENCO products—

PERFORMANCE • ENDURANCE • RANGE • PRICE • DELIVERY

Write, on firm letterhead, for samples and catalog.

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

Foreign Radio and Electronic Manufacturers communicate direct with our Export Department at Willimantic, Conn., for information.

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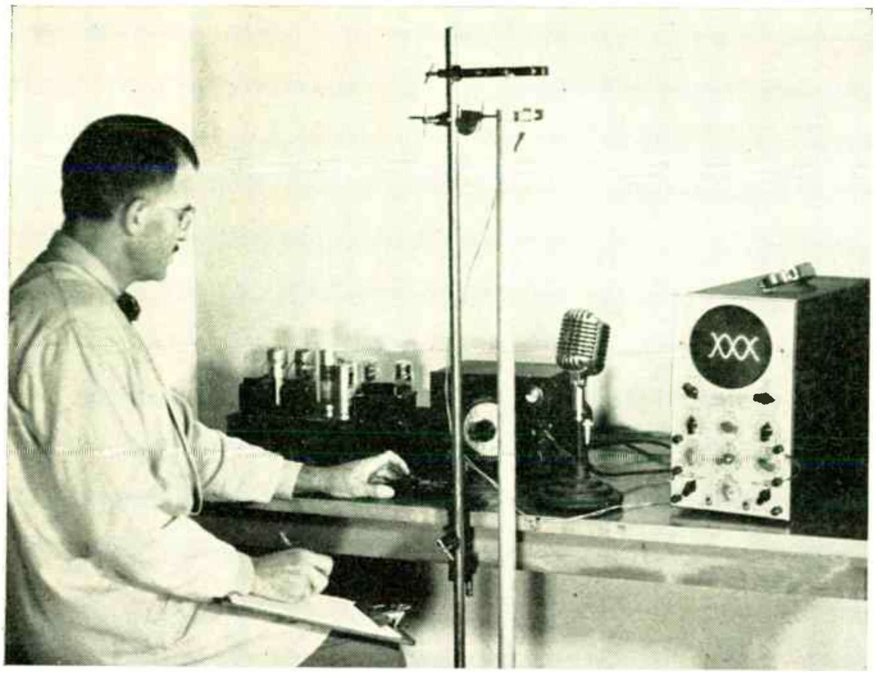
MOLDED MICA El Menco MICA TRIMMER

CAPACITORS



Laboratory set-up for measuring tone of chime tubes. Lissajous figure on screen of cathode ray oscilloscope is being used to determine the frequency (cycles per second) of the chime's fundamental note.

Revere Tubes make Good Music

BECAUSE of the importance of the market for brass tube used in door chimes, Revere some time ago embarked upon a complete scientific study of the musical qualities of such tube, to determine the factors responsible for pleasing tone. Here is a brief report of the work, which offers an example of the thoroughness with which Revere attacks problems concerning the application of its mill products.

The first step was purely experimental. We proceeded by ear. Over 100 samples of tubes in various alloys, tempers and gauges were hung up, struck, listened to, and preferences obtained from many people. These tests indicated not only what was the best alloy, but also what were the proper temper and wall thickness requirements to produce the most acceptable and desirable tone. But Revere did not stop there. It was desirable to know what made that tone preferable, what were the factors that influenced it, and how they could be controlled. It was felt that only with such complete information in hand could Revere be in position to control chime tube quality accurately, and fill customers' orders reliably with a standard product.

The project then was turned over to a laboratory physicist who is also a talented musician. Here began the most ambitious and lengthy and scientific part of the work, employing the most modern electronic apparatus, including a beat-frequency oscillator and a cathode ray oscilloscope. These made it possible to dissect the tone produced, measuring the frequency and intensity of the fundamental note and its partials with an accuracy of one cycle per second. Much new information was uncovered. For example, the strike tone so clearly heard when the chime is struck does not actually exist in the tube, but is a difference tone between the 1st and 3rd partials. Hence, for good tone, those partials must be equal in intensity and duration.

It requires seven closely-typed pages just to sum up the work in general terms; the laboratory records fill a large volume. The net of it is that Revere really knows about all there is to know about chime tube, scientifically, musically, physically, and, of course, how to produce it. If you need such tube, come to Revere.

Perhaps you use brass tube not for its sound, but for its corrosion resistance, strength, machinability, the polish it takes, the ease with which it can be bent, soldered, brazed, plated. Revere also knows how to control the factors influencing such applications, so come to Revere for brass tube for any purpose.

Revere also makes other types of tube, including copper water tube, condenser tube in such alloys as Admiralty, Muntz, cupro-nickel, tube in aluminum and magnesium alloys, lockseam tube in copper alloys and steel, and electric welded steel tube. Many of these can be had not only round, but also square, rectangular, oval, and in various flutings and special shapes. The Revere tube line therefore is complete, and awaits your orders.

The Technical Advisory Service will gladly collaborate with you in such matters as selection of alloys, tempers and gauges, and in fabrication processes.

REVERE

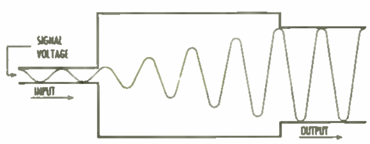
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

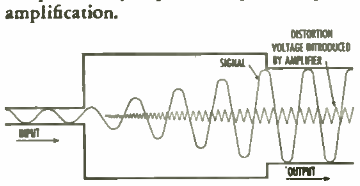
230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y. — Sales Offices in Principal Cities, Distributors Everywhere.

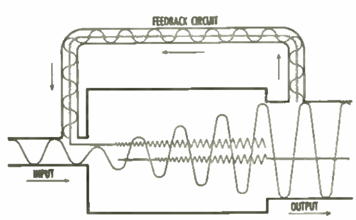
How stabilized feedback reduces amplifier distortion... keeps gain constant



(A) IDEAL AMPLIFIER existing only in theory. Output exactly duplicates input, except for amplification.



(B) AMPLIFIER WITHOUT FEEDBACK. Signal suffers distortion, shown as separate a-c voltage accompanying output signal.



(C) AMPLIFIER WITH STABILIZED FEEDBACK. Sample voltage, containing signal and distortion in same ratio as in output, is fed back in opposing phase to input. Distortion portion is amplified in opposition to distortion arising in amplifier.

LIKE many other major advances in electronics, the development of stabilized (negative) feedback was a direct outgrowth of telephone progress. To produce telephone repeaters with the necessary gain stability and low distortion, H. S. Black, of Bell Telephone Laboratories, took a sample voltage of the amplifier output and fed it back into the amplifier in *opposing* phase. Before-and-after effects are shown in simplified form in the accompanying figures.

How Feedback Reduces Distortion

Signal portion of feedback subtracts from input signal. (In practice, input receives additional amplification to maintain original output voltage.)

Distortion portion, encountering no opposing voltage in input, is amplified in opposition to distortion voltage arising in amplifier. Hence distortion voltage largely cancels itself out – output corresponds closely to input. Noise originating in the amplifier is reduced in a similar way.

How Feedback Stabilizes Gain

The relations of input, output and gain can be shown as follows:

Voltage Gain without Feedback	Total Input	Feedback Voltage (negative)	Net Input (less feedback)	Output	Overall Gain
1000	10.1	10	.1	100	9.9
500	10.2	10	.2	100	9.8

As shown, the gain of the amplifier stages incorporating feedback can drop 50 percent, with a drop in *overall* gain of only 1 percent.

Hence *gain remains virtually constant*, regardless of changes in power supply or performance of components.

Users of all line and power amplifiers and all AM transmitters designed by Bell Laboratories and made by Western Electric benefit by these outstanding advantages of stabilized feedback: greatly reduced distortion and noise, virtually constant gain.

BELL TELEPHONE LABORATORIES

World's largest organization devoted exclusively to research and development in all phases of electrical communications.

You get feedback at its finest . . . in Western Electric equipment

WHILE stabilized feedback is now accepted as an indispensable technique in the communications art, *actual design* of a stabilized-feedback amplifier calls for painstaking mathematical analysis and control of phase and gain characteristics over a wide frequency spectrum. *Without such control, feedback may introduce new faults more objectionable than those eliminated.* The extensive experience of Bell Laboratories engineers gives to the users of Western Electric equipment assurance that the outstanding advantages of feedback will actually be realized.

Assurance of Quality Performance

As used in all Western Electric Audio Amplifiers (except one-tube pre-amplifiers) properly applied stabilized feedback insures flatter gain-frequency characteristic and automatic suppression of noise and distortion arising from sources within the amplifier. In new loudspeaker amplifiers (which include the output coil within the feedback loop), output impedance is so low that matching to multiple loudspeakers is as simple as adding lamps to a lighting circuit.

Flat Frequency Response

Flat frequency response is maintained in Western Electric AM Transmitters by stabilized feedback actuated by the final radio frequency output. Hence attenuation of high modulating frequencies is virtually eliminated. No hum suppression circuits are needed, because of reduction of noise and distortion from all sources, including final amplifiers.

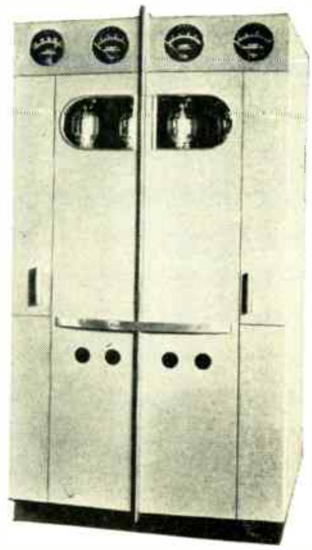
Stabilized feedback, correctly applied, is just one of the factors in the outstanding performance of Western Electric Amplifiers and AM Transmitters. For *full* information on all operating features, call your local Graybar Broadcast Representative, or write Graybar Electric Company, 420 Lexington Avenue, New York 17, N. Y.

Correctly applied feedback gives you these advantages

IN AMPLIFIERS

Feedback *as you want it* keeps gain virtually constant in Western Electric Audio Amplifiers — cuts noise and distortion down to a minimum.

IN AM TRANSMITTERS



Feedback designed by Bell Laboratories does away with need for hum suppression circuits — maintains flat frequency response.

—QUALITY COUNTS—

Western Electric

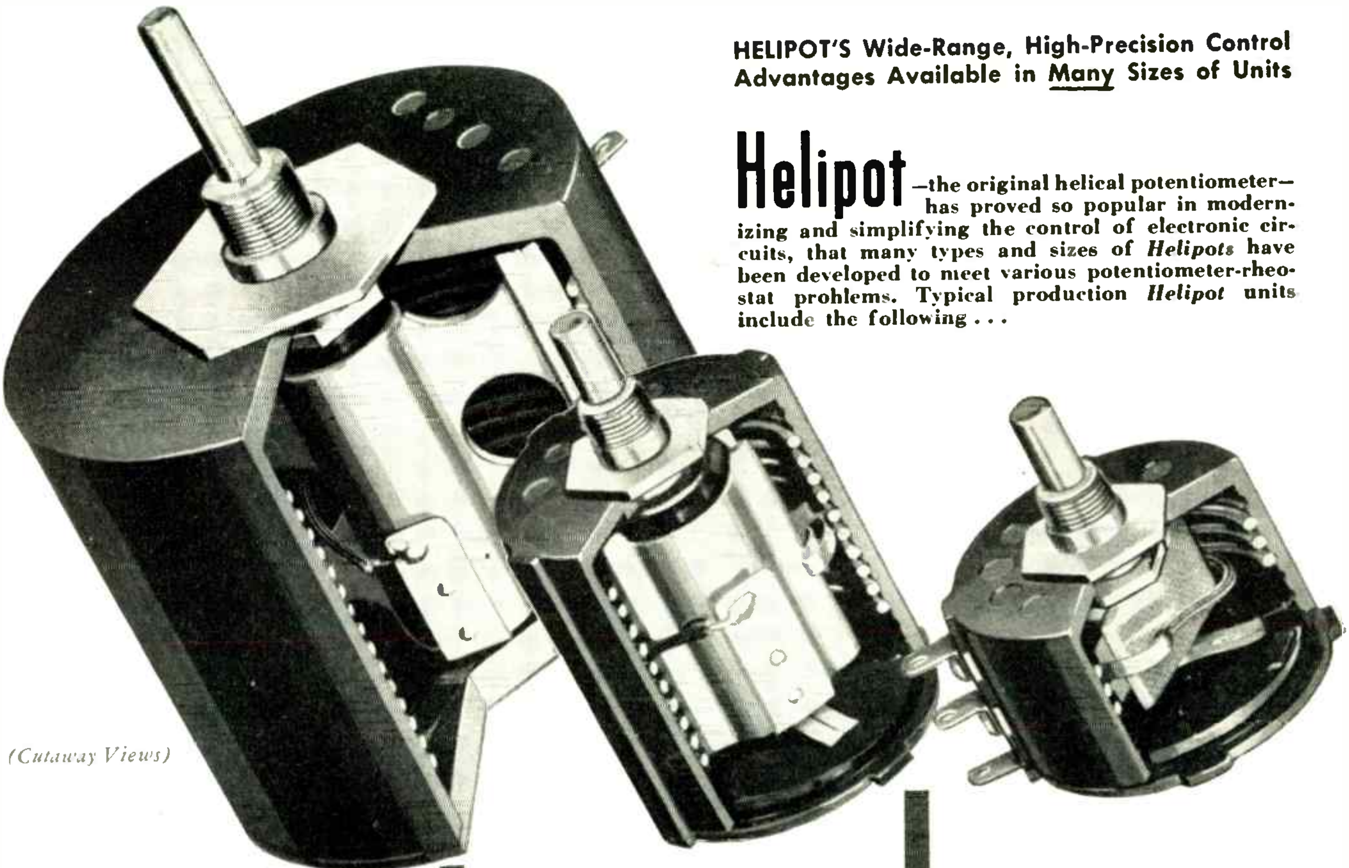
Manufacturing unit of the Bell System and the nation's largest producer of communications equipment.

Distributed by GraybaR
OFFICES IN 93 PRINCIPAL CITIES

DISTRIBUTORS: IN U. S. A.—Graybar Electric Company. IN CANADA AND NEWFOUNDLAND—Northern Electric Co., Ltd.

There's a Beckman Helipot
(Trade Mark of the HELIcal POTentiometer)

to simplify YOUR Potentiometer—Rheostat Problems!



(Cutaway Views)

HELIPOT'S Wide-Range, High-Precision Control Advantages Available in Many Sizes of Units

Helipot—the original helical potentiometer—has proved so popular in modernizing and simplifying the control of electronic circuits, that many types and sizes of *Helipots* have been developed to meet various potentiometer-rheostat problems. Typical production *Helipot* units include the following . . .

MODEL B—Case diameter—3.3"; Number of turns—15; Slide wire length—140½"; Rotation—5400°; Power rating—10 watts; Resistance ratings—50 to 200,000 ohms.

MODEL A—Case diameter—1.8"; Number of turns—10; Slide wire length—46½"; Rotation—3600°; Power rating—5 watts; Resistance ratings—10 to 50,000 ohms.

MODEL C—Case diameter—1.8"; Number of turns—3; Slide wire length—13.5"; Rotation—1080°; Power rating—3 watts; Resistance ratings—5 to 15,000 ohms.

WIDE CHOICE OF DESIGN FEATURES

Not only are Helipots available in a wide range of sizes and ratings, but also can be supplied with various design features to meet individual requirements . . .

- Available with special length shafts, flatted shafts, screw-driver slots, etc.
- Can be supplied with shaft extensions at each end to permit coupling to indicating instruments or other devices.
- May be provided in ganged assemblies of two or three units, all operating from a common shaft.
- Available with linearity tolerances of 0.1%—and even less.
- Models A & B can be modified to include additional taps at virtually any point on windings.

. . . and many other special features.

Investigate the many important advantages to be gained by using the *Helipot* in your electronic control applications. Write outlining your problem!

SPECIAL MODELS

In addition to the above standard *Helipot* units, special models in production include . . .

MODEL D—Similar to Model B, above, but longer and with greater length of slide wire. Case diameter—3.3"; Number of turns—25; Slide wire length—234"; Rotation—9000°; Power rating—15 watts; Resistance ratings—100 to 300,000 ohms.

MODEL E—Similar to Model B, but longer and with greater length of slide wire than Model D. Case diameter—3.3"; Number of turns—40; Slide wire length—373"; Rotation—14,400°; Power rating—20 watts; Resistance ratings—150 to 500,000 ohms.

Send for HELIPOT Literature!

THE Helipot CORPORATION
1011 Mission Street
South Pasadena 3, California

Many Bliley crystal units are first produced on a custom-built basis for special application. Quite often these designs contain outstanding features that are desirable in many applications and when this occurs the unit is included in our catalog listing. Our Bulletin 36 contains 22 standard crystal units, all widely used in commercial and governmental applications.

Bliley engineers are constantly utilizing our many years of specialized experience to solve new frequency control problems. If you have a frequency control application, whether standard or specialized, we can probably come up with the right answer. Remember to specify Bliley TECHNIQUALITY crystals for greater accuracy, stability, quality, and advance design.

WRITE FOR YOUR COPY OF BULLETIN 36

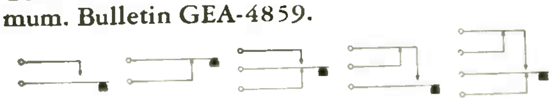
BLILEY ELECTRIC COMPANY • UNION STATION BUILDING • ERIE, PENNSYLVANIA

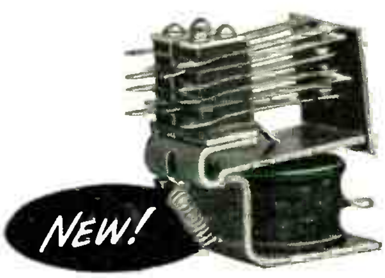
ELECTRONICS Designers

RELAYS . . . for any duty, any duty cycle

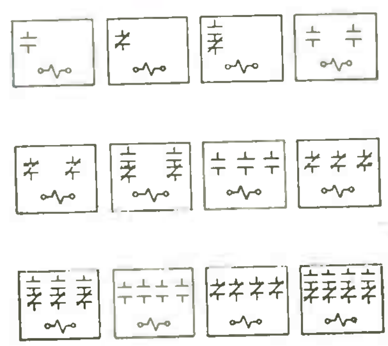
COMMUNICATIONS AND SIGNALING Designed specifically for use in industrial electronic equipment, communications and signaling equipment, this General Electric telephone-type relay has a service life measured in many millions of operations. Working from five basic contact arrangements, combinations can be stacked to satisfy intricate circuit switching requirements.

Welded-crossbar palladium contacts, new-type molded insulation and stainless steel bearings contribute to this d-c relay's longevity. Coils rated 1 to 250 volts, 0.1 to 26,000 ohms; contacts 3 amps maximum. Bulletin GEA-4859.



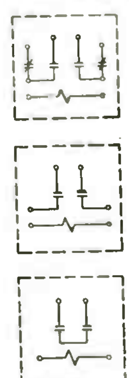


VENDING MACHINES AND DISPENSERS Designers of coin changers, coin-operated phonographs, drink dispensers, and similar automatic devices will soon be familar with G.E.'s new appliance relay, an inexpensive multi-contact unit. Featuring quiet operation, reliability and compactness, the CR2790G relay is available in ratings of 24 and 115 volts a-c, 24 volts d-c, 5 amps continuous. Bulletin GEA-4864.



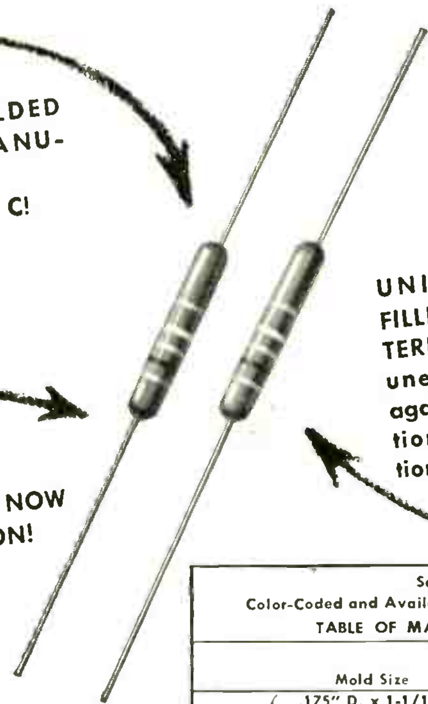
HEAVY-DUTY GENERAL-PURPOSE Three contact arrangements—spst, dpst, and dpdt—plus four mounting arrangements give the CR2790E real versatility. Mounting arrangements available are the enclosed form shown here, open form, back-connected form for panel mounting, and a plug-in form for use in process control equipment.

Its heavy silver contacts are rated 10 amps continuous at 115/230 volts, 60 cycles; normally open contacts will make and break 45 amps, normally closed contacts 20 amps. Bulletin GEC-257 gives full details.



GENERAL ELECTRIC

A QUIET REVOLUTION IN CAPACITOR DESIGN



ACTUAL SIZE
ILLUSTRATION
TYPE 65P

THE SMALLEST MOLDED TUBULAR EVER MANUFACTURED! . . . and rated up to 125° C!

UNIQUE, MINERAL-FILLED MOLDING MATERIAL! . . . Provides unequalled protection against moisture absorption even under conditions of extreme humidity!

A PROVEN PRODUCT NOW IN MASS PRODUCTION!

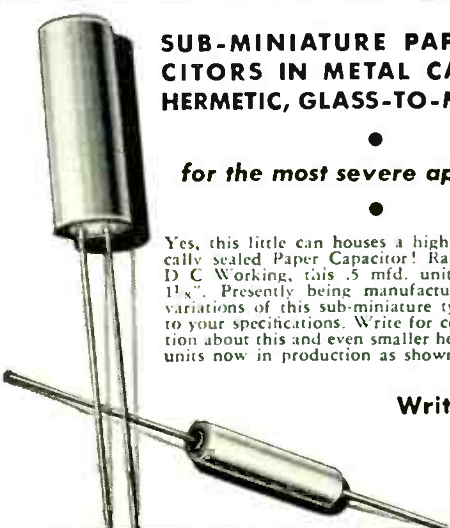
Seven Physical Sizes
Color-Coded and Available in 20%, 10% and 5% Decade Values
TABLE OF MAXIMUM NOMINAL CAPACITIES

	Mold Size	100V @ 125° C.	200V @ 85° C.*	400V @ 85° C.	600V @ 85° C.
65 P	.175" D. x 1-1/16"	.015	.01	.0068	.0022
	.195" D. x 1-1/16"	.022	.015	.01	.0033
	.250" D. x 1-1/16"	.047	.033	.022	.0068
	.375" D. x 1-1/16"	.15	.1	.068	——
75 P	.175" D. x ¾"	.0068	.0047	.0033	.001
	.200" D. x ¾"	.01	.0068	.0047	.0015
	.250" D. x ¾"	.022	.015	.01	.0033

* alternate rating 150V @ 125° C.

NEW SPRAGUE MOLDED PROKARS*

. . . dependable capacitors for sub-miniature assemblies



SUB-MINIATURE PAPER CAPACITORS IN METAL CANS WITH HERMETIC, GLASS-TO-METAL SEAL

●

for the most severe applications

●

Yes, this little can houses a high quality hermetically sealed Paper Capacitor! Rated at 100 volts, D C Working, this .5 mfd. unit measures .4" x 1-1/8". Presently being manufactured in quantity, variations of this sub-miniature type can be made to your specifications. Write for complete information about this and even smaller hermetically sealed units now in production as shown below.

These new molded Prokars were designed specifically to satisfy stringent military requirements. Types 65P & 75P are now in mass production and are available in a wide range of capacities—from .00047 mfd. to .15 mfd! Though higher in price than standard units, they easily justify the term "premium" in performance. Rated for —50° C to 125° C operation, these small but rugged units are ideally suited for any electrical or electronic application in which size, temperature, humidity and physical stress are dominant considerations.

*T. M. Reg. U. S. Pat. Off.

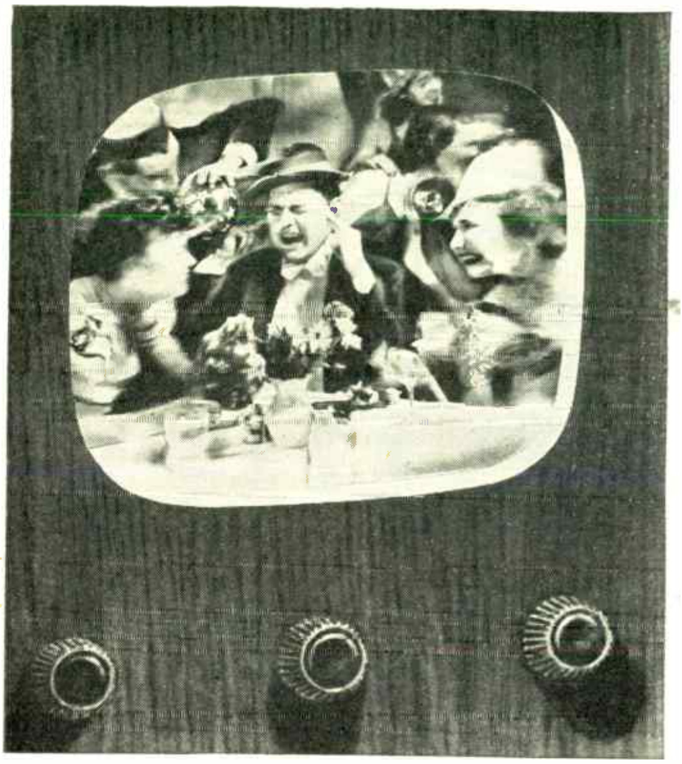
Write for Engineering Bulletin No. 205 A

SPRAGUE

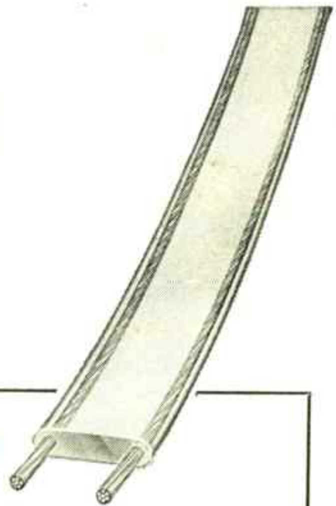
SPRAGUE ELECTRIC COMPANY,
NORTH ADAMS, MASS.

PIONEERS OF ELECTRIC AND ELECTRONIC PROGRESS

CONFUSING? OR AMUSING?



Lead-In Lines Play an Important Part in Television Reception



The effects of attenuation and impedance mismatch on FM and Television reception are minimized by Anaconda Type ATV* lead-in lines.

The satin-smooth polyethylene insulation of Type ATV line sheds water readily, thus avoiding subsequent impedance discontinuities. This material also has exceptionally high resistance to corrosion. Count on Anaconda to solve your high-frequency transmission problems—with anything from a new-type lead-in line to the latest development in coaxial cables. 47439

**An Anaconda Trade-Mark*

A Type ATV Lead-In for Every Need

Anaconda offers a complete selection of Type ATV lead-in lines for 75, 125, 150 and 300 ohms impedance unshielded and 150 ohms shielded. For an electrical and physical characteristics bulletin, write to Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y.

ANACONDA from mine to consumer

ANACONDA WIRE AND CABLE COMPANY

TELE-TIPS

10-TUBE TV receiver is nearer to being an actuality than some may think. And it will result in a $100 set with a 7-in. picture tube. Unlike the $99.50 TV receiver dud referred to in this column on two occasions, this time we've seen the plans. We will report further after the patent has been granted on the circuit.

STRATOVISION is still very much alive. For the past several weeks Westinghouse has been testing above the Baltimore-Pittsburgh area with favorable results. A Pennsylvania hopeful with a television receiver, waiting for "The Day" when a station should start programming within his receiving range, inadvertently flipped his receiver switch and suddenly found himself gazing at Westinghouse's test program, much to his and everyone else's surprise.

MICROWAVE service will be available shortly to television stations in the New York area on a rental basis. Bell Labs is installing facilities in the Empire State building which will be available for picking up remotes beyond line-of-sight of local stations. New York's WPIX may use the new microwave facilities for some of its distant remote programming.

50-KW TELEVISION transmitter is under development by Eitel- McCullough, Inc., in California. Application is being made for channel 13, which in the wide-open spaces (both geographical and spectrum-wise) will afford excellent testing ground for this milestone in TV advance.

ONE MILLION TUBES, more than half of which will come from one manufacturer, will be made in 1948, according to an industry authority. Two-thirds of these will be of the 10-in. variety. (This prediction checks with TELE-TECH's estimate that 910,000 receivers will be in use by the end of the year). In 1949, 1½ million tubes are forecast with two-thirds of them coming from the same industry leader.

FLAT 20-IN. TUBE is under development by RCA. Its production will affect receiver design; also influence production costs of glass blanks which is still a problem in the manufacture of large-diameter picture tubes. Handmade glass blanks for 20-in. tubes cost around $100 today.

AN INDUSTRY LEADER is trying to juggle half a dozen huge military projects without cutting into its commercial electronic program; is seeking permission to sub-contract; thinks spreading the "stuff" around is good for the industry. Check.

BENDIX and **TELETONE** see it differently. The former will begin selling direct to dealers; the latter will sell through jobbers. To each his own!

GENERAL ELECTRIC is pricing its new 10-in. receiver just under $300.

TV TRANSMITTER SALES, as revealed by recent survey, showed RCA with 90 percent of the business. Taking note of this, we have it on highest authority that GE is laying plans to level-off this one-sided sales picture.

WOR-TV, according to chief engineer Jack Poppele, is planning to build its tower atop the 500-ft. Palisade cliffs on the Jersey shore, opposite New York City, and thus approach NBC's TV tower height of 1260 ft. atop Empire State building.

DOLLAR VOLUME in receiver sales for 1948 will reach $250 million; station advertising volume will reach $5 million—we predict. -S. G.

AM · FM · TV
RAYTHEON SPEECH EQUIPMENT

For the last word in complete, up-to-the-minute facilities . . . or simple, low-cost equipment to suit your limited requirements . . .

Look to RAYTHEON for All Your Needs

RC-11 STUDIO CONSOLE

NOW WITH CUE POTS FOR TWO TURNTABLES

Provides complete high-fidelity speech input facilities with all control, amplifying and monitoring equipment in one cabinet. Seven built-in pre-amplifiers, nine mixer positions, cue attenuators for two turntables. Simple, positive controls reduce operational errors. Frequency response—2 DB from 30 to 15,000 cycles; Distortion—less than 1% from 50 to 10,000 cycles; Noise Level—minus 65 DB's or better. Meets all FCC requirements for FM.

RPC-40 PORTABLE CONSOLETTE

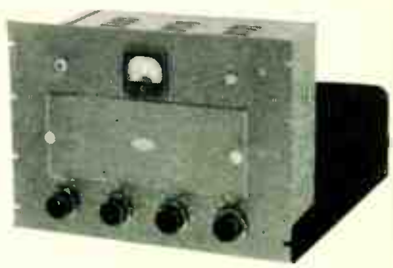
Ideal for remote pickups yet complete enough to serve as a studio console. Four input channels for microphones or turntables, high level mixing, two output lines. Two RPC-40's interconnected provide 8-channel mixing—a feature of special interest to new TV stations planning future expansion.

RR-30 REMOTE AMPLIFIER 3 CHANNEL

A lightweight, easy-to-carry combination of amplifier and power supply—simple and quick to set up. Provides three high-fidelity channels, excellent frequency response, high over-all gain.

RR-10 REMOTE AMPLIFIER SINGLE CHANNEL

A complete, self-contained unit with built-in power supply. An excellent low-cost amplifier for remote pickups requiring only one high-fidelity channel.



RL-10 VOLUME LIMITER

Engineered for high-fidelity AM, FM or TV speech input. Increases average percentage modulation without distortion.

RP-10 PROGRAM AMPLIFIER

High gain, low distortion, excellent frequency characteristics. For rack or cabinet mounting.

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Industrial and Commercial Electronic Equipment, FM, AM and TV Broadcast Equipment, Tubes and Accessories

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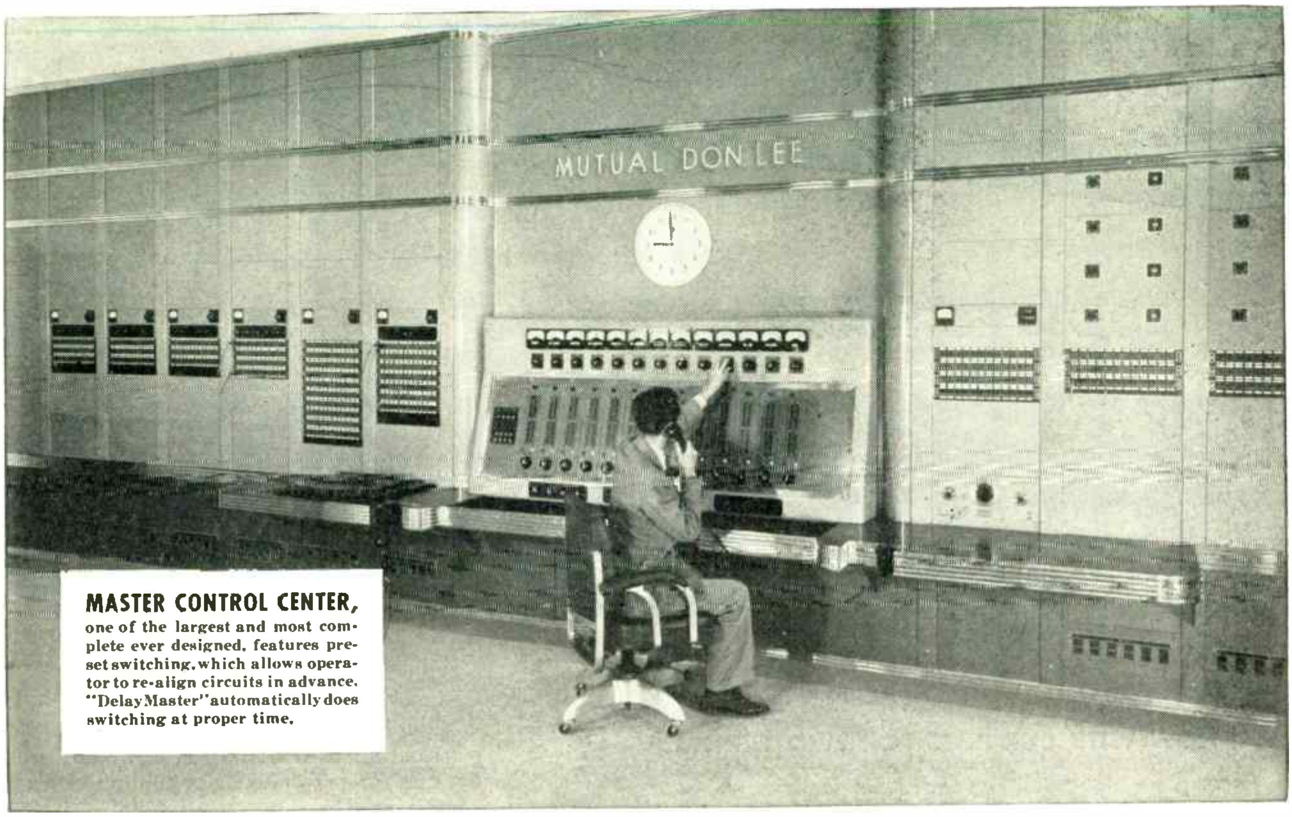
Raytheon Manufacturing Company, 50 Broadway, New York 4, N. Y., WH. 3-4980

New Mutual-Don Lee Studios



MASTER CONTROL CENTER, one of the largest and most complete ever designed, features preset switching, which allows operator to re-align circuits in advance. "DelayMaster" automatically does switching at proper time.

MUTUAL-DON LEE'S brand new 3 million dollar Hollywood studios serve as the heart of the network's West Coast AM-FM-TV activities. The block-square building is as modern as tomorrow, and its audio facilities are unexcelled anywhere in completeness and flexibility.

The impressive Master Control—custom-built by Western Electric—is one of the world's largest and most complete control centers. It contains equipment for simultaneous multiple dispatching to 10 outgoing networks and 4 recording channels of programs originating in the 12 studios, 3 announce booths, 96 remote pick-up lines and 7 incoming networks. Many extra circuits are provided to handle special requirements and a complete monitor system makes all programs available to managerial, sales, and public rooms. Through the use of pre-set program control with automatic switching, only one master operator is required.

Besides the Master Control equipment, Western Electric supplied for the studios 14 custom audio desks of the three types shown on the opposite page.

The "king size" of this installation is indicated by the number of components in Master Control and the 14 desks: 212 amplifiers, 67 rectifiers, 996 relays and 6,999 jacks, joined by 145,500 feet of wire with 108,074 soldered connections.

Western Electric and Bell Laboratories engineers are experts in the design and construction of custom-built audio and switching systems for stations of every size—as simple or complex as you require. For details see your Graybar Broadcast Representative, or write to Graybar Electric Company, 420 Lexington Avenue, New York 17, N. Y.

—QUALITY COUNTS—

Distributed by GraybaR — OFFICES IN 95 PRINCIPAL CITIES

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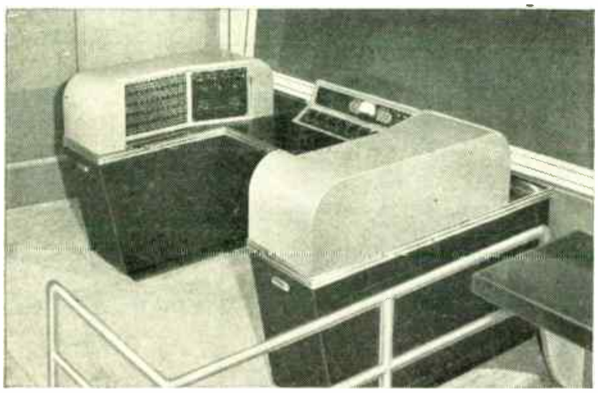
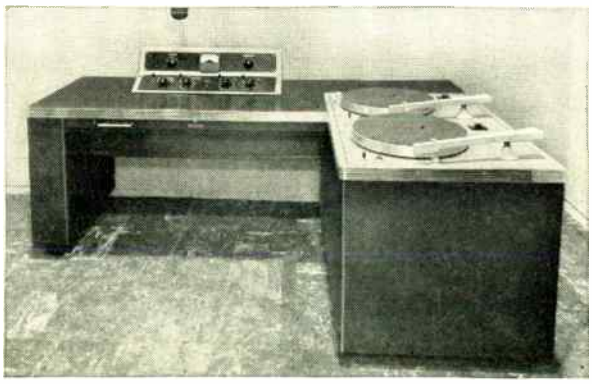


STUDIO CONTROL CONSOLES–Eight of these serve the auditoriums and drama studios in the new Mutual-Don Lee headquarters. Each console provides for six microphone inputs, a reverberation circuit, two transcription inputs and a remote input channel.

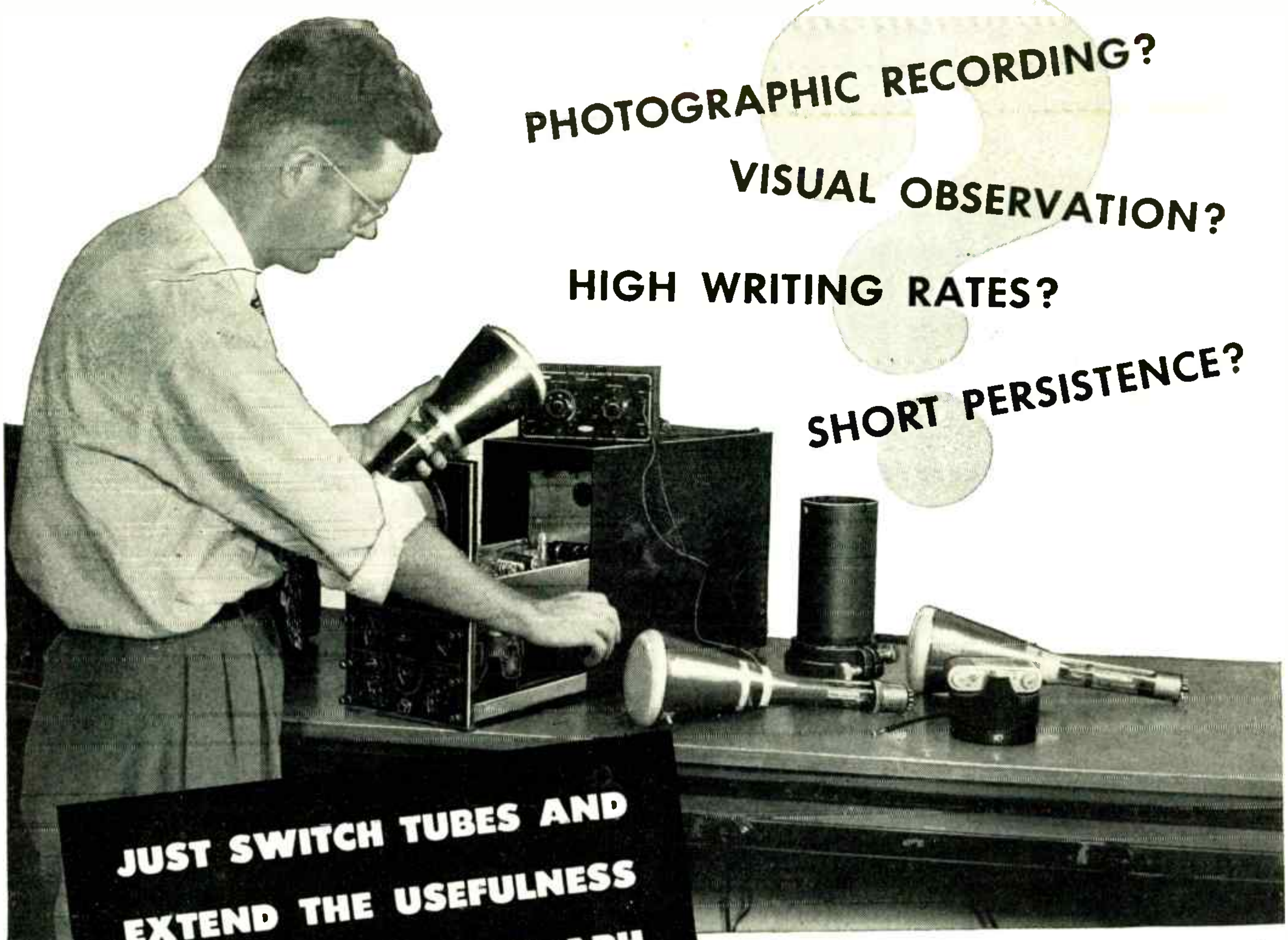
STUDIO-TYPE TRANSCRIPTION CONSOLES
Three of these are used in the smaller studios for handling commentary and round-table discussion programs, disc jockey shows, and the playback of delayed broadcasts with facility for cut-in announcements.



ANNOUNCE-TYPE TRANSCRIPTION CONSOLES—Three of these provide facilities in the KHJ network and FM announce booths for fading into and out of programs, giving identification and spot announcements and playing transcribed commercials and recorded fills.

Mutual-Don Lee's new $3,000,000 block-square Hollywood home.

Electric



JUST SWITCH TUBES AND EXTEND THE USEFULNESS OF YOUR OSCILLOGRAPH

SCREEN CHARACTERISTICS AT A GLANCE . . .

The following types of fluorescent screens are available in Du Mont cathode-ray tubes:

P1: Medium persistence green. High visual efficiency. For general-purpose visual oscillographic and indicating applications.

P2: Long persistence blue-green fluorescence and yellow-green persistence. Long persistence at high writing rates. Short-interval excitation.

P4: Medium persistence white for television images.

P5: Extremely short persistence blue for photographic recording on high-speed moving film. Persistence time for energy drop to 50% is 5 microseconds. Available on special order.

P7: Blue fluorescence and yellow phosphorescence. Long persistence at slow and intermediate writing rates. For filtering out initial "flash" and for high build-up of intensity under repeated excitation, this screen may be used with Du Mont Type 216-J Filter.

P11: Short persistence blue. For recording high writing rates. Persistence time for energy drop to 50% is 10 microseconds.

There's a screen for *every* oscillographic purpose. But *only* Du Mont makes *all* types of screens. By having that extra Du Mont tube with the right screen available, you can cover a wider range of applications more quickly and realize far greater value from your oscillograph, simply by switching tubes.

As a time-, trouble- and money-saver, that extra, dependable, high-quality Du Mont tube should be on hand when you need it. So why not buy it now while you're thinking about it?

And when replacing cathode-ray tubes, always remember that Du Mont tubes are made to RMA specifications and therefore fit *any* standard oscillograph.

Use the right screen for the right job. Descriptive data on request.

DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: ALBEEDU, PASSAIC, N. J., U. S. A.

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, EDITOR ★ M. CLEMENTS, PUBLISHER ★ 480 LEXINGTON AVE., NEW YORK (17) N. Y.

ELECTRONIC SUB-CONTRACTING should be encouraged at this juncture in the national preparedness program. Government agencies are already putting out big construction schedules, assigning these to a few large concerns. But in light of experience of the past 6 or 7 years, it was the sub-contracts to the smaller companies which built up the huge production output. All these concerns should have a hand in present preparedness.

RECEIVER RADIATION may be one of the hurdles to good television reception as the number of sets in use increases. Principal offenders will be some of the low-price TV sets which are being sold in quantities. Television makers may easily strangle themselves and the new industry, if they permit sets to go out that cripple or render inoperable other sets in the vicinity.

COSMIC STATIC or radio interference coming from the stars, is now being talked about a great deal, without bringing out any very definite information concerning its actual intensity in microvolts. Cosmic static is a fascinating subject, worthy of the most painstaking scientific study. But radio engineers need not worry about it as an interference bugaboo, for such stellar static comes in at levels far too low to be even detectable in present home or commercial receivers.

QUALITY CONTROL—Most of us are familiar with the legend in which, for want of a nail, a kingdom was lost. Current analogy is communications equipment prematurely failing due to faulty components or poor quality materials. Better quality control of materials and components at their source would go a long way towards eliminating many of the failures occuring in equipment after it leaves the factory.

DON'T NARROW TV CHANNELS, we plead, in answer to proposal being made to gain spectrum space for more television stations. With unprecedented pressure now being exerted by nearly 200 applicants for TV licenses, —and more to come,—one bright (?) suggestion has been to cut down frequency-width since, it is claimed, only a 350-line picture is now obtainable anyway.

Television needs the full detail of the 525 lines now authorized. Any fewer lines will forever hobble the new art.

COST FACTORS IN TV RECEIVERS—The CR tube, cabinet, circuit design and method of circuit manufacturing are the major components and factors contributing to the cost of television sets. The sooner tube costs are lowered and new circuit designs resulting in the use of fewer tubes are developed, the sooner receiver costs will come down. Several firms are working with printed circuits, believing that these offer one step in the direction of lower costs. All in all, it is not surprising that competent engineers are predicting the next two years will see new circuits and new manufacturing methods drastically affecting receiver costs.

AT&T COAXIAL LINKS GO WEST—At least 10 new coaxial cable links for television service are provided for in AT & T's $93 million expansion program for 1948. These links will transmit video programs from Boston to Richmond and as far West as St. Louis. Over 2000 miles of coaxial will connect the middle West by Fall In December coaxial cables between Philadelphia and Cleveland will be activated. By the same time the link will be extended to Richmond and will continue westward as video stations go on the air.

TELE-TECH SALUTES WPIX

Complete engineering analysis of construction, installation and operation of the New York Daily News television station WPIX will be published exclusively in TELE-TECH in July. Watch for this comprehensive engineering story on the postwar's No. 1 independent TV station.

Press Assn. Photo

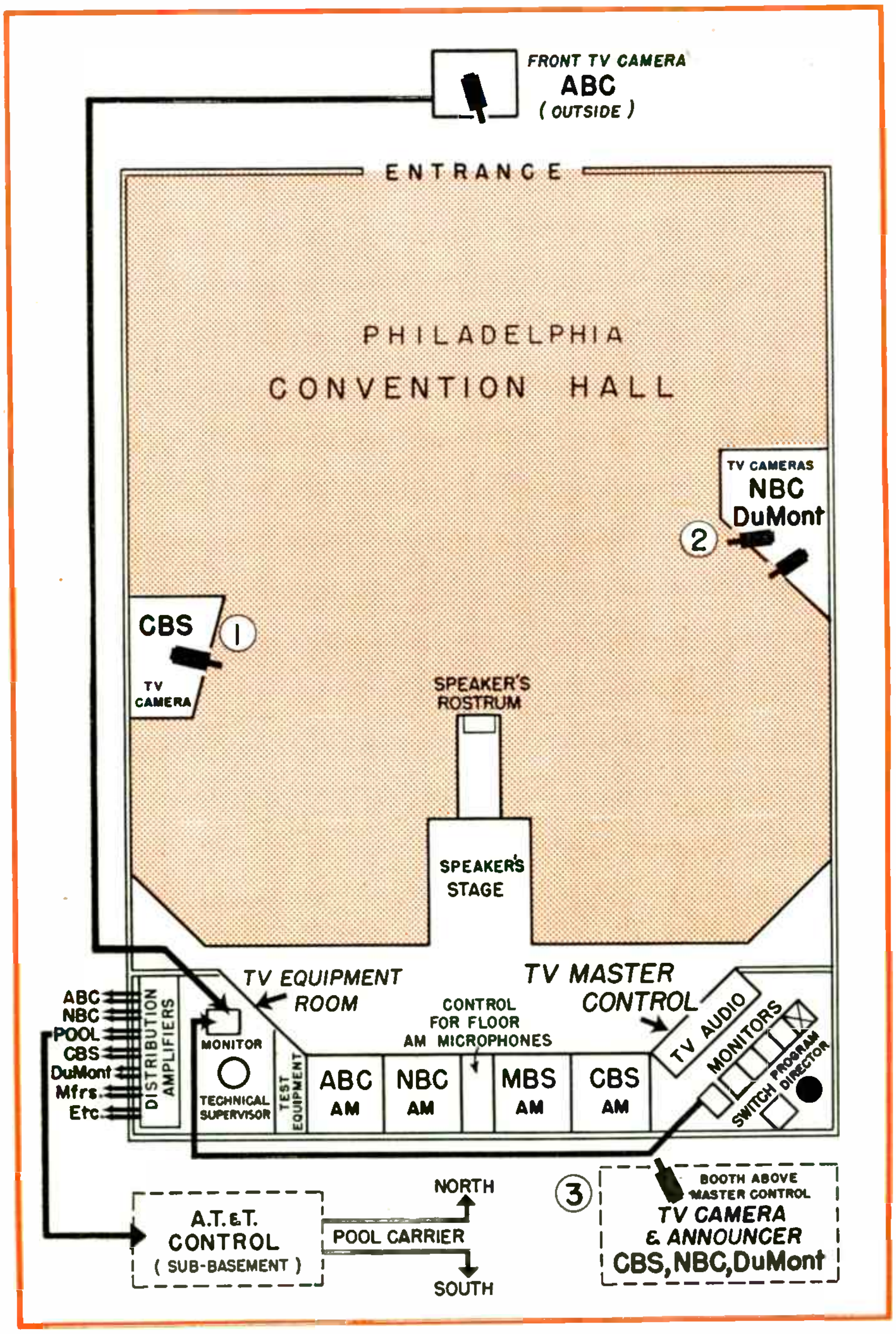


Diagram showing position of 4 TV cameras at 3 locations to be operated as a network pool during the Republican and Democratic conventions. Note fifth camera operated by WFIL-TV personnel for ABC at entrance. Operating details are described in story

TV POOL at National Conventions

Engineering details of network TV pool operations at Philadelphia political meets

By STANLEY GERSTIN

ENGINEERS responsible for recording on television screens the history-making events expected to transpire in Philadelphia's convention hall in June for the Republican presidential convention and in July for the Democratic conclave have finally completed their plans, except for minor details. Programwise, this greatest of all television shows to date will feature continuous convention-floor coverage and dozens of special events which will be televised from temporary studios from within the convention building. Engineering-wise, the two major national conventions will mark the most gigantic undertaking yet attempted by the still-young television industry, and it is expected that plans for convention coverage will serve as a guide or primer for future coverage of comparable national events.

BASIC ENGINEERING PLAN

In order to provide equal facilities for all the television interests, operations are based on a plan whereby 4 networks; namely, NBC, CBS, DuMont and ABC, will operate a television pool. They will operate

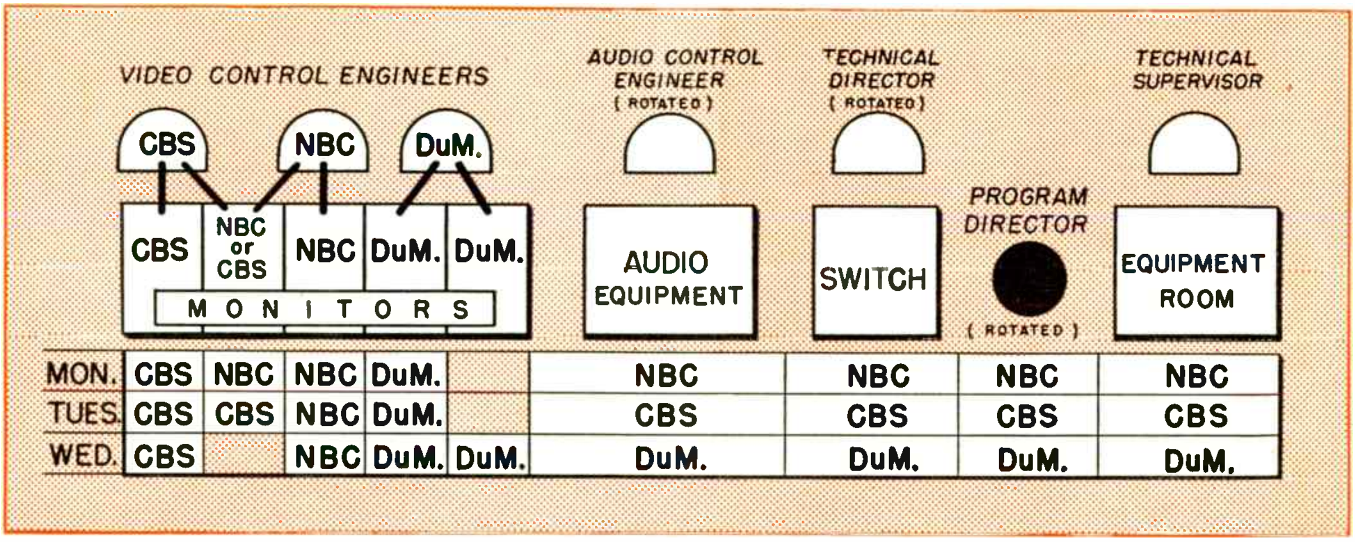


Diagram illustrating assignment of personnel by 3 participating nets (CBS, NBC, DuMont). Daily order of assignments is illustrative, not factual. Note that day each net becomes responsible for two cameras, same net's personnel takes charge throughout

5 cameras; 4 within the convention hall from 3 platforms and one outside the building at the entrance. This pool will use the AM audio facilities. The pool will be available to any television station desiring its pickup. Each net will also operate its own special studio elsewhere in the building for special-events programming; local affiliates of each net will also operate their own cameras in temporary studios. Independents (unaffiliated TV stations such as WPIX, New York News station) will operate individual studios for exclusive programming.

Several miles of coax cable will connect all pool cameras to the master control room and from there to the AT&T control room; other cameras will be connected directly to the AT&T control room.

Cameras will be equipped with image orthicons and crews will depend on lighting installations being made for newsreel camera operations.

AT&T will have 4 cable lines running through Philadelphia. One originates from Washington, D. C., and runs through Philadelphia to New York. The second reverses this course from New York to Washington. These will be used to carry regular programs. Two additional coaxials will be provided by AT&T, starting from Philadelphia and running 2 northward to New York and 2 southward to Washington. These latter 2 cables will carry the convention show. One of the 2 cables will be used continuously and exclusively by the television pool. The second or share cable will be used by all the stations and nets for exclusive periods by allotted time determined by drawings. If the pool cable fails, the share cable will be taken over for pool telecasts.

Both north and south cables will terminate in AT&T's receiving stations in Washington and New York from where feeds will go to respective stations desiring to pick up the Philadelphia convention signal.

Respective operations of the pool, independents, local stations and the television newsreels, in detail, will be as follows:

NETWORK TELEVISION POOL

As stated above, NBC, CBS, ABC and DuMont will comprise the pool which will provide exclusive coverage on the convention floor. Four cameras will be used in 3 positions with CBS occupying camera position No. 1; DuMont and NBC at position No. 2 with one camera each; one camera at position No. 3 atop the master control room will be operated by camera crews from NBC, CBS and DuMont in rotation. An announcer will also be in the booth for camera position No. 3. ABC will operate the outside camera at the entrance to the auditorium.

Actually, 8 cameras will be available for the pool; that is, 2 from each net. although only 5 (4 inside and 1 outside) will be in constant use, with the remaining cameras as spares. All cameras will be coordinated by a common sync generator. DuMont agreed to modify its cameras for use with another manufacturer's generator to facilitate pool operation.

The master control room for the pool will be a special booth built above the speakers' rostrum on the right. This control room will be occupied by the technical director, the program director, the monitoring panels and the audio control panels. The 4 cameras in the 3 positions inside the hall will feed to the master control room where the final outgoing picture will be selected.

At the same time, sound will feed to the control room from the centralized sound control booth located between the 4 AM booths behind the rostrum (see drawing). AM sound installations will serve

(*Continued on page 68*)

What They Say about

Third article in a series conducted by editors of Tele-Tech

ENGINEER PAY

Engineers, who brave electronic unknowns, fear to tread in field of human relations; hesitate to speak publicly on "engineer pay"

READERS of TELE-TECH have manifested considerable interest by mail, phone and in personal conversation with the editors on the subject of this series of articles on engineer pay. But almost to a man they hesitate being quoted. "I believe that. . . ."one engineer writes, "but don't quote me." An executive says "Because of my position in the industry I wouldn't want to stick my neck out by being quoted. However, I believe that. . ."

Pay, like certain social diseases, is not a subject to be hushed up. Talking about it will do more good, let off more steam and clear the atmosphere for better understanding and make possible a realistic evaluation of an engineer's worth than any form of silent treatment.

In this, our third in a series of articles on the subject, we are publishing a few letters and comments about engineers and engineer pay. Previous articles appeared in the April and May issues of TELE-TECH. Readers who wish to comment for publication are assured that their names will not be used if they so request. Pertinent comments follow:

PAY FOR EXPERIENCE

By RALPH H. LANGLEY,
Radio Consultant, Great Neck, N. Y.

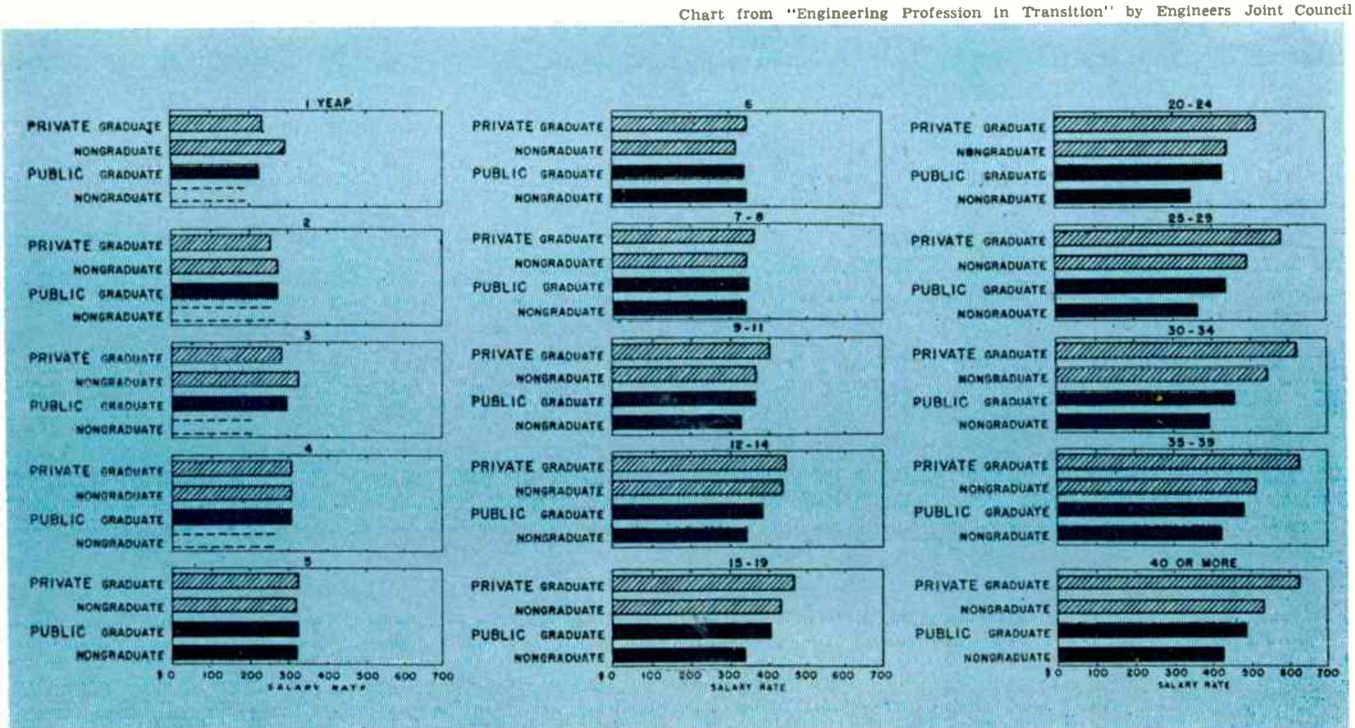
Two thoughts come to mind in reading the article "How Much Pay is an Engineer Worth?"

I wonder just how many of the men you classify as "Studio Engineers", "Transmitter Engineers" and "Chief Engineers" have any right to call themselves engineers at all. Too many of them, in my experience, are no more than amateurs carried away by the romance of radio, and getting no small part of their satisfaction from the mere privilege of working in this fascinating field. No uniform salary base can be set up for these people, and if it were, they would be the first to undersell themselves. This is only the topic paragraph for what could run into quite an article.

Any discussion of salary that does not take into account the worker's years' of experience in his field is basically unsound. No doubt many station operators prefer to hire new

Median base monthly salary rates of graduate and nongraduate engineering employees in public and private employment by experience level

Chart from "Engineering Profession in Transition" by Engineers Joint Council



men as often as there is a request for a raise. But unless there is some relation between pay and accumulated proficiency, the worker has only a job, with no security and no incentive. This, perhaps, is where the union steps in to set wages and salaries, and put a price on a man's efforts, no matter how long he has served or how good he has come to be.

The most satisfactory method I have found for determining what an engineer's pay should be is to base salary on years out of school and I mean, of course, engineering school. There are salary tables on this basis for minimum, average, and maximum rates. These need adjustment for today's cost of living, but they indicate what a man should be earning if he is good enough to be in engineering work. If an applicant can be hired at a lower figure, that may be a sound reason for not hiring him. If he asks for more, it is at least worth while to find out why he thinks he is worth it. He may be right.

The poor old law of supply and demand has taken quite a kicking around in the last few years, but I am afraid that it what is setting the salaries for broadcast personnel, and for many others who are working in the engineering field. This situation cannot be cured, however, by putting a price tag on each job.

WHAT DO YOU THINK ABOUT ENGINEER PAY?

Does the pay of engineers in the communications industry keep pace with the rise in income in other industries and professions? Considering the elements of education, application of skill, engineering responsibilities and contribution to communications and our economic life, are engineers receiving adequate pay?

Do engineers feel adequately paid?

In short, how much is an engineer worth?

The editors of TELE-TECH invite expression of opinions from the engineers themselves. Tell us what you think. Your name will not be used if you wish to remain anonymous.

JOBS FOR ENGINEERS

(ANONYMOUS)

I have been greatly disturbed by the probably lack of openings for electronic engineers, and the fact that colleges have done little about taking care of these men. In fact, many colleges are encouraging men into electronics and away from power, whereas I saw recently that General Electric expects to take 10 power men for their training course to one electronic engineer.

You unquestionably have seen the reference that by 1951 it is estimated that there will be only 50% of the positions available to all classes of engineers graduating. The implication is that every other engineer must enter some other field from that for which he had planned.

The peak year is considered to be 1950 when there will be around 70,000 graduates with only 30,000 positions available. If we use the 1951 and subsequent estimates, there should be nearly 20,000 electrical engineers for less than 10,000 openings. If we attempt to apply the General Electric figures to the strictly communications industry and generalize a bit, one could readily come up with the fact that only one in 4 electronic engineers would have an electronic position available to him.

(Editor's note: It is difficult to estimate the effect on pay levels that the above described situation will have, but it is obviously an important consideration in the whole economic picture.)

STATISTICS ON ENGINEERS

(From Engineers Joint Council report)

Engineers (all types) by 1950 will total 337,000

25 percent of all are electrical engineers

Medium income of inexperienced engineers:

1929: $1300
1939: 1580
1946: 2500

30 percent of all engineers are in administrative work: design, development and applied research

Educational status:

3.7% are PHDs
15.4% are MAs
4.1 have no degree
76.8 are bachelors

Earning power for most engineers peaks off after 35 to 40 years of service

ENGINEERS IN MANAGEMENT

By Dr. O. H. CALDWELL, Editorial Director, TELE-TECH

Radio engineers can be proud of the industrial wealth they have created and continue to create. They have observed that their knowledge and their efforts are at the center of businesses which collect hard round dollars in the millions. From now on, radio engineers must not be satisfied to be merely employees and staff aides in the huge industries they have created.

Radio engineers should themselves take business and industrial leadership. It is time for the radio engineer to be the "big boss" of his own concern and shape its general policies. Instead of avoiding and evading business responsibility in order to keep close to the design room and slide rule, radio engineers should prepare to reach out themselves for the top management positions,—for independent proprietorships—for public service in fitting radio into broader usefulness to humanity.

Radio engineers are perfectionists. But even from this aspect of perfectionism alone, radio men will admit that fullest perfection in radio cannot come unless the radio engineer has the greatest freedom in which to work. And this means that there must be radio engineers at the top who can give sympathetic encouragement to radio engineers throughout the organization. Let radio men accept and even seek out these management responsibilities.

New Circuit Design for WOW TESTER

Pitch perceptor measures variations in amplitude at any rate from a half to 40 cps; provides inked graphs and oscillograms of the characteristics under study

By M. G. NICHOLSON, Colonial Radio Corp., Buffalo

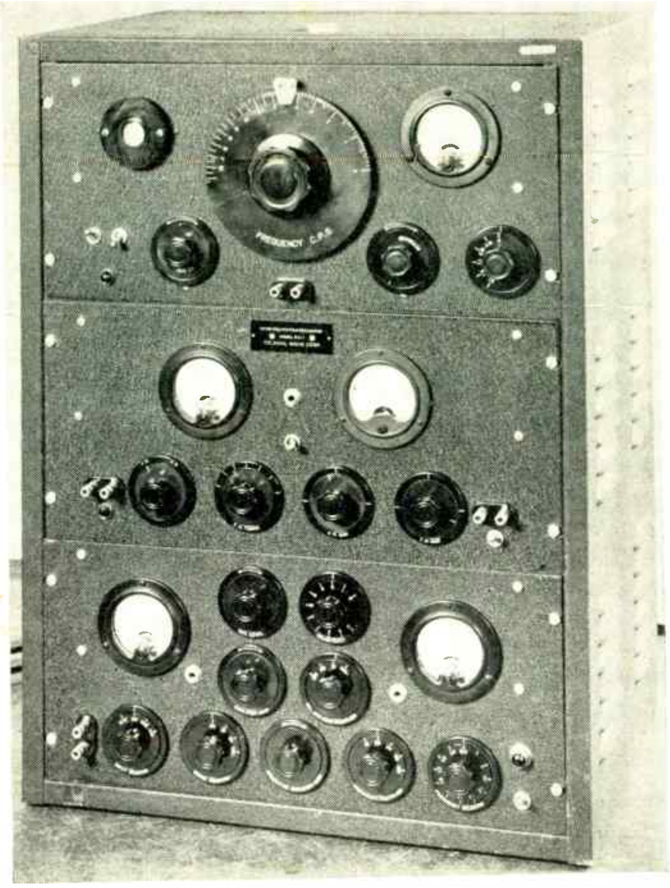


Photo shows rack with beat oscillator at top; center unit takes signal through discriminator; voltmeter and analyzer at bottom

IF VARIATIONS in speed of phonograph recording or playback occur at a rate of one or two per second or slower, with appreciable amplitude, a listener will recognize a continuous change of the pitch of the music being reproduced. If, on the other hand, these variations are at a higher rate, a listener probably will not recognize the effect as one of changing pitch, but as a vibrato to the music, if the rate is in the order of 5 to 10 per second. For variations at rates of about 15 per second, the effect may be described as a flutter. For rates still higher, the general effect is one of dissonance, often quite difficult to recognize and isolate.

These variations in frequency (pitch) in the reproduction of a constant frequency note is defined as "wow." This equipment will measure wow from a negligible quantity up to 2.5%, where wow is defined as the peak variation in frequency from the mean frequency divided by the mean frequency. This definition should be further restricted, as to the frequency of the wow, but since there is little agreement in this matter, we have arbitrarily designed this equipment to cover the spectrum of one-half to 40 cycles per second (See Footnote A). This includes wow from eccentric turntables (78 rpm), idler wheels, motors up to 2400 rpm, and spools in wire recorders.

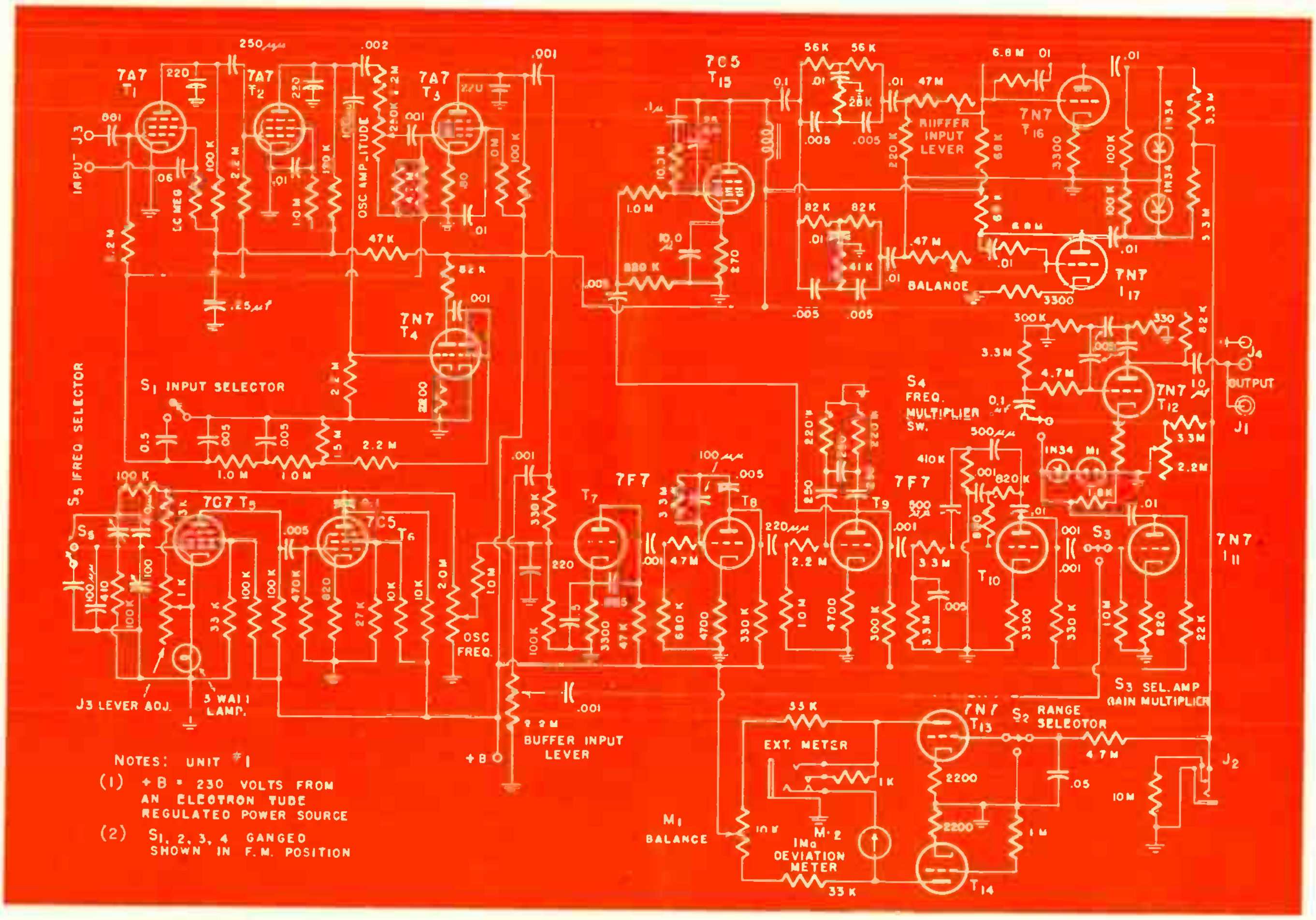
Frequency variations at rates less than one-half of a cycle per second are not read on the wow meter, but since they cannot be ignored in the proper design of phonographs and wire recorders, provisions are made in this equipment where slow variations from zero to one-half of a cycle per second are read simultaneously on a separate meter. This meter is calibrated in cycles per second deviation. An example of a slow speed variation in frequency (pitch) is a phonograph, where the decrease in load upon the motor as the pick-up moves from the outer edge of the record towards the center allows the turntable speed to increase during the playing of a record. Another example is a wire recorder where the loading of the motor varies as the wire level wind-cycle, which may be in the order of 4 cycles per minute.

This equipment will also measure variations in amplitude at any rate from one-half to 40 cps for variations up to 25%. This percentage figure corresponds to the accepted definition of percentage amplitude modulation. An example of variations in amplitude is a wire recorder with the wire not being continuously held in contact at the gap in the head due to mechanical flutter of the wire. This would not necessarily result in frequency variation (wow) but the audible effect would be practically identical.

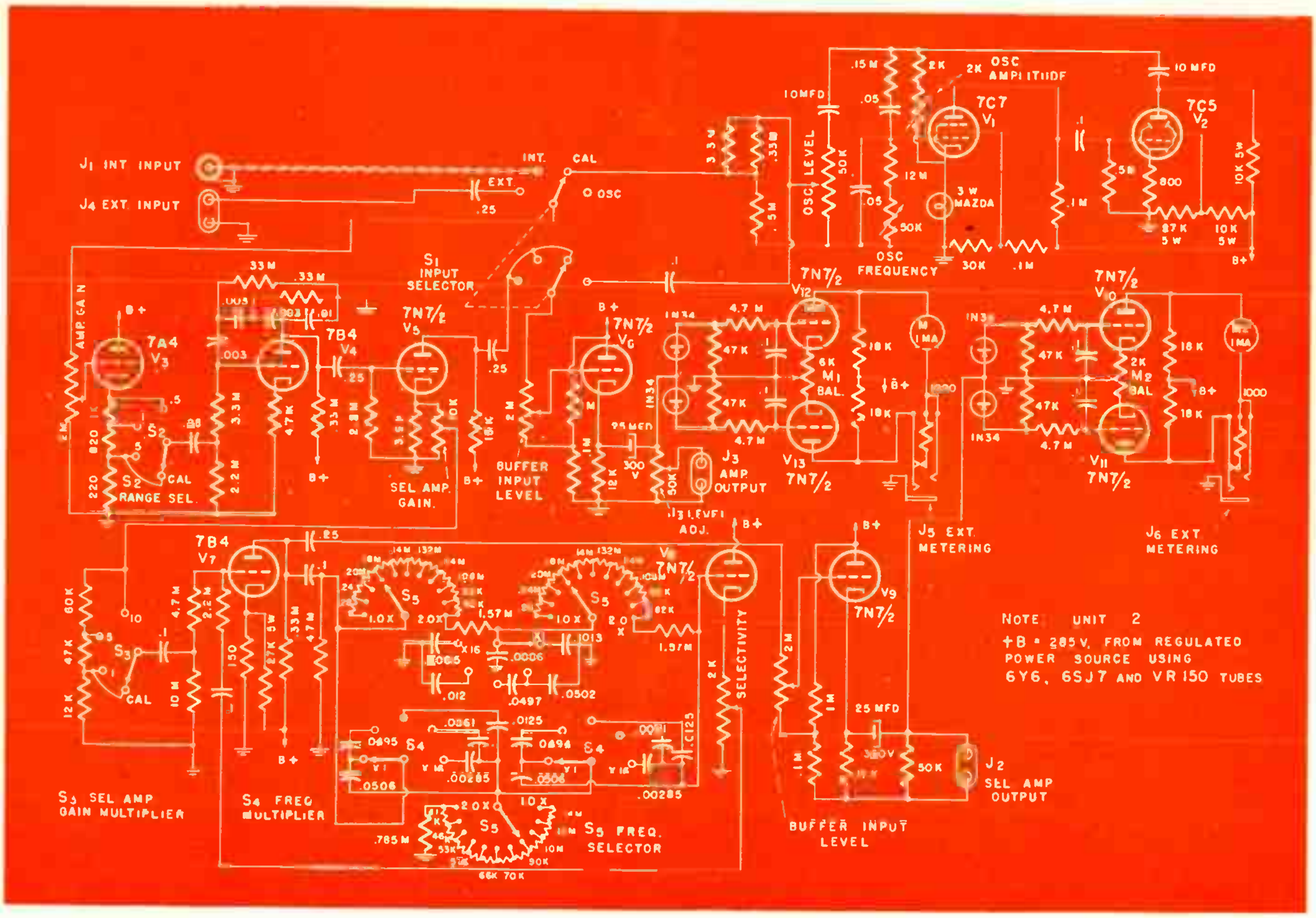
Provisions for recording milliam-

(*Please turn to next page*)

Footnote A. Since the time of the design and construction of this equipment there has been a draft of proposed standards relative to flutter or wow by the Sound Committee of the SPME reported in the Journal of the Society of Motion Picture Engineers in August 1947. Flutter (wow) is defined as the R.M.S. value rather than the peak value as used in the calibration of this equipment. The range of frequencies considered as flutter is "all rates up to 200 cycles per second".



Above shows schematic of the pitch perceptor and below is the low frequency voltmeter and wave analyzer circuit



WOW TESTER CIRCUIT DESIGN (Continued)

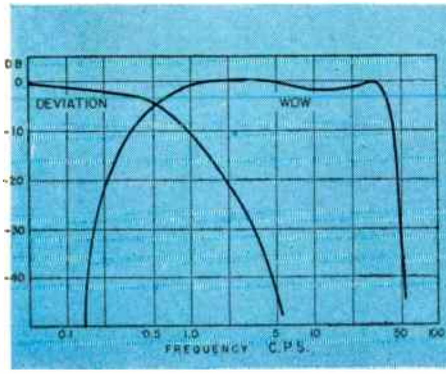


Fig. 1: Showing wow and deviation circuit responses recorded by equipment used with Esterline-Angus recording milliammeters

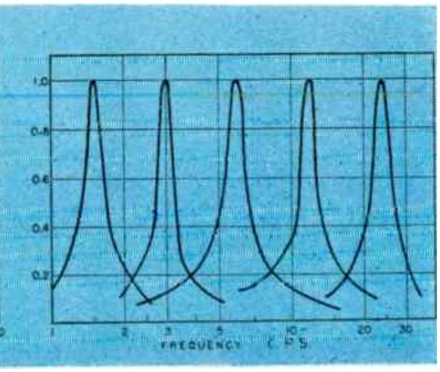


Fig. 2: The selectivity characteristic of the selective amplifier is illustrated for 5 different frequencies across the band

meters and a recording oscillograph make it possible to obtain automatically inked graphs and oscillograms of the characacteristics being measured. It is particularly desirable to use recording meters on wire recorders since there is usually an appreciable change in wow and slow variations in the frequency throughout the entire length of the wire.

Measuring Wow Sources

Wow usually consists of more than one component. Thus, a means for measuring the amplitude and frequency of the major components will enable the user to identify the various sources. As an example, a phonograph record changer may be found to have one component at 1.3 cps, another at 5.5 cps, and very little else. The source of the 1.3 cps component may be the result of eccentricity of the turntable or spindle since it revolves at 1.3 revolutions per second (78 rpm). The 5.5 cps component may be from a high spot on the idler wheel which revolves at 5.5 revolutions per second. If, on the other hand, a component at 11 cps were found, it could be from an elliptical idler wheel. An analyzer covering the spectrum from one to 32 cps has been built into this equipment for determining the nature of the wow and amplitude modulation. The selectivity is substantially independent of the frequency.

A constant frequency recording known to have very low wow is used in testing phonographs. The problem of testing wire recorders is complicated by the fact that the wire speed on most machines increases as the takeup spool fills, and by the difficulty in obtaining a recording with sufficiently low wow to be negligible. If a constant frequency note is recorded on the machine being tested, and then played back, there will probably be cancellation of some of the wow components. If, however, the wire is completely rewound on the spool, and then rethreaded in the machine with the various idlers, level winding mechanism and spools, in a new random relationship, cancellation is quite unlikely. This condition approximates the condition of recording on one machine and playing it back on another.

The frequency of the constant frequency record may be anything between 2200 and 4000 cps. A frequency of 3000 cps is preferred, since the wow meter is calibrated to read directly at that frequency (See Footnote B).

The output of the unit being tested is amplified, then frequency-converted in a mixer to 450 cps, passed through a balanced discriminator, filtered and then read on a vacuum tube voltmeter as wow. The low frequency output of the discriminator is filtered and applied to the deviation meter which reads up to plus and minus 50 cps from the center. This meter is very useful in indicating proper "tuning in" of the signal from the constant frequency record.

Two rack-mounted units are required to perform the complete operation. The first unit carries the signal through the discriminator. The second unit measures and analyzes the output of the first unit. This second unit may be used separately as a vacuum tube voltmeter and analyzer for frequencies from one to 32 cps.

In the course of development of this equipment, it was necessary to have a source of voltage variable in frequency from one to 20 cps in addition to that available in existing laboratory equipment for all frequencies needed above 20 cps. Rather than build a temporary oscillator for this purpose, a permanent piece of equipment was constructed. It is included as a third unit in the same rack with the 2 wow measuring units, but is not necessary to their operation.

Typical Wire Tests

The photograph shows the complete rack of equipment. The top unit is the one to 20 cps beat oscillator. The center unit takes the incoming signal up through the discriminator. The lower unit contains the vacuum tube voltmeter and frequency analyzer. Typical tests on a wire recorder are shown in Figs. 5, 6 and 7. A signal of 3000 cps was recorded on the wire recorder, and then played back for measurement of low frequency deviation, wow and amplitude modulation. Fig. 5 is

Footnote B. The above committee proposed that the standard flutter test frequency for 35 mm film and discs be 3000 cycles per second.

Fig. 3: Bandpass amplifier circuit with degenerative network. Details of this circuit shown in schematic on preceding page

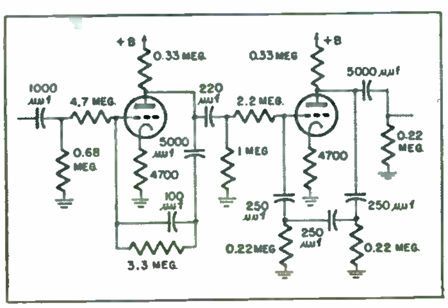
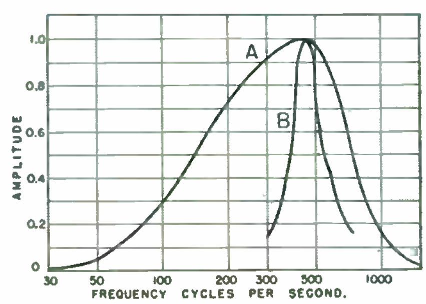


Fig. 4: Output of bandpass amplifier (T10) shown as curve A, with response of tuning (t12) shown in curve B. Details in article



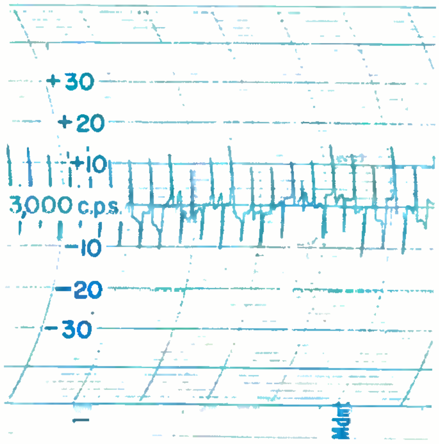


Fig. 5: Low-frequency deviation from 3000 cps

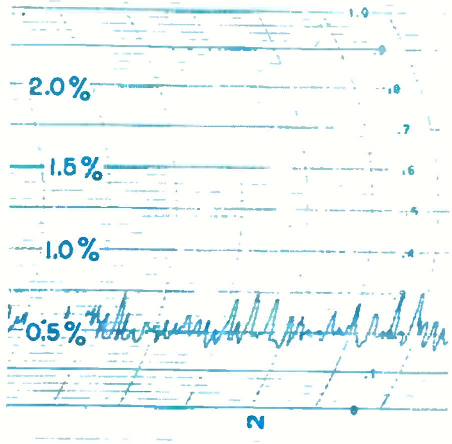


Fig. 6: Wow recorded during test

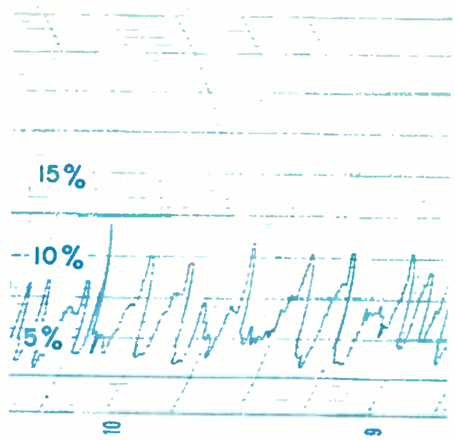


Fig. 7: Amplitude modulation recorded in test

a record showing the low frequency deviation from 3000 cps which is represented by the center line. Each small division represents a frequency shift of 2 cps, with the upward direction representing an increase in frequency. The speed of the tape was about one division per 50 seconds. It can be seen that the frequency from the wire recorder increases sharply about every 15 seconds. This corresponds to the rate at which the level winding mechanism operates. A microswitch was attached to the mechanism and connected to the edge marker pen of the E-A recording meter, to give an impulse at the instant when the head of the wire recorder reached the top of its travel. By comparing these edge marks with the frequency shift, the effect of the mechanical loading upon the driving motor by the level winding mechanism can be readily seen.

Fig. 6 shows the wow produced by the system. In this particular recorder there is very little change in the wow at the rate of operation of the level winding mechanism, even though there was a pronounced pattern on the chart obtained on low frequency deviations.

Fig. 7 shows the resulting amplitude modulation. There appears to be a rhythmic variation corresponding to the level winding rate on parts of the chart, but not on others. This may be the result of the vectorial sum of the amplitude modulation put on the signal in the process of recording and that added during the play back.

The input impedance of the first unit is about 2 megohms. The input voltage may be any value from 0.0005 to 0.1 of a volt at any frequency between 2200 and 4000 cps. The incoming signal passes through a three stage amplifier equipped with an automatic gain control which holds the output level to within one db over the range of input voltages from 0.0005 to 0.1 of a volt. The source of signal to operate the gain control circuit is taken from the output of the second stage. Since the AGC biasing voltage is proportional to the output voltage of the second stage, it follows that if the third stage can be adjusted so that its gain is inversely proportional to the AGC biasing voltage, the output voltage will be a constant. A very close approximation over the indicated range is obtained with the choice of screen, plate and cathode resistor values shown in the circuit diagram.

A limiter could have been used for wow measurements instead of the AGC on the amplifier but since AGC would have been necessary when making measurements on variations in amplitude, it is used for both conditions of operation. The AGC circuit is very rapid in operation when used for wow measurements, thus effectively "wiping off" any amplitude variations. The AGC circuit is made to operate at a very low rate of speed when used in measuring variations in amplitude. This change is done automatically by the FM/AM selector switch.

The constant level output voltage of the input amplifier is converted to a center frequency of 450 cps in the triode mixer tube (T7). The oscillator injection is obtained from the variable frequency oscillator consisting of tubes T5 and T6.

The output of the mixer consists of signals of several frequencies. The desired signal component is centered at 450 cps, being the difference in frequency of the local oscillator and the incoming signal. The undesired signals consist mainly of components at the local oscillator frequency, the signal frequency, the sum of these two, and harmonics of each. A band-pass amplifier is placed immediately following the mixer, consisting of 2 triodes (T7 and T8) connected with degenerator networks of resistor and capacitor elements. Choice of circuit arrangement and values was dictated by the need for high attenuation at and above 2200 cps, which is the lowest frequency component of the undesired signals mentioned above.

Tuning Indicator

Since it is necessary to tune the local oscillator to approximately 450 cycles from the incoming signal, a tuning indicator is required. For this purpose, a degenerative selective amplifier (T10) adjusted to give maximum gain at 450 cps is connected to a part of the output of the band-pass amplifier and the amplifier (T11) which drives the rectifier and monitor meter (M1) combination. The response of the tuning indicator is shown in Figure 4, Curve B. The output of the band-pass amplifier operates a beam power tube which drives the discriminator.

The balanced discriminator consists of 2 double-T networks (modified Wien bridge), one having zero

(*Continued on page* 62)

Fig. 3: Conductance meter containing the circuit described in this article (lab model)

New Measuring Circuit

Instrument provides simple device for determination

By W. A. McCOOL, Radio Engineer.

FOR MEASURING the loss characteristics of a given insulating material, a suitable specimen is prepared as the dielectric between metal electrodes to form a capacitor, the losses in which are primarily due to the dielectric. These losses are usually expressed and evaluated in terms of power factor.

This circuit, Fig. 1, is similar to those employed with resonant rise technics (i.e., Q-meter, susceptance variation) but has been refined to attain a high degree of resolution in detecting changes in the resonant voltage of the measuring circuit. It permits the direct substitution of both the conductive and susceptive components of the specimen, and eliminates evaluating the total measuring circuit parameters for calibration.

The circuit normally operates at resonance as indicated by the maximum deflection of the voltmeter. Obviously, when a capacitor specimen is substituted in the measuring circuit, the susceptive component is given by the change in capacitance of the variable air capacitor; the conductive component is given by the change in the variable conductance.

$$C_x = C_1 - C_2 = \Delta C \quad (1)$$

$$G_x = G_1 - G_2 = \Delta G \quad (2)$$

The capacitance settings (C) are determined by the resonance indication without and with the specimen, respectively. The conductance settings (G) are determined by maintaining the same magnitude of resonant voltage without and with the specimen. Thus, the total measuring circuit conductance and capacitance are unchanged by substitution of the specimen. The magnitude of the resonant voltage (E) may be used as a measure of the conductance since the circuit Q is equal to $E/e = \omega C/G$, where e represents the constant induced voltage, from which

$$G = e\omega C/E \quad (3)$$

Therefore, the total conductance can be adjusted by means of the magnitude of the resonant voltage, all other factors remaining constant.

Theoretically, then, this technic is ideal for rf impedance measurements since it employs direct substitution and the results are determined entirely from differences, as indicated by equations (1) and (2). In practice, however, the accuracy of measurement is limited by the calibration accuracy and stability of the variable circuit parameters and the resolution in resetting the resonant voltage.

A real continuously variable conductance, suitable for this application, is not practicably realizable. However, the equivalent conductance of a series diode circuit, excited from an anti-resonant circuit, is very stable and can be accurately calibrated in terms of the dc load resistance.

The resolution in resetting the resonant voltage in the basic circuit of Fig. 1 is poor because very small voltage changes cannot be detected. In fact, with an ordinary vacuum tube voltmeter, no voltage change at all can be detected when a very low-loss specimen is substituted in the measuring circuit. Fig. 2 is a diagram of a "differential" type of voltmeter which can be employed for detecting small voltage changes simply by comparing the magnitude of the resonant voltage with a fixed reference. The basic measuring circuit with refinements have been in-

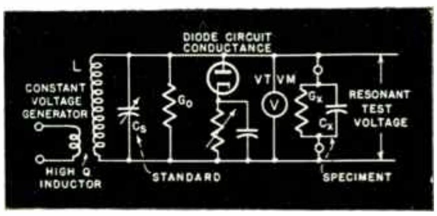


Fig. 1: Basic measuring circuit. Here, G_0 represents the diode circuit conductance

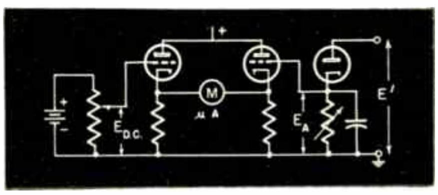


Fig. 2: Diagram of differential voltmeter. DC load voltage E_A is balanced by E_{DC} The

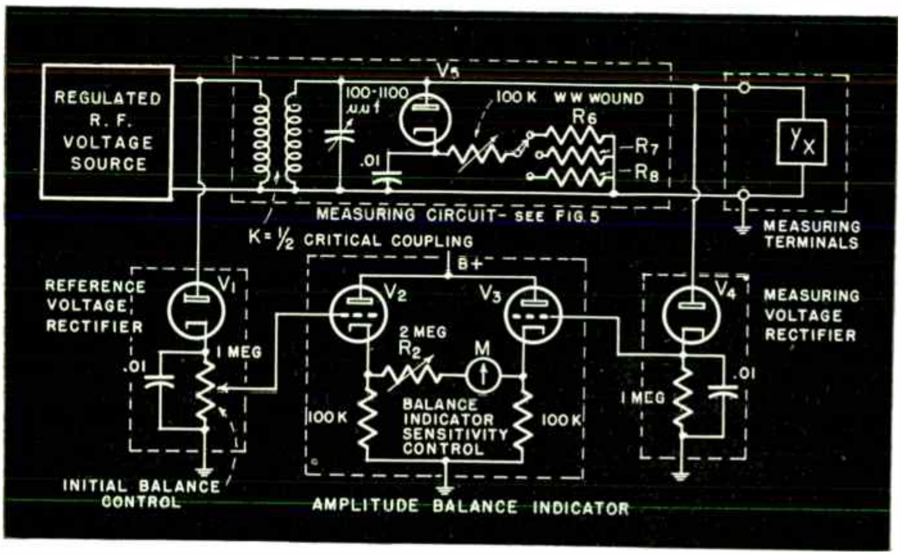


Fig. 4: Circuit includes conductance diode, differential VM, oscillator, power supply

for Conductance Meter

of rf losses in high quality insulating materials

Naval Research Laboratory, Washington, D. C.

corporated into the complete laboratory instrument which conclusively demonstrated that the inherent theoretical possibilities can be realized.

In the laboratory model (photo and Fig. 3 showing schematic of circuit), operation is limited to a single frequency (one mc) for simplicity of design and construction. The reference voltage for the voltmeter is supplied from the oscillator output, thus providing compensation for any fluctuations in the measuring circuit excitation. This oscillator output is regulated by means of an automatic amplitude control, which practically eliminates the interaction between the coupled circuits. In other words, the induced voltage in the measuring circuit is maintained at a constant value despite a considerable transfer of power, in contrast to the very loose coupling usually used in resonant rise technics.

The operation of the conductance meter is simple and straightforward. The voltmeter, which incorporates a sensitive center zero microammeter, can be adjusted to read very small or very large changes in the measuring circuit voltage (depending upon the amount of degeneration employed) and, therefore, serves as both a balance and a resonance indicator, respectively. It is interesting to note that the voltmeter does not accurately measure the resonant voltage but simply facilitates maintaining it at some constant level (±1 millivolt in 50 volts) during the course of a measurement. Otherwise, the measuring procedure is identical to that outlined previously for the basic circuit.

The conductance calibration of the series diode circuit is derived from its rectification characteristic.[1] If the conducting portion of the static diode characteristic is assumed to be linear, and if the series diode circuit is excited by an anti-resonant circuit, it can be shown that the effective residual circuit conductance G_D, in terms of the dc load resistance R_L, the applied peak ac voltage E', and the dc voltage E_A is given by

$$G_D = \frac{\theta - \sin\theta\cos\theta}{R_L(\tan\theta - \theta)} - \frac{1}{R_D} \qquad (4)$$

where θ is one-half the angle of "current flow" ($=$ arc cos E_A/E') and is used as an independent parameter. For a suitable range of θ, E_A/E' can be plotted against R_D/R_L, resulting in a universal diode curve from which the effective conductance of any series diode circuit can be determined by applying measured values of R_L, E', and E_A. The time constant of the resistance-capacitance load must be very much greater than the period of the operating frequency. The error involved in assuming a linear static characteristic is negligible when R_L is very much greater than the average dynamic plate resistance.

Fig. 4 illustrates a typical diode calibration from which restricted ranges have been selected for use in the conductance meter. From this curve various values of fixed resistance are selected to connect in series with a single variable resistance to provide these ranges. Since conductance change is given by load resistance change, this arrangement permits direct calibration in terms of the specimen conductance.

The calibration accuracy has been checked by substituting the equivalent conductive component of a precision resistor-capacitor series combination for that of the diode cir-

(*Continued on page 48*)

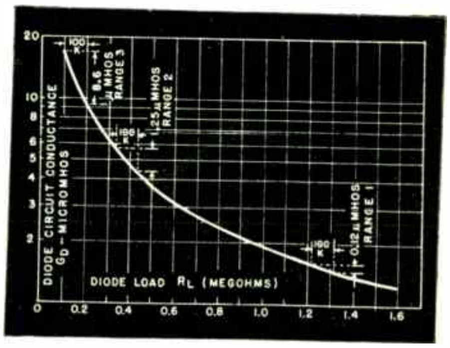


Fig. 5: Diode circuit conductance curve with selected operating range points indicated

[1] Everett, W. L. "Communication Engineering," page 427.

Where to Sell to Uncle Sam

Military and civilian agencies buying radio and electronic communication equipment for national defense requirements listed by department name, headquarters and address

Air Corps
Technical Services
Navy Department
Atomic Energy Commission
Gov't Civil Agencies
European Recovery Program

MILITARY

SIGNAL CORPS
Office of the Chief Signal Officer, Pentagon Bldg., Washington, D. C., REpublic 6700.
Signal Corps Procurement District: Signal Corps Depot, (Purchases all Signal equipment), 2800 South 20th St., Philadelphia, Howard 5-2000; Signal Corps Electronic Lab. (Procures research and development equipment), Fort Monmouth, N. J., Eatontown 3-1060.

AIR CORPS (Aircraft radio and other equipment installed in ground locations bought by Signal Corps).
Headquarters U. S. Air Force, Director of Air Communications, Pentagon Bldg., Washington, D. C., REpublic 6700.
Army Air Forces Materiel Center, Wright Field, Dayton, Ohio, Madison 6511.
Procurement Districts: 111 E. 16 St., New York City, GRamercy 7-4700; 8505 West Warren Ave., Detroit, Hogarth 7504; 506 Santa Monica Blvd., Santa Monica, Calif.
Air Transport Command: (Air Supply Divisions) 67 Broad St., New York City, WHitehall 4-1600; 18 Tremont St., Boston, Capitol 7-9700; 39 So. LaSalle St., Chicago, Randolph 9720; West Warren St., Detroit, Hogarth 7504; 1114 Commerce St., Dallas; 3636 Beverly Blvd., Los Angeles, Calif., Drexel 7081.

MEDICAL DEPARTMENT (Short wave diathermy equipment, ultra-violet and infrared sources, electrocardiographs, galvanic generators, etc.)
Office of the Surgeon General, Supply Division, Pentagon Bldg., Washington, D. C., REpublic 6700.
Army-Navy Medical Procurement Office: 84 Sands St., Brooklyn, N. Y., MAin 5-4581.

CHEMICAL WARFARE SERVICE (Miscellaneous electrical equipment; clips, connectors, wire, etc., under radio and electronic heading).
Office of the Chief Chemical Officer, Pentagon Bldg., Washington, D. C., REpublic 6700.
Chemical Procurement Districts: Army Chemical Center, Edgewood, Md.
District Offices: 111 East 16th St., New York City, GRamercy 7-4700; 158 W. Harrison St., Chicago, Harrison 4390; 1114 Commerce St., Dallas; Bldg. 141, Ft. Mason, San Francisco, West 1-6111.

ENGINEER CORPS (Welding equipment, alarm systems, etc.)
Office of the Chief of Engineers, Graverly Pt., Washington, D. C., REpublic 6700.
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TRANSPORTATION CORPS
Office of the Chief of Transportation, Pentagon Bldg., Washington, D. C., REpublic 6700. (All procurements from Transportation Corps Depot, Marietta, Pa.)

ORDNANCE DEPARTMENT (Limited amounts electrical and electronic test and measurement equipment).
Office of the Chief of Ordnance, Pentagon Bldg., Washington, D. C., REpublic 6700.
Main Ordnance Procurement Districts: 116 East 16th St., New York City, GRamercy 7-4700; Detroit Arsenal Administration Bldg., 28251 Van Dyck, Centerline, Mich., Plaza 3700; Boston Army Supply Base, 140 Federal, Boston, Hubbard 2-9800; 1660 East Hyde Park Blvd., Chicago, Butterfield 5-800; 311 Old Post Office Bldg., 4th Ave. & Smithfield St., Pittsburgh, Grant 5966.

QUARTERMASTER CORPS
Office of the Quartermaster General, Supply Division, Temporary A Bldg., 2nd Street, S.W., Washington, D. C., REpublic 6700.
Washington Quartermaster Depot (Lamps, ranges, fixtures, generators, etc.), Alexandria, Va.
Quartermaster Procurement Districts: 111 E. 16 St., New York City, GRamercy 7-4700; 1819 W. Pershing Rd., Chicago, Lafayette 5-5500.
Quartermaster Depot: Oakland 14, Calif.
Quartermaster Purchasing Office: 1819 W. Pershing Rd., Chicago.

NAVY DEPARTMENT: Washington, D. C., REpublic 7400, Bureau extensions listed below:
Bureau of Supplies and Accounts: (Handles all contractual details). Capt. Roberts, Room 0121 Navy Bldg., Constitution Ave. at 18th St., N.W., Ext. 2136. (Direct contacts with Lt. Comdr. J. M. Malloy, Rm. 0135, Ext. 5141.)
Bureau of Ships: (Handles majority of radio and electronic purchases). Necessary for suppliers to get on Master List. Forms requesting such listing available at office of E. Homer Bowie, Code 117, Rm. 1026, Navy Bldg., Ext. 2834 or Miss Crumb, Rm. 3038, Ext. 3922.
Bureau of Aeronautics: Mrs. Helen C. Schmidt, Purchases, Navy Bldg. "W", Rm. 2W06, Ext. 5293.
Bureau of Ordnance: Capt. William Porter, Ass't. to Contracting Officer, Rm. 3148, Navy Bldg., Ext. 3276.
Naval Research Lab.: Anacostia, Wash. 20, D. C. Supply Officer, Code 302A, TRinidad 2424, Ext. 30.
Bureau of Yards and Docks: Mr. Donald M. Patterson, Manager, Contract Branch, Yards & Docks Annex (Arlington Farms), Rm. 2-B66, Ext. 4928. (Occasional purchases).
Army-Navy Medical Procurement Office: 84 Sands St., Brooklyn, N. Y., MAin 5-4581.
Marine Corps: Lt. Col. H. G. Fortune, Arlington Annex, Arlington, Va., Room 4000, Ext. 7583.

CIVIL AGENCIES

ATOMIC ENERGY COMMISSION: Washington, D. C. (Purchases also made at the various labs. and plants.)
Procurement Sect., Field Operations Branch, Office of Administrative Operations, Bldg. T-3, 16th & Constitution Ave., N.W., STerling 8000, Ext. 498.

OFFICE OF NATIONAL DEFENSE, Pentagon Bldg., Washington, D. C., REpublic 6700.

STATE DEPARTMENT, 21st St. and Va. Ave., N.W., REpublic 5600.

INT'L BROADCAST DIVISION, Office of Assistant Secretary of State for Public Affairs. (Procurement of relay "Voice of America" broadcast transmitters and related equipment.)

U. S. COAST GUARD (Coast Guard radio equipment). 1300 E Street N.W., Washington, D. C., EXecutive 6400.
Radio Engineering Section, Materiel Division: U. S. Coast Guard, Washington, D. C.

CIVIL AERONAUTICS ADMINISTRATION
Radio Engineering Section, Signals Division, Civil Aeronautics Administration, Department of Commerce, Washington, D. C., EXecutive 2460 (Bulk of CAA procurement.)
Central Depot, Civil Aeronautics Administration, Fort Worth, Texas. (Maintains a reservoir of replacement parts.)
Regional Offices (Emergency purchases): New York, N. Y.; Atlanta Ga.; Chicago, Ill.; Fort Worth, Texas; Kansas City, Mo., Los Angeles, Calif.; Seattle, Wash.; Anchorage, Alaska.

MARITIME COMMISSION
Procurement Division, Commerce Bldg., 14th & Constitution Ave., N.W., Washington, D.C., EXecutive 3340.

WEATHER BUREAU
Procurement Section, U. S. Weather Bureau, Department of Commerce, Washington, D. C., MIchigan 3200 (Handles actual purchase details).
Instrument Division, U. S. Weather Bureau, Department of Commerce, Washington, D. C., MIchigan 3200 (Designs all equipment).
Regional Offices (Emergency purchases): New York, N. Y.; Atlanta, Ga.; Chicago; Fort Worth, Texas; Kansas City, Mo.; San Francisco; Seattle, Wash.; Anchorage, Alaska.

NATIONAL BUREAU OF STANDARDS
Purchase Section, National Bureau of Standards, Connecticut Ave. & Upton St., N.W., Washington, D. C., ORdway 4040.
Radio Division, National Bureau of Standards, Washington, D. C. (Radio and electronic equipment.)

COAST AND GEODETIC SURVEY
Office of the Chief Clerk, Coast and Geodetic Survey, Department of Commerce, Washington, D. C., DIstrict 2200 (Actual purchase details).
Division of Coastal Surveys, Coast and Geodetic Survey, Department of Commerce, Washington, D. C.
Division of Geomagnetism and Seismology, Coast and Geodetic Survey, Department of Commerce, Washington, D. C.

FEDERAL COMMUNICATIONS COMMISSION
Engineering Department, Federal Communications Commission, New Post Office Bldg., 14 & Constitution Ave., N.W., Washington, D. C., EXecutive 3620.

FOREST SERVICE
Division of Fire Control and Improvement, Forest Service, Agriculture Department, 14th St. & Independence Ave., S.W., Washington, D. C., REpublic 4142.
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TREASURY DEPARTMENT (Bureau of Federal Supply, 7th and D Sts., S.W., Washington, D. C., DIstrict 5700).

FOREIGN PROCUREMENTS (Apply to respective Embassies, Washington, D. C.)

EUROPEAN RECOVERY PROGRAM (State Department, Virginia Ave. & 21st St., N.W., Washington, D. C., REpublic 5600).

Rieke Diagrams for

OSCILLATOR DESIGN

An improved method for plotting load changes aids in analyzing oscillator performance and also facilitates critical coupling

*By LEONARD S. SCHWARTZ, Naval Research Laboratory, Washington, D. C.**

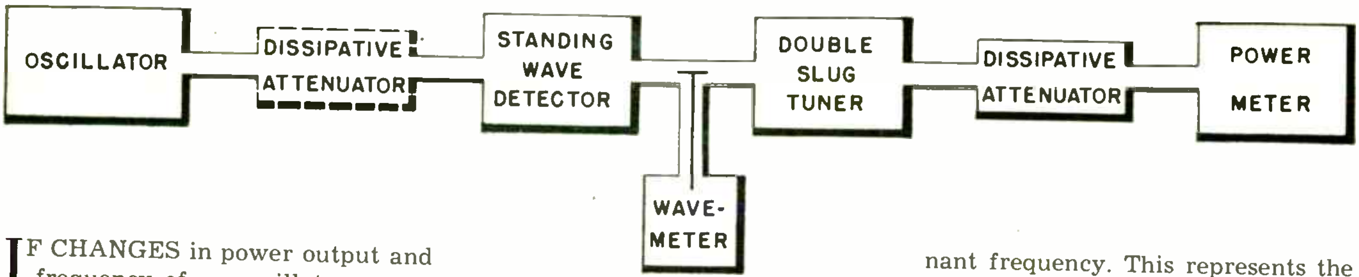

Fig. 1
Equipment for obtaining Rieke Diagrams

IF CHANGES in power output and frequency of an oscillator corresponding to changes in its load are plotted on a circular type of impedance diagram such as a Smith[1] chart, one obtains contours of constant frequency and power output. Such a plot is known as a Rieke diagram.[2] This form provides a powerful tool for the analysis of the performance of microwave oscillators such as determining the proper coupling between an oscillator and a transmission line, and other performance factors. For example, an oscillator is normally designed to deliver power to a matched load, but if the load changes, both the frequency of the oscillator and the power it delivers may change. Since we do not often have control over the variations in the load connected to an oscillator, it is desirable to design the oscillator in a way to minimize the changes in power and frequency. Rieke diagrams will aid us in doing this. The equipment needed for acquiring the data of a Rieke diagram is shown in Fig. 1.

As to the wavemeter shown in Fig. 1, it may be any one of three main types, operating according to the transmission or absorption principles: (1) coaxial-line, (2) cylindrical-cavity, and (3) transition. The oscillator, standing wave detector, etc. would be connected together by means of coaxial cable (air or dielectric-filled) or wave guide. The wavemeter might be connected to the line by means of a T-section with a probe.

In employing Smith charts to plot Rieke diagrams, it is first necessary to obtain a reference point on the chart that corresponds with a physical point on the slotted line, and that is associated not only with the impedance characteristics of the oscillator under test but with the characteristics of the measuring system as a whole. A procedure is to remove the plate voltage from the oscillator tube and then to feed power from a signal generator into the load end of the slotted line in the direction of the non-oscillating cavity. The signal must be at or near the mid-frequency or matched load frequency of the oscillator. The cavity is detuned from the signal frequency, and the probe moved to a position of a voltage minimum called the position of the "detuned short." The cavity is then tuned until the voltage at the probe rises to a maximum value for which setting the system is tuned to its resonant frequency. This represents the condition for impedance match. Unless the transmitter cavity is very loosely coupled to the line, it is more accurate to move the probe a quarter wavelength away and tune for minimum probe pickup.

The zero impedance at this point looking towards the cavity is the impedance which would be seen at the successive voltage minima looking towards the load if a short were placed across the load end of the line. On the Smith chart this impedance is represented by a point on the periphery at zero angle.

The Smith chart is a system of orthogonal circles, those with centers on the diametric line being contours of impedance with constant reactance. In plotting Rieke diagrams, it is unnecessary and even undesirable from the standpoint of clarity of illustration to include these circles, although it is desirable to remember that if they were present they would determine the impedance of the points we plot.

For a given incident wave the voltage measured by the probe at any position along the slotted line is proportional to the length of the vector drawn from the zero impedance point on the Smith chart to the point representing the load impedance seen at that position. In particular, as the probe is moved along

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*Now with Hazeltine Labs.
[1] P. H. Smith "Transmission Line Calculator" Electronics, vol. 12, p. 29, Jan. 1929.
[2] F. F. Rieke and E. Evans, "R-F Loading of 10 Cm. Magnetrons," Radiation Laboratory Report 62-2, Aug. 24, 1942.

the line away from the load this impedance point moves in a clockwise direction along a line of constant voltage standing wave ratio, represented by any of the concentric circles in Figs. 2, 3, and 4.

Usually, we are only interested in the length of the voltage vector which represents the voltage induced on the probe and not in its phase. How this length varies with probe position is shown by allowing the point representing the load impedance to rotate as the probe is moved. It should be evident, however, that as far as the length of this voltage vector is concerned, it is immaterial whether the point representing the load impedance rotates in a clockwise direction or the point on the periphery of the Smith chart to which the voltage vector is drawn rotates an equal amount counter-clockwise.

The advantage in the latter view is that if we visualize the movement of the probe as a movement of this peripheral point, we can hold the impedance plot fixed. In this way the impedances are always represented by their values measured at a fixed position, for example, the position of a detuned short. From this, one can formulate the rule for locating the probe position on the Smith chart. Measured from the zero impedance point (on the diameter at the periphery marked zero), the angular position on the Smith chart is equal to twice the electrical length of slotted line between the probe and the reference point at which the load impedance is measured (position of detuned short). The sense is clockwise when the probe is on the load side of this reference point.

In the experimental procedure, points which represent fractions of a wavelength are marked off from the zero reference position on the slotted line on a scale alongside the milled slot. The signal generator is then replaced by the load consisting of the double slug tuner, dissipative attenuator, and power meter, and plate voltage is reapplied to the oscillator tube. Thereupon, the oscillator generates standing waves in the slotted line, and one of the minima is made to fall on the reference

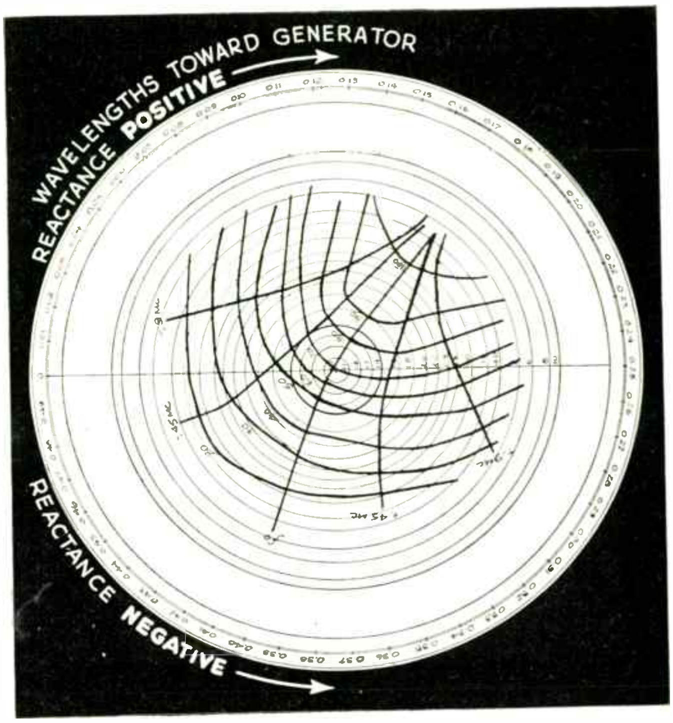


Fig. 2 at right shows the Rieke diagram as charted at 70% coupling

Fig. 3 (center diagram (at right) illustrates recording at 100% coupling

Fig. 4 at far right is a Rieke diagram at 128% coupling. Detailed explanations appear in the first column of text on this page

points successively by means of the double slug tuner. In this way a complete traverse of the Smith chart is made. Power and frequency readings are plotted for several standing wave ratios, different graphs representing different values of coupling of the oscillator to its load. A succession of power and frequency points of the same or approximately the same value are connected to form a system of curves, as in Figs. 2, 3, and 4.

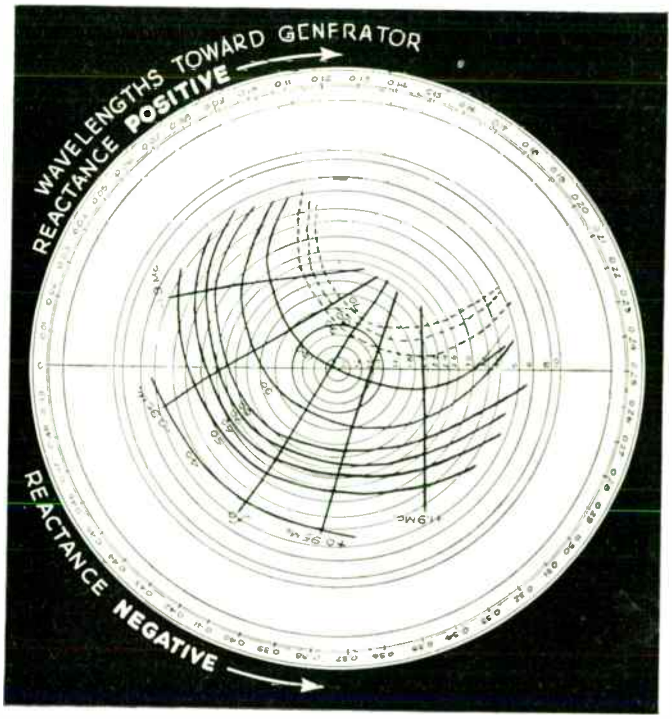
Rieke Diagram Theory

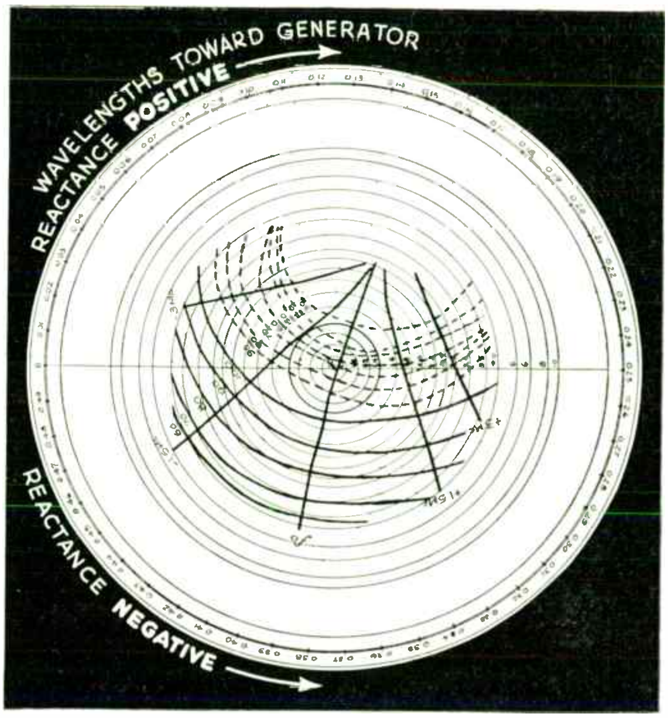
At ultra-high frequencies and microwaves, the oscillator circuit is some form of completely enclosed cavity. Energy is coupled out of it by means of a capacity probe, a loop, or an iris (a simple hole). The extracted energy may be essentially due to capacitive or inductive coupling, depending on the size and position of any of the three coupling elements with respect to the oscillating field within the cavity.

The definition of coupling that we are now about to make has a unique meaning if, and only if, we specify the standing wave ratio along the transmission line between the oscillator and the load. The percentage of critical coupling is the ratio of the power delivered to a matched load (one that terminates a transmission line in its characteristic impedance) to the maximum power that the oscillator is capable of delivering to that load. Suppose, for example, that the line is terminated in its characteristic impedance and that a capacity probe is being gradually inserted in the oscillator. The amount of power coupled out of the oscillator will increase to a maximum and then decrease as the probe is inserted deeper and deeper. At the point corresponding to maximum power output the coupling is said to be critical or 100%. In the region beyond critical coupling, the probe is over-coupled to its load.

An explanation of what is happening can be assisted by a study of Fig. 5 which is an approximate equivalent circuit for an oscillating cavity coupled to its load through a length of transmission line l. The coupling is represented as inductive, but it could be capacitive or a combination of capacitive and inductive as it is intended to be a general coupling network. For convenience we shall use the constant current form of the oscillator circuit and employ admittances in place of impedances.

Now assume that the equivalent of the tube and oscillator cavity conductance is G and that the oscillator itself is resonant at some frequency f_m. In general a transmission line will have a characteristic admittance Y_m, but usually this admittance is chiefly conductive, so





we designate it as G_o. Across the end of the line at terminals 3 and 4 a load admittance Y_L is connected. If this load is matched to the line, it will have the value $Y_L = G_o$; then, if one were to look in the direction of the load at terminals 1 and 2, he would see a conductance G_o. This value G_o is transformed by the coupling network into an equivalent conductance G_e which is the load actually seen by the oscillating circuit. When one inserts the capacity probe deeper and deeper into the oscillating cavity, he is changing the value of G_e. For zero coupling G_e is zero, and it increases with the coupling. It can be readily shown that the oscillator will deliver maximum power to G_e when $G_e = G$. This is what is meant by 100% or critical coupling. For $G_e > G$ the power transferred again decreases. It is thus seen that the "right" depth of probe for critical coupling means simply that the coupling network transformation ratio is appropriate to convert G_o into G.

Standing Wave Characteristic

On the other hand, suppose that the line is terminated by an admittance $Y_L = G_L$ where $G_L \neq G_o$. Then standing waves will be set up in the line. Consider for the moment only the conductance that would be seen at terminals 1 and 2, looking in the direction of the load. Assume that the standing wave ratio is r. Then if the length of the line l is varied, the conductance presented to the input terminals 1 and 2 will vary through the extreme values G_o/r and rG_o as shown in Fig. 6. This variation in load conductance will be transformed into a conductance $G_e/r < G_e < rG_e$ across the oscillator circuit.

Now, clearly, a different depth of insertion of the probe for either rG_e or G_e/r is necessary to produce maximum power transfer; i.e., critical coupling, than would be required for G_e. At the same time, however, it is to be noted that if the probe depth is that which gives critical coupling for a matched load and if then the matched load is replaced by an unmatched load, it is still possible to get a maximum transfer of power from the oscillator to the load simply by changing the length of line until the conductance at terminals 1 and 2 looks like G_o. Instead of changing the length of line an equivalent process would be to shift the phase of the standing wave along the line.

There are, therefore, three things involved in making $G_e = G$: (1) the physical coupling, (2) the value of G_L, and (3) the length of the line l, or what is the same thing, the position of the standing wave minimum along the line. However, once we select two of the conditions the third is determined, so that in effect there are only two degrees of freedom. It can be seen that it is important to specify the conditions of match or lack of match along a transmission line when speaking about coupling.

Increasing the Coupling

In commenting on the procedure of varying the coupling, we have limited ourselves to the capacity probe form only because it is the easiest to vary. But if we were experimenting with loops, we would increase the coupling by increasing the size of the loop; and if it were an iris by increasing the size of the hole. Most important we would find that the performance of an oscillator as far as frequency and power variations with load are concerned is dictated primarily by the extent of the coupling and not by the kind.

An attempt has been made to shed some light on the meaning of coupling. We involved Figs. 5 and 6 in the discussion, and in the interest of simplifying the analysis, we spoke of the load as being solely conductive. Actually, of course, the load will in general be an admittance. Our previous arguments will apply except that we must remember that the G_e which the oscillator sees will be the result of a transformation of admittance which in-

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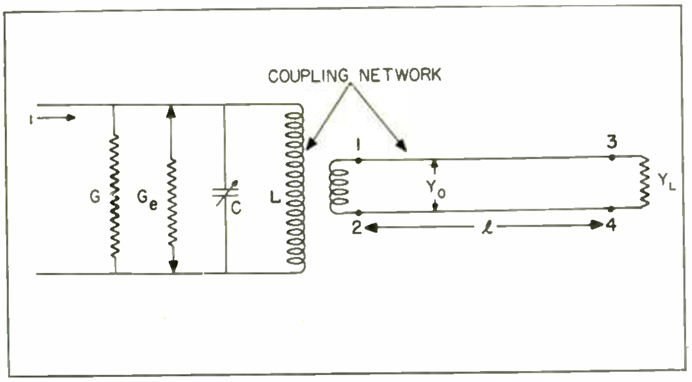


Fig. 5: In equivalent circuit of loaded oscillator, G_e is equivalent conductance coupled into oscillator circuit

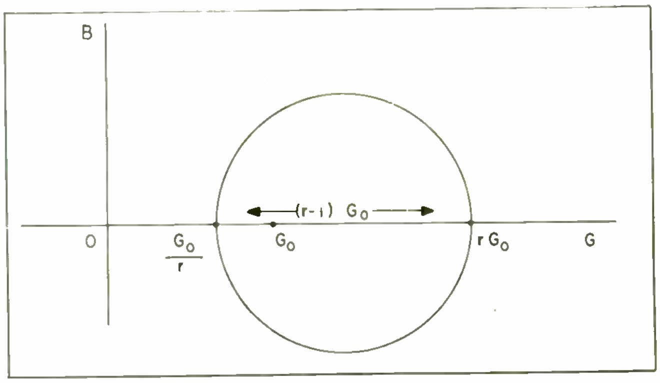


Fig. 6: This drawing illustrates the admittance variation with the change in position of the standing wave minimum

cludes susceptance as well as conductance and that the susceptance component of the admittance at terminals 1 and 2 will also contribute to the conductance, as well as contributing to the equivalent susceptance, shunted across the oscillator circuit. By the same token, the conductance component of the load will alter the equivalent susceptance in shunt with the oscillating circuit.

It is emphasized that the above explanation of the behavior of the oscillator is based on a model which only approximately corresponds to an actual oscillator in that the effects of feedback are neglected. On the basis of studies made at 1000 mc, however, it does appear that this model is useful provided that the coupling is not appreciably greater than critical.

Power Contours

The power curves are plotted in terms of the percentage of the maximum power delivered to the load by the oscillator. In Figs. 3 and 4 the dashed contours represent the power output for the over-coupled condition. The percentage of critical coupling can be read from the diagram directly by noting the power contour which passes through the center of the circle. Thus, in Fig. 2 the power contour marked 70 passes through the center of the circle, and we say that the oscillator is 70% coupled to its load. On the other hand in Fig. 4 we see that the center of the circle diagram lies between dashed contours 70 and 80. Estimating that its position is roughly 72, we say that the oscillator is 28% over-coupled to its load, or that the coupling is 128%. In Fig. 3 we note that the contour marked 100 passes through the center of the diagram meaning that the oscillator is 100% or critically coupled to its load. How are the power contours obtained?

As has been said, one changes the standing wave ratio by changing the load (the double-slug tuner behaves as the load in the experiment) and by moving the position of the minimum one obtains a succession of values for maximum coupling which, when plotted on the Smith chart, yield the contour marked 100. For the same insertion depth of the coupling probe, we then take a series of readings which hold for 90% coupling by adjusting the VSWR and the position of its minimum accordingly. Thereupon, we change the insertion depth of the coupling probe so that when $Y_L = Y_0$, $G_e \neq G$. Assume this means that the oscillator delivers 70% of the maximum power of which it is capable as in Fig. 2. Then, as before, we obtain a series of values by varying the VSWR and positions of its minimum to acquire contours for this fixed value of coupling which gives 70% output when $Y_L = Y_0$. A similar plot may be made for the over-coupled case. It happened that for the probe setting used in obtaining the data of Fig. 4, the oscillator delivered only 72% maximum power.

It will be observed that this is a different procedure from that described earlier for obtaining the data for a Rieke plot. Actually either method could be followed, but in the writer's opinion the method first described is easier.

General observations regarding the power contours are: (1) It will be noted from the diagrams that the power contours between 90 and 100 are more widely spaced than between say 50 and 90, signifying that the power variation with changes in VSWR is much less at critical coupling than for smaller values. The close spacing of the dashed contours in the over-coupled region will also be noted. This means large changes in power for relatively small changes in VSWR. These facts and the desirability of maximum power output argue strongly for critically coupling an oscillator to a matched load.

Critical Coupling

However, there are several points to be considered. One is that if the oscillator is pulse-operated, performance in the region beyond critical coupling results in the generation of pulses which may be badly deformed, the amount of the deformation depending on the extent of the over-coupling. A second point is that frequency pulling is much more severe beyond critical coupling that it is for values less than 100% coupling. A third point is brought out by Figs. 3 and 4 which show a greater relative crowding of the dashed power contours, implying a more rapid variation in power output with standing wave ratio for coupling somewhat greater than critical than for coupling somewhat less.

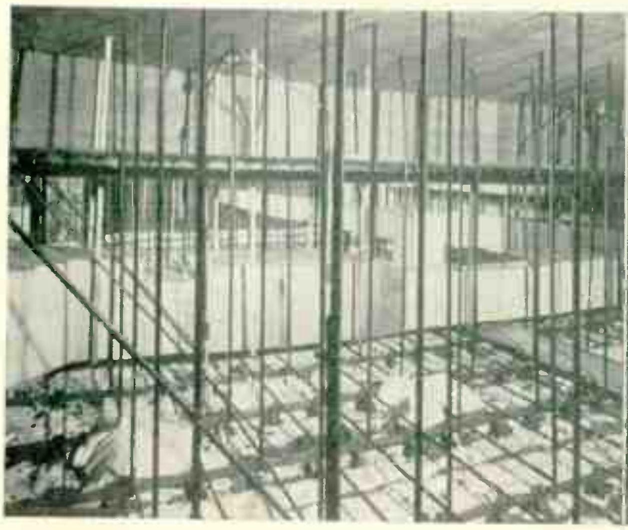
Now it is evident that if the coupling is adjusted to a critical value for a matched load and if a mismatched load is then connected, the

(Continued on page 64)

KOMO

STATION WITH THE "NEW LOOK"

ENGINEERED to provide the Pacific Northwest with the most modern radio station extant from the point of view of engineering, equipment, layout efficiency, building construction and studio design, Fisher's Blend Station, Inc., presents these photos of KOMO, Seattle, as evidence of a station engineered for the "new look." Conceived by O. W. Fisher, president of the station, in collaboration with F. J. Brott, chief engineer, representative photos show two studios with one control room (above left); polycylindrical walls and ceiling of "floating" studio (above right); transmitter with duct system to carry off excessive heat (right); area between studio ceiling and roof showing method of suspending room to eliminate vibration, etc., (below left); AM-FM transmitter (below right) and control equipment set within an angle of two studios. AM transmitter is an RCA 50 kw.



Sound Measurements in

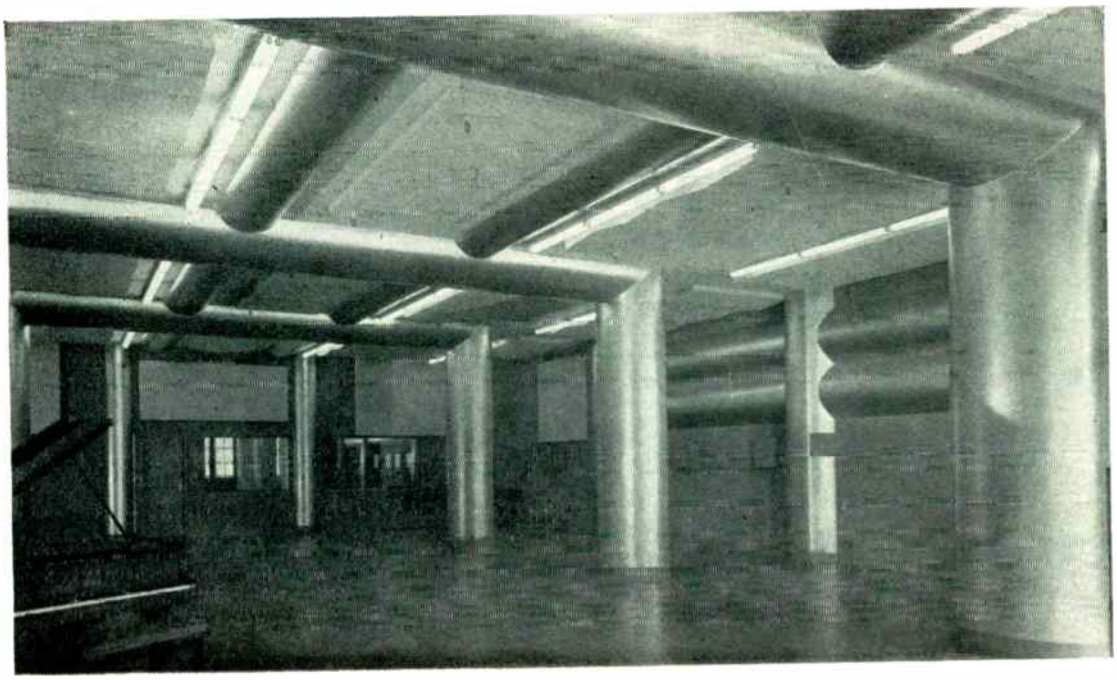
Study of sound characteristics in laboratory and studio emphasizes need for new technics, materials and construction methods

THE acoustical engineer, in order to be of widest service, should know how sound acts in the studio and how to translate studio sound requirements into technics, materials and construction methods based on acoustical measurements in studios and in the laboratory.

A free sound field is one in which the sound waves from a source (a violin for example) diverge from it, with none of these waves returning. This condition is met in free space, at a great distance from all reflecting surfaces. It is met closely enough for most laboratory purposes in special rooms having thick sound absorbing boundaries, as much as 4 ft. thick. Such enclosures are called anechoic chambers. The "cut-off frequency" is that below which the boundaries have a coefficient of absorption less than 0.99. At frequencies higher than cut-off the absorption is so great that the amount of energy returned is negligible. While the anechoic chamber is an enclosure, there are no "room acoustics." The violinist may not care for the sound of his fiddle in it.

The ordinary enclosure, such as a typical living room, contains materials whose coefficients of absorption at 512 cps vary from the 0.03 of glass and plaster to the 0.75 or more of cushions. Experiment has shown that sound in a typical living room behaves approximately as if all the absorption were on the surfaces of the room and these surfaces had a coefficient of absorption of about 0.10. A typical broadcasting studio might have an average absorption of 0.25. Although by ordinary standards of auditoriums the studio is considered acoustically rather dead, it is very live compared to the anechoic chamber. A simple rectangular room containing the furniture of a studio and treated with a sufficient area of commercial 1-in. thick acoustical tile on the ceiling, so that the average absorption coefficient at 512 cps was 0.25, would exhibit many of the phenomena of room acoustics and furthermore would be a poor broadcasting studio by modern standards.

Let us examine such a room in comparison with a free field or its equivalent, the anechoic chamber. The rms sound pressure level at a point is that due to all the sound waves passing through the point. In a free field only the wave directly from the source passes through the point. In the room, because of partial reflection from the walls, the pressure level at a point is that due to many wave trains. Of importance in the room is the fact that at 2 points equidistant from the source, the pressure levels are different due to the nature of the wave trains. At one point the important component waves may conspire, in amplitude and phase, to give maximum reenforcement, resulting in relatively high pressure level. At the other, there may be maximum cancellation, resulting in a relatively low



Reeves Laboratory band studio in New York City where some of the sound measurement tests were made. Note the acoustical construction of the walls. Equipment used in recording the tests is shown on following pages

BC Studios

By WILLIAM JACK, Johns-Manville Corp., Somerville, N. J.

pressure level. As we recede from the source, the pressure level jumps about in an erratic manner and it is a common observation that certain points can be found more distant from the source higher in pressure level than certain points nearer the source. This is known as sound pattern.

In a free field, the pressure level decreases uniformly with distance

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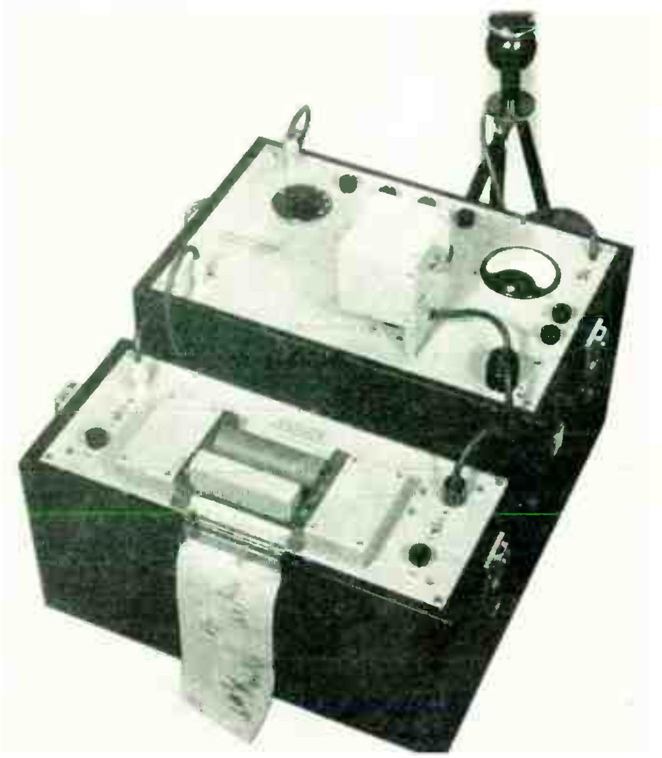
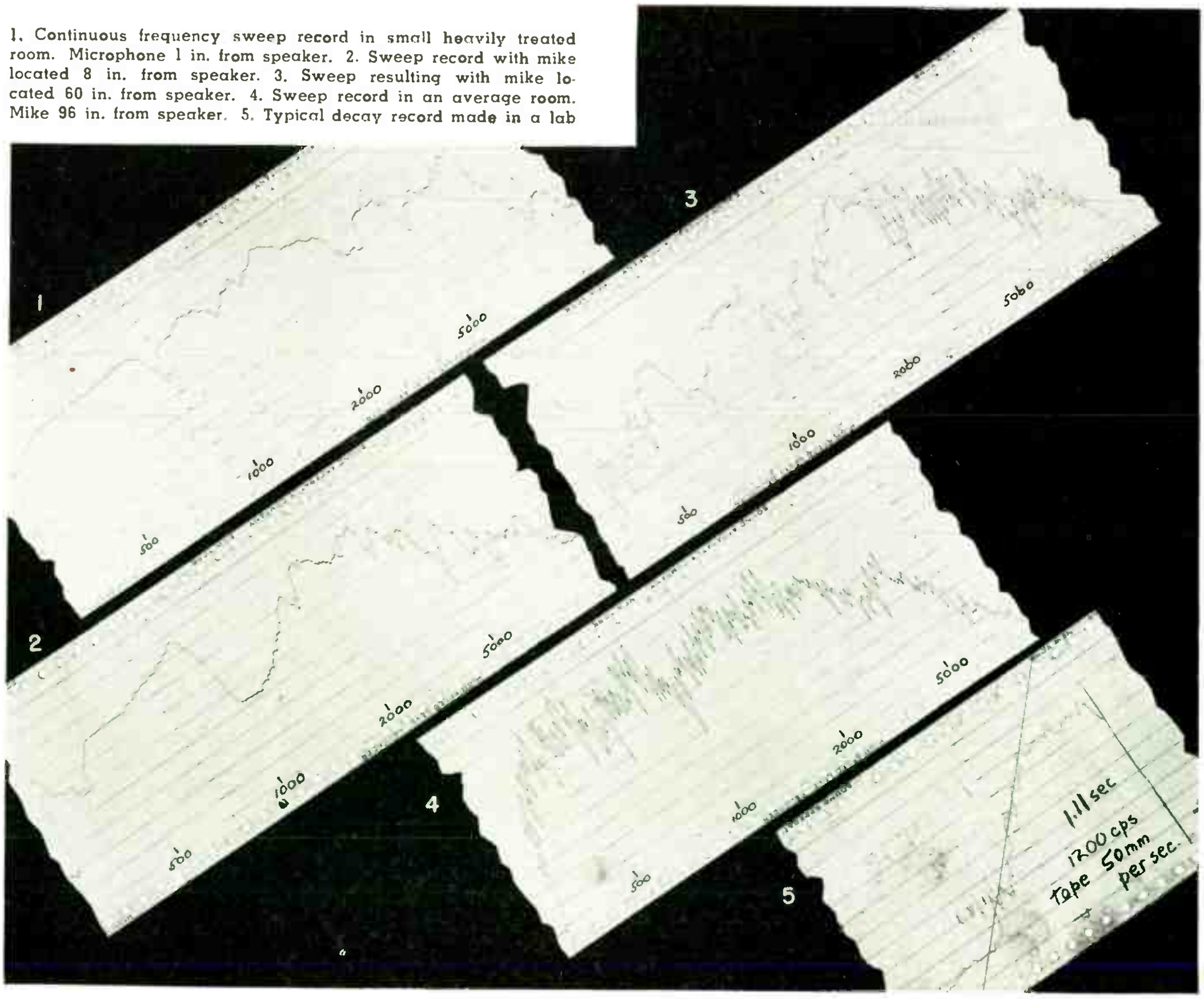
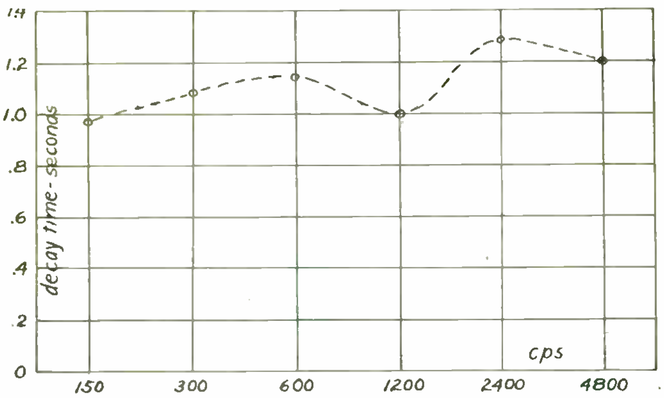


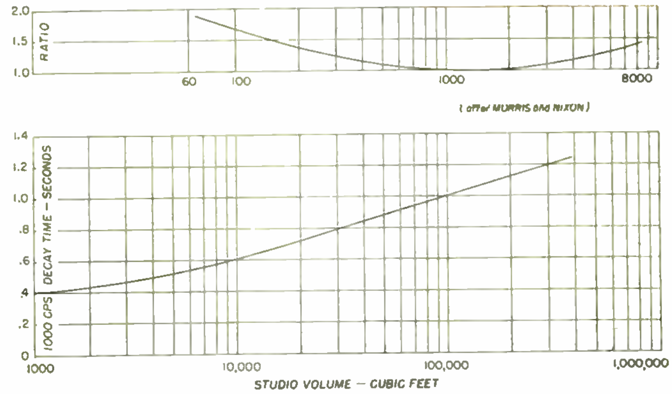
Automatic analyzer and recorder for frequency analysis of a sustained sound. Test characteristics are described in the accompanying article

1. Continuous frequency sweep record in small heavily treated room. Microphone 1 in. from speaker. 2. Sweep record with mike located 8 in. from speaker. 3. Sweep resulting with mike located 60 in. from speaker. 4. Sweep record in an average room. Mike 96 in. from speaker. 5. Typical decay record made in a lab





Decay time over frequency range at one pair of speaker-microphone positions. Each point is decay average at that frequency



Lower curve gives decay at 1000 cps for volume in question. For decay at other frequencies, multiply by ratio value in top curve

from the source at the rate of 6 db decrease per distance doubled. In the room, with the source in a fixed position, there is a definite sound pattern for each frequency. Suppose that the violin is sounding its A, consisting of the fundamental at 440 cps and its second harmonic at 880 cps. We will define the true output of the source as that which occurs in a free field and will further suppose that at a distance of 4 ft. the fundamental measures 79 db and the harmonic 74 db. Two components at these levels sum to 80 db. In a free field 8 ft. from the source, the fundamental will be 73 db and the harmonic 68 db. The 2 components sum to 74 db. Anywhere in a free field the harmonic will be 5 db lower than the fundamental.

Effect of Sound Pattern

Suppose that the violin has the same output but it is in the room. No longer do we have a consistent decrease with distance for each component, nor even for the sum of the 2 components. At one point we might find the fundamental 10 db above the harmonic and at another point 10 db below the harmonic. We might find variations in total level of as much as 15 db from point to point. The effect of sound pattern is two-fold on these steady state examples. A small change in the position of the listener might give a large change in pressure level, or a large change in quality, or both.

Let us further examine the room in comparison with a free field for the case of sound dying away after the source has stopped. The Eyring equation for reverberation is

$$T = 0.05V/-S \ln(1 - \alpha$$

where T = time in seconds for the average sound energy to drop 60 db
V = volume of room in cu. ft.
S = area of the absorbing surfaces in sq. ft.
ln = logarithm to the naperian base
α = average absorption coefficient of the absorbing surfaces given by Σ di Si/S

Suppose that when the violinist stops playing a certain note the vibration characteristics of the instrument are such that it decays at the rate of 60 db in 0.1 sec. At any point in a free field the reverberation time is 0.1 sec. In general, however, each frequency component decays at its own rate near the violin.

Suppose that the 440 cps note decays in 0.1 sec and the 880 cps harmonic formed with it decays in 0.05 sec. At any point the auditor chooses to listen in a free field, these certain decay times will be associated with these notes. Using our example of 79 db and 74 db for the 440 cps and 880 cps components, respectively, at 4 ft. from the source, after 0.01 sec. from the stopping of the source the 440 cps component has decreased to 73 db and the 880 cps component has decreased to 62 db. The harmonic is 11 db below the fundamental. After 0.02 sec. the levels are 67 db and 50 db respectively, with the harmonic 17 db below the fundamental. The ear recognizes this effect and the brain ascribes a certain quality to the way the total tone dies away.

A similar situation exists for sound building up. If the vibrations at the violin can be made to stop at once, the sound at every point in the room, from the viewpoint of an auditor at such a point, stops at once. There can be no reverberation in a free field. Any continuation of sound is due to a continuation of the source. The Eyring equation meets this extreme case, giving T = O for α = 1.0. Taking a broadcasting room space of 40 x 24 x 16 ft. with α = 0.25, the average decay time is 0.68 sec. If the average absorption is 0.25 for both 440 cps and 880 cps, at a typical point in the room after the source has stopped both components will die away at the rate of 0.88 db every 0.01 sec.

Tonal Decay Rate

Using our example, this means that the 880 cps component, which was initially 5 db down from the 440 cps component remains 5 db down from it during the entire decay. After 0.1 sec from the stopping of the source the levels will be 70 db and 65 db respectively. Not only will the ear be conscious of a longer decay rate compared to a free field, but it will ascribe a certain quality to this constant difference of 5 db between the components. If the average absorption is 0.15 for the 440 cps component and 0.25 for the 880 cps component, for example, the fundamental will die away at the rate of 0.46 db every 0.01 sec and the harmonic at the rate of 0.88 db every 0.01 sec. After 0.1 sec from the stopping of the source the 440 cps component has decreased to 74 db and the 880 cps component has decreased to 65 db. This combination of decay rates has a quality of its own. The important thing to notice is that the tonal characteristics which the ear hears are due both to the violin and to the room. In cases where the source dies away quickly the decay rates of the component tones are due entirely to the room.

Room Sound Characteristics

We have been discussing a rather simplified picture. Actually the violinist is playing a combination instrument—the violin and the room itself. In a free field he plays only the violin, the sounds he produces radiating into space, with no portion of them returning. In the room size used, a source at the room center is 8 ft. from the nearest surface. At any other point the source will be 8 ft. or less from the nearest surface. For sound to travel the 16 ft. from the source at the room center to the nearest surface and back at 1125 ft. per sec requires 0.014 sec. The first sound traveling outward for 0.007 sec is in a free field, but as musical notes are sustained longer than this, for most of the note the source is emitting in a field containing a standing wave system.

The combination in a room of various standing wave systems for a sustained note are responsible for the large variations in pressure level from point to point. Modern acoustical theory looks at the room as a system having many natural frequencies, those in a hard-walled rectangular room being given by

$$n = c/2 \ (p^2/H^2+q^2/W^2+r^2/L^2)^{1/2}$$

where c = velocity of sound in ft. per sec.

H, W and L = room dimensions in ft.

p, q and r = integers in the series 0, 1, 2, 3, etc.

The lowest natural frequency is obtained by p = 0, q = 0, r = 1. At low frequencies there are relatively few natural frequencies in a given band, say, 100-150 cps. In the 500-550 cps band, which has the same width, there are relatively many natural frequencies. Each natural frequency has an associated mode of vibration, called a normal mode, of the air particles, giving a definite pressure pattern throughout the room. Under controlled experimental conditions single normal modes have been excited in small rooms and the plots of sound pressure shown to agree with theory.

The boundaries of a room which affect its natural frequencies can vary as to volume, general shape and sound absorption. Walls can have smaller scale variations such as sawtooth irregularities, splays, curved surfaces and recesses. The sound absorbing material can be concentrated or scattered in patches. Various types of sound absorbing material, having different characteristics of absorption vs. frequency can be used. Delayed reradiation after-effects from thin plywood units may be of some concern.[1] The furniture must be taken into account.

When a source is sounded in a room, various normal modes are excited depending on the room, the nature of the source and its position in the room. Thus it becomes clear why the true acoustical output of a violin is different in different rooms or even in various positions in the same room. When the source is stopped each of the various modes excited decays exponentially, but each at its own rate. The composition of the resulting tone depends on the listener's location in the room, the initial level of the component notes, the various rates of decay involved and the length of time elapsed since the source stopped.

Decay vs. Frequency

The designation of studio performance most commonly used is decay time vs. frequency. Various technics are used in obtaining this relationship. A typical method, for a studio suitable for a small orchestra, uses a loudspeaker position at the center of the orchestra and a microphone position at the director's location. The speaker is energized at the test tone by a warble tone oscillator or disc records of such a

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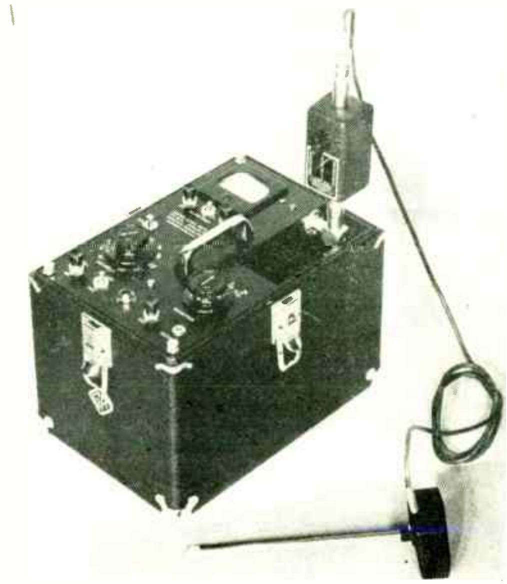
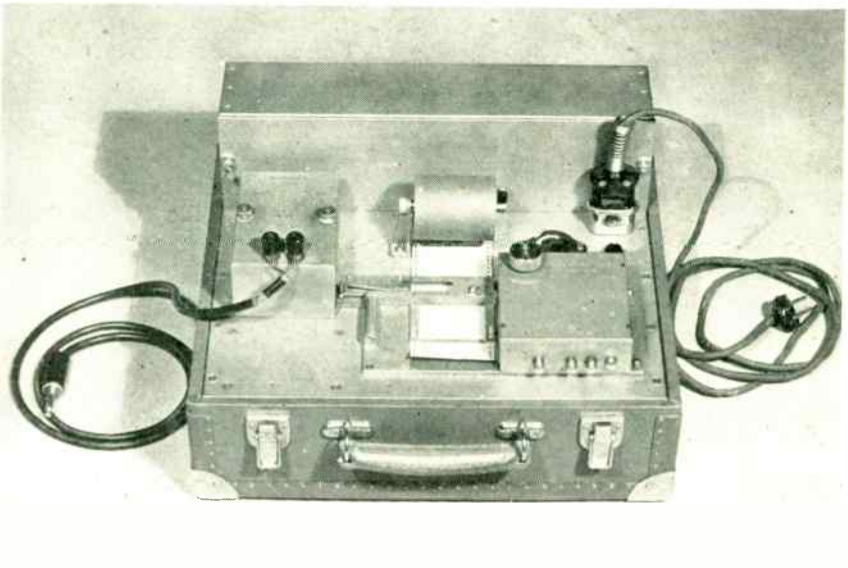
[1]Tele-Tech, Mar. 1947, p. 52

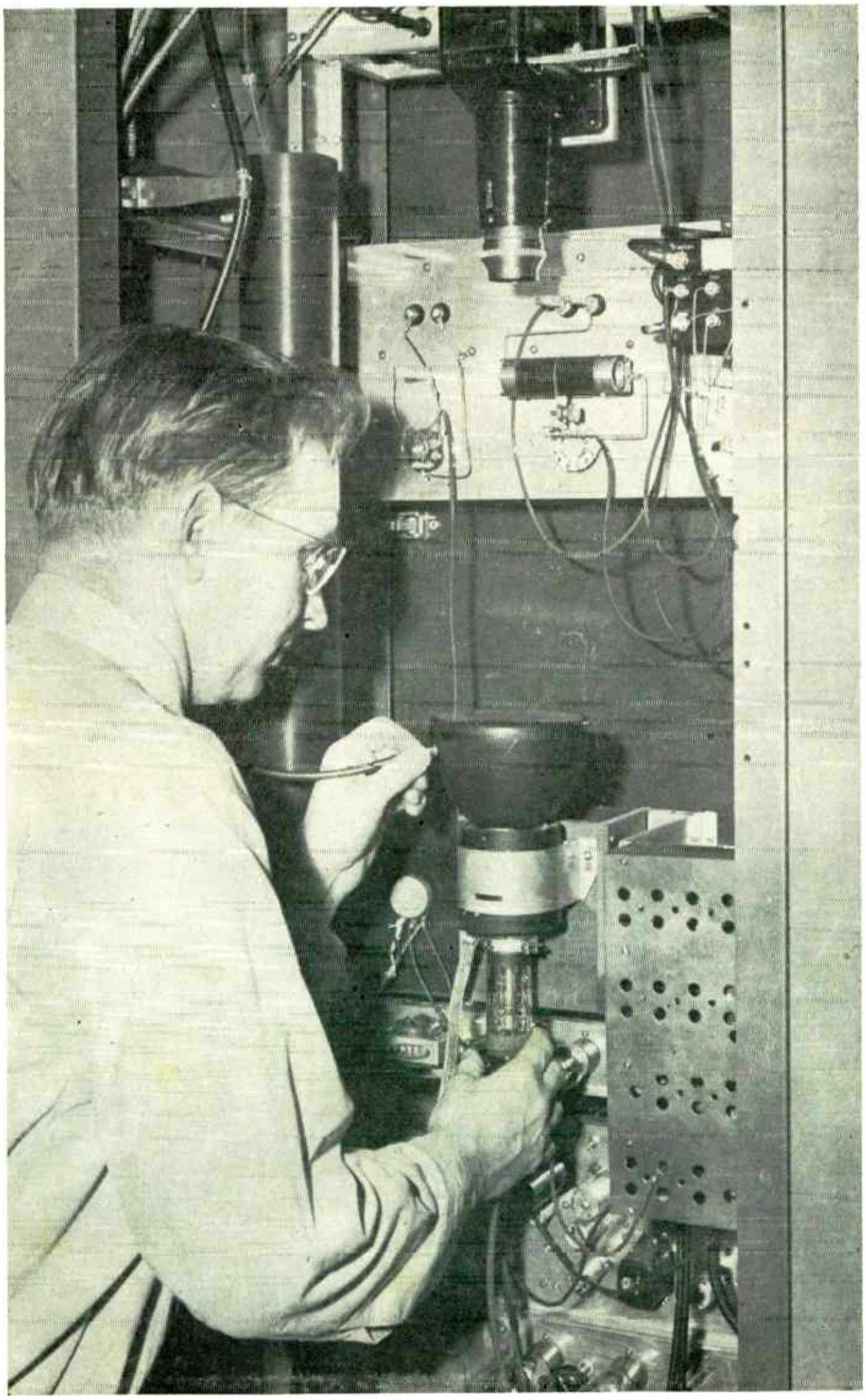
Photos below show sound testing equipment. Left: Sound level meter with vibration pickup. Right: High-speed level recorder





Flying Spot Designed for

New RCA cathode-ray tube makes possible an improved method for converting title plates, test patterns and films to television signals



Until the advent of Farnsworth's dissector tube and Zworykin's iconoscope, earlier methods of scanning live television scenes utilized the flying spot method whereby a highly intense beam of light was projected on the subject through a succession of lenses on a scanning disc.

Early experimenters with cathode-ray systems also found an easy way of televising fixed pictures (photographic negatives) by placing them against the fluorescent screen of a tube whose beam was scanned in two directions in some prescribed manner. A phototube placed in front produced a series of video pulses that could be applied to a second cathode ray tube circuit, as in Fig. 1.

Two regular oscillographs and a phototube with its amplifier were all that were needed to set up such a "picture transfer" system. Since the transmission was generally over local circuits only, usually the ordinary oscillograph circuits were modified so that one of them produced the horizontal (or line) frequency potentials to drive both cathode-ray tubes. Similarly the second oscillograph was wired to supply the vertical scans of both. Dispersion of the light spot through the glass introduced one of the main difficulties toward attaining good reproduced detail, however, so some sort of lens system was frequently introduced between the screen of the "transmitting" tube and the film.

These early experiments had one redeeming feature — simplicity. However, at scanning speeds suited

Flying spot being adjusted in video signal generator by senior engineer L. E. Swedlund

Television Studio Scanning

to televising live scenes, the delay characteristics of the phosphorescent screen contributed a smearing effect with some loss of detail.

A similar problem still confronts television operations — that of producing test patterns and other fixed titles or announcements. A common method is to set up a card on an easel and focus one of the studio cameras on it. This ties up a camera and operating personnel and is an expensive method. In an alternate system a monoscope tube is used which has a fixed scene permanently etched on the inside of the tube. However each station likes to have its own pattern, with call letters, included. The production of handmade monoscopes with such special patterns is costly.

A solution to this difficulty has been provided by the RCA type 5W(P15) tube, a 5-in. cathode-ray tube intended primarily for use as the scanner in a flying-spot video-signal generator. It has the advantages of permitting a change of picture (or test pattern) at will, and of reproducing the picture with the halftone fidelity of photographic film.

The type 15 phosphor with a metallized back has a spectral-emission characteristic with peaks in the blue-green and near-ultraviolet regions. The ultraviolet radiation has a persistence characteristic which is appreciably shorter than that of the visible region. Thus, by utilizing only the ultraviolet radiation, it is possible to minimize trailing in the reproduced picture. Magnetic deflection and electrostatic focus are utilized to permit obtaining essentially uniform focus over the useful screen area.

A flying-spot video-signal generator consists essentially of (1) a flying-spot cathode-ray tube with its power supplies, deflection yoke, and scanning circuits; (2) a system to project the raster on the subject to be scanned, the latter may be a slide transparency, motion picture film, or an opaque object; (3) a multiplier phototube and circuit to intercept the radiation transmitted or reflected by the subject; (4) a video amplifier.

A block diagram of such a system arranged for use with a slide transparency is shown in Fig. 2. For best results, the enlarger type objective lens should be designed for low magnification and, preferably, be corrected to handle ultraviolet radiation. The diameter of the objective lens should be adequate to cover the slide to be scanned.

Suitable filters for absorbing the visible and passing the ultraviolet radiation of the screen are any of the following: Eastman Wratten Nos. 18A, 34, and 35 as well as the Corning Nos. 9863 and 5970. The choice of filter for a particular generator design is affected by a compromise between the permissible loss of signal output through absorption by the filter on the one hand, and the amount of trailing which can be tolerated, or the extent of equalization needed, on the other hand.

The lag in buildup and decay of output from any screen of a tube used for this purpose produces an effect similar to the aperture effect. As a result the reproduced picture has an appearance similar to that produced by a signal deficient in high frequencies. Thus, it is necessary to enhance the high-frequency response of the video amplifier by introducing equalizing networks of the resistance-capacitance type with suitable time constants. Sufficient equalization should be provided to give the desired screen-wave response.

Compared with standard phosphors the persistence of the P15 screen is comparatively short so that less equalization is needed. If the P15 is used without an ultraviolet filter, less equalization is required

(Continued on page 67)

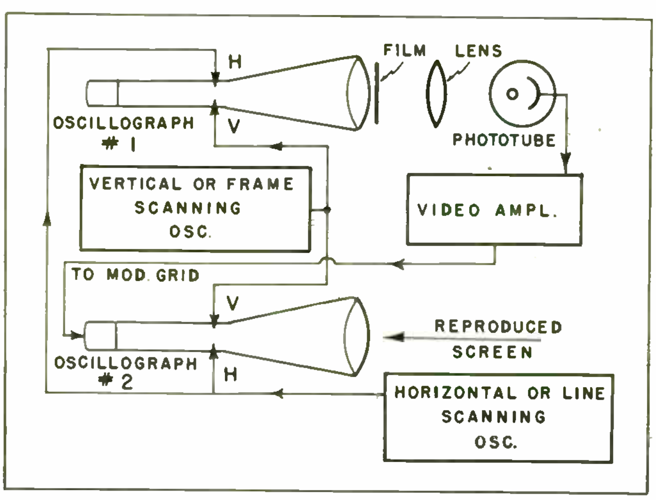


Fig. 1: Basic fixed picture television or facsimile system using the new flying spot cathode-ray tube from the oscillograph tube

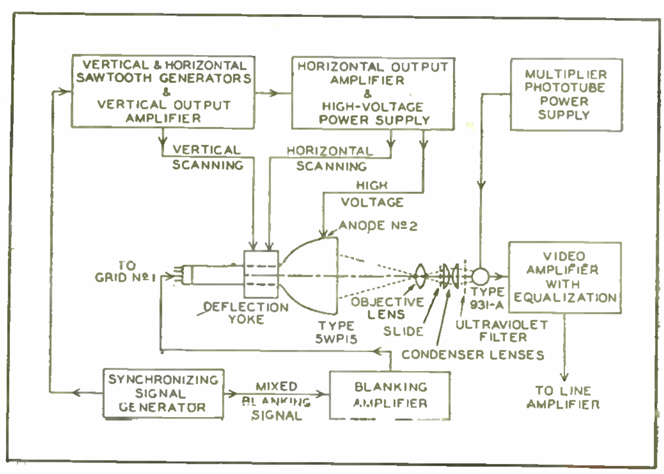


Fig. 2: Showing block diagram of the flying spot video-signal generator system for slide transparencies used in studio telecasting

Engineers Reveal TV Developments

Cincinnati IRE Spring technical sessions featured by disclosure of new tuner circuits, special equipment

By RALPH R. BATCHER, Engineering Editor, TELE-TECH

TECHNICAL progress in television was again aired at the Cincinnati Spring meeting of the IRE in April, not only at the technical sessions but at many informal discussions between the engineers in attendance. The feature of the program was the well selected papers, presented in non-concurrent sessions, with preprints available at the time to facilitate discussion.

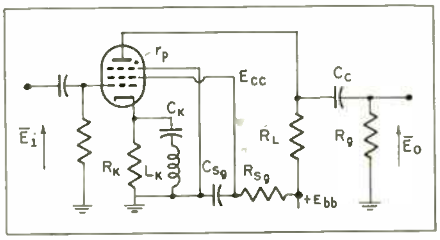


Fig. 1: Basic video amplifier stage with cathode compensation for high frequency loss

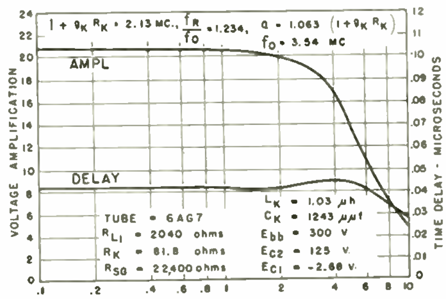


Fig. 3: Theoretical curves of compensation characteristics. See text for full details

Video Amplifier Compensation

The first paper by A. B. Bereskin (Univ. of Cinn.) described a theoretical development of a new type of video amplifier compensation using cathode compensation with experimental verification of the principles involved, featuring low cost, simplicity, favorable time delay characteristics and linearity over wide frequency ranges. The paper disclosed how feedback, uniquely obtained in the cathode circuit of a video stage produced an unusual range with amplitude linearity.

The compensating elements in the cathode circuit (Fig. 1) consist of a small (1-2 microh.) inductance in series with a small mica capacitor, of the order of .001 μf. The large electrolytic capacitor normally used in the cathode circuit is eliminated, thus increasing the reliability of operation. The total cost of the small mica capacitor and the inductor used for compensation is considerably less than that of the electrolytic capacitor that was eliminated.

Typical results are shown in Fig. 2. One of the parameters of the design is a factor $(1 + g_k R_k)$ which is equal to the ratio of R_2/R_1 where R_2 is the equivalent load resistance in a typical stage circuit which, when all cathode bypass capacitance is removed, will produce a middle frequency gain 3 db higher than it

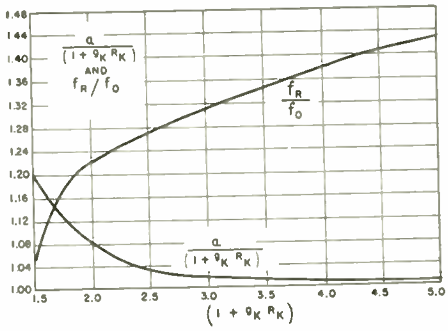


Fig. 2: Showing compensating circuit constants giving values of design parameters

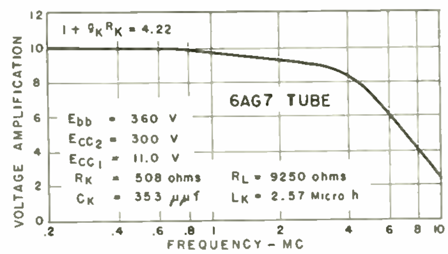


Fig. 4: Compensation curve of amplifier indicates good input and output linearity

is at some high frequency reference point (f_o). R_1 is the equivalent load resistance with perfect bypassing that will give similar results. Here the equivalent load resistance is equal to the values of tube plate resistance, plate load resistance and following grid resistance, all considered in parallel.

Another design parameter is the factor (a). The variables for Fig. 2 were obtained from the two curves in Fig. 3. These two curves are the key to the compensation discussed in this paper and have been designed to produce a time delay characteristic that will dip approximately 4% to the valley and then rise about 6% to the peak. Either flatter amplitude or time delay characteristics can probably be obtained with slight variations in (a) and f_R/f_o.

Fig. 4 shows amplification and delay curves for a cathode compensated stage as in Fig. 1. It was also shown that when an extended voltage range is desired with linearity between input and output, a higher plate load resistance can be used, with typical values (Fig. 4) giving linear output up to 70 volts at 1 mc and up to about 50 volts at 3 mc.

Low/High Band Tuner

A capacity tuned tuner using specially developed gang condensers was described by J. A. Stewart (Gen. Inst. Corp.). With two distinct L/C circuits used, one for each band: for the low band (dropping channel 1) 54 to 88 mc, a capacity ratio of 2.7 to 1; and for the high band, 174 to 216 mc, a capacity ra-

(Please turn to page 46)

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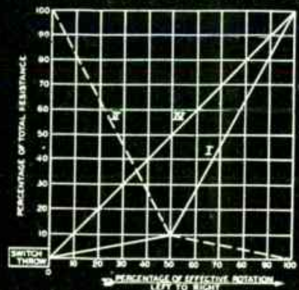

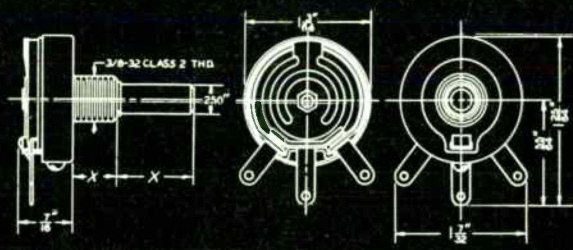

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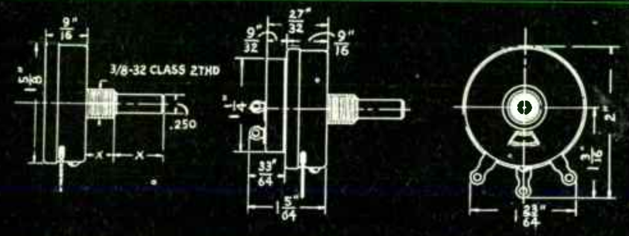

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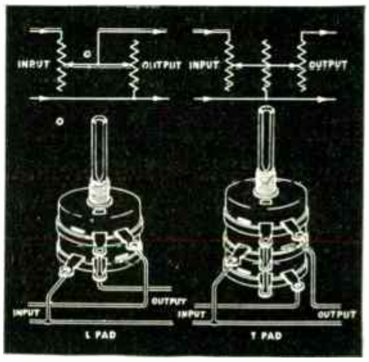

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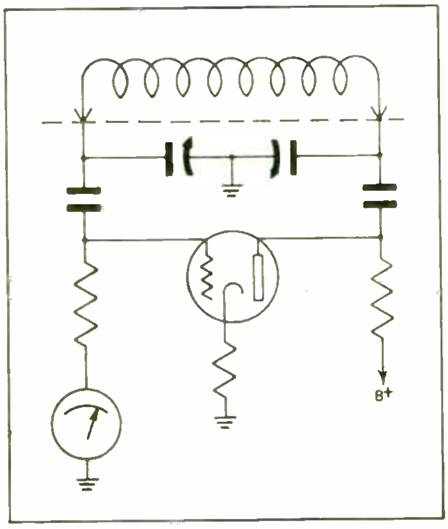
tio of 1.54 to 1. The plate shape of the condenser was designed for modified straight line frequency to give good channel distribution. A detent mechanism on the shaft permits switch-type channel selection, and a concentric shaft vernier drive permits fine tuning adjustment.

The rf amplifier is a double-tuned push-pull stage using the 6J6 twin triode. Push-pull operation gives higher gain, improved selectivity, more stable operation with a grounded rotor condenser, and the signal-to-noise-ratio of a triode is about three times better than that of a pentode.

Grid Dip Oscillator

An analysis of test equipment required by a television receiver designer was given by Jerry Minter (Measurements Inc.) He outlined the problems encountered and described test methods suitable for their solution. The apparatus included a simple grid dip oscillator for testing active and passive circuits (Fig. 5), determining frequency ranges, IF and video adjustments and dozens of other tests on circuits without their being connected to a power source. This grid dip oscillator also serves as a frequency marker for a sweep frequency generator, especially if connected through an RC high pass filter (or differentiating) circuit. Square wave generators were also suggested for generating bar patterns for sweep

Fig. 5: Grid dip oscillator circuit



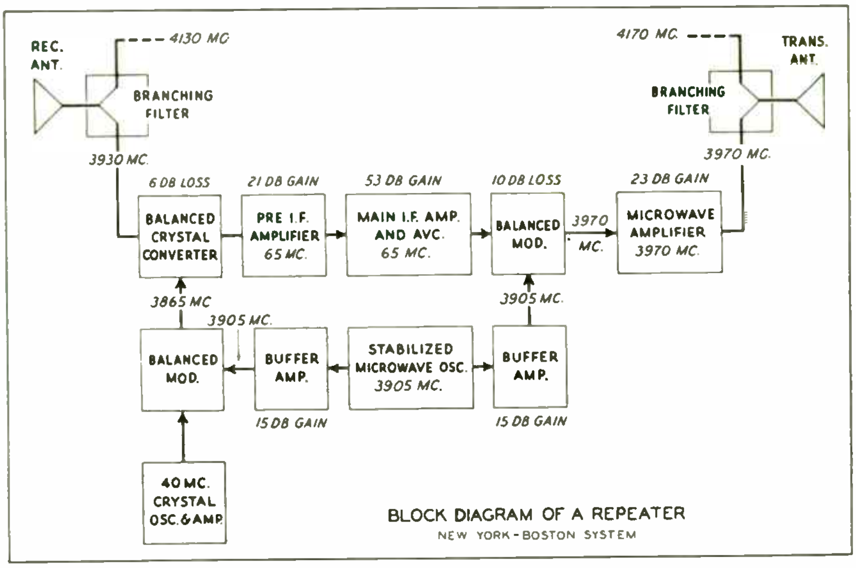


Fig. 6: Block diagram of currently used repeater station in Bell relay system

linearity checks, etc.

A vacuum tube voltmeter finds frequent use as does a sweep frequency generator when used together with a germanium crystal probe and an oscilloscope serves to give stage gain and selectivity curves.

TV Film Camera

T. T. Goldsmith and H. Milholland (DuMont) described electronic and camera equipment for recording television sight and sound on film, the picture made directly from the face of the cathode-ray tube. The camera was described in some detail. The application of this technic was analyzed with regard to documentary recording, network syndication use, and theater television.

For this service a 12-in. cathode-ray tube was operated at 25,000 volts. Due to the larger aperture of the lens, it is customary to scan an area of only 6x8 in. on the face of this large tube in order that the full rectangle of the picture is substantially flat and is exposed to the camera without any cutting of the corners, thus keeping good focus both electrically and optically.

To transpose from the incoming 30-frame system to a 24-frame per second film, careful adjustment of the open/closed shutter intervals must be attained. If this shutter is not adjusted correctly a bar of distortion is likely to appear in the recorded film picture. Such a lap-dissolve bar is noticeable as a flicker due to either underexposure on a few elements or lines of the picture. For best results, the shutter closure period (during which all pull-down motion must be completed) is very closely equal to one-half the television field interval, or 1/120 second with the open interval on shutter equal to 4/120 second, both combining to the required 1/24 second for a frame on the film.

Bell Microwave Relay

A report on latest microwave radio relay facilities of the Bell Systeam was given by J. H. Moore, A.T &T). System operation using frequencies of the order of 4000 mc was described in terms of directly, fading, etc. was described. A block diagram of a presently-used repeater station is shown (Fig. 6). A general survey of the television as it is working out now, was given by R. E. Shelby (NBC) with a report on the overall system problems that have shown up and must be considered for improving television quality.

Mallory Inductuner

The characteristics of the latest designs of inductuner, used by DuMont and others, were described by Myron F. Melvin of the P. R. Mallory Co. Diecast frames, improved (*Please turn to page 48*)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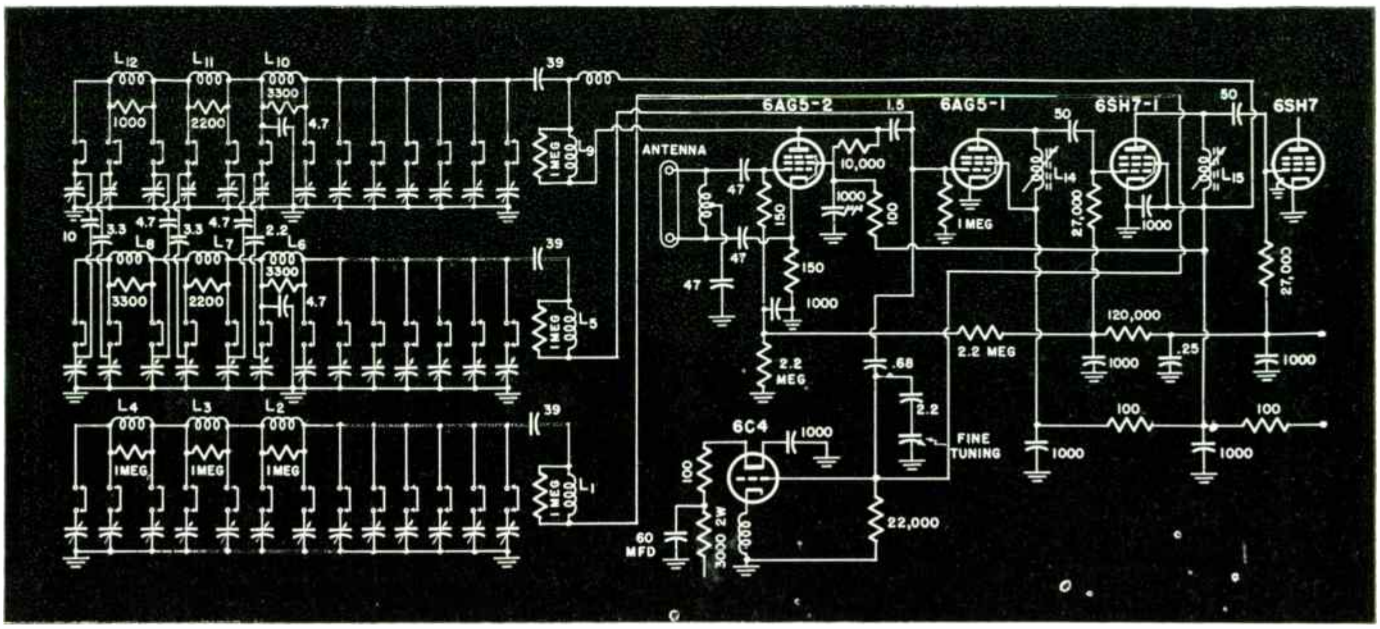

Fig. 7: Three groups of 13 trimmers mica connected to series tuned circuit of Hallicrafter's low-cost television receiver

contacts and better temperature stability were particularly mentioned.

The circuit as used in the DuMont receiver has a gain of 18 at channel 1 and a gain of 10 at channel 8. This figure was obtained by placing the input at the antenna terminals and measuring the output at the grid of the first IF stage. Image ratio is 41.5 db max. and 23 db min. with a better than 40 db rejection of channel 10 when tuned to channel 6, a special problem found on other receivers in the Philadelphia area.

Hallicrafter RF Tuning Circuit

The push-button controlled tuner used by Hallicrafters was described by C. T. Carroll. Here 3 groups of 13 mica trimmers are connected in 3 at a time to series tuned circuits (rf amplifier, mixer and the oscillator (Fig. 7).

The switch, coils and trimmer strips make up a single sub-assembly. The trimmer strips are secured to the switch by soldering each off-ground timmer lug directly to its switch lug. The 3 tubes associated with the tuner are mounted on the main chassis and the 3 off-ground connections between the tubes and sub-assembly are made by the first coils.

The gain on all channels is approximately equal to three times, measured from a 300 ohm dummy antenna to 1000 ohms in the plate of the mixer. Image ratios are about 15 times on the high-frequency channels and 60 times on the low-frequency channels.

CONDUCTANCE METER CIRCUIT (Continued from page 31)

cuit. The results have agreed consistently within 1%.

Although the total measuring circuit parameters need not be known, the residual parameters of the variable air capacitor must be determined. It is well known that the equivalent conductance of a variable capacitor varies with setting due to the residual series resistance, and that the static capacitance differs from the effective capacitance due to the residual series inductance. When measuring low-loss insulating material specimens at a frequency of one mc or higher, suitable corrections, equation (2), must be applied for accurate results.

The characteristics of the diode itself have relatively little effect on the conductance calibration, particularly when the load resistance is quite high. For example, in a diode circuit using a type 6H6 diode and a load resistance of 100,000 ohms, a 5% change in conductance can be expected from a 50% change in average plate resistance. It is also interesting to note that the applied voltage can be varied over a wide range (e.g., 20 to 25 volts) with negligible effect on the calibration.

TABLE 1
Typical Conductance Meter Measurements at 1 Mc For Determining the Power Factor of Various Insulating Materials.

Specimen Material	Capacitance $\mu\mu f$	Conductance μmhos	P.F. 10^{-4}	Measurement Accuracy %
Lucite	43.4	4.01	147	3
Hard Rubber	45.6	4.33	72.5	3
Micalex	121.9	4.62	60.1	3
Glass	151.5	1.78	18.7	3
Steatite	182.4	1.073	9.36	3
Polystyrene	76.8	0.103	2.13	5
Fused Quartz	110.4	0.061	0.88	5
Dry Air (1 atmos.)	315	0.004	0.02	50

In Table 1 listing the power factors of several insulating material specimens, the estimated accuracy of measurement is given to indicate the efficacy of the improved circuit.

According to equation (4) the diode circuit conductance is not a function of frequency; however, the practical limitations are transit time and resonance of the diode, and difficulties in evaluating the residual parameters of the measuring terminals, leads, etc. Conductance calibrations made at a frequency of 10 mc were identical to those obtained at lower frequencies.

WASHINGTON NEWS LETTER

TV CHANNEL No. 1—Orderly growth, at least during the present "shake down cruise" period, of the two leading postwar services, television and safety-mobile, appears to have been made possible in the FCC's action allocating TV channel 1 (44-50 megacycles) to safety-mobile, but eliminating sharing of other TV channels by the fixed and mobile services. At the same time, the Commission fixed rigid standards for use of the 72-76 mc band (between TV channels 4 and 5) to prevent interference to video from use of that space by other radio services.

The Commission's group of related actions, however, presages even more important developments later. Allocations to specific safety-mobile services were expected to be taken up soon in FCC proposed rules, and the FCC moved toward a more permanent solution of its severe frequency allocation situation by setting a hearing for Sept. 20 to seek data on development of TV equipment capable of operating in the 475-890 mc band. The Commission reiterated its previous stand that there is insufficient spectrum space below 300 mc to make possible a "truly nationwide and competitive television system and that such a system must find its lodging higher in the spectrum where more space exists."

In its far-reaching decision, the Commission also handed down a proposed revision of TV channel allocations, going beyond the original list of 140 areas and aimed at affording television service in the smaller cities and communities. A hearing on the proposal is scheduled for June 14.

TV NETWORKING RATES—The FCC, which on June 14 will hear testimony on its new proposed TV channel allocations, will swing the following day into one of the major questions surrounding continued nationwide video progress—the reasonableness of the networking rates filed by the Bell System and Western Union. Both the rates and some of the conditions of service are expected to meet strong TV broadcaster opposition at the session, before the full FCC.

The Commission upheld its previous stand that video networking should be put on a commercial basis, to avoid discrimination against other users of communications services, in rejecting a request of the Television Broadcasters Association for suspension of the rates, effective May 1. It did, however, go along with the TBA request for the investigation of the charges.

DURR SUCCESSOR NAMED—Miss Frieda B. Hennock has been nominated by President Truman to succeed Clifford J. Durr whose term ends June 30, 1948. The Senate's reaction to the naming of Miss Hennock could not be ascertained at press time, but if she is confirmed, she will take FCC office July 1 for a 7-year term. Miss Hennock is a New York lawyer who received strong support for the appointment from several New York Democratic party leaders. Now in her early 40s, she was the youngest woman to pass the New York bar and will be the first woman to serve as a member of the Federal Communications Commission. There is no evidence that she has had actual experience in the communications field.

NO INVESTIGATION OF COMMISSION IN CARDS—Reliable political informants have indicated to TELE-TECH that there is little possibility of the threatened probe of the FCC by the House Un-American Affairs Committee. The threat came in a floor speech by Rep. Hebert (D., La.), veteran and respected Congressman and a former New Orleans city editor, who flayed the agency for granting 3 FM and 2 television stations to two corporations headed by a suspected communist fellow traveler. Rep. Hebert did emphasize, however, that Commissioner Robert F. Jones, former Ohio Congressman, has taken a vigorous stand against the grant of stations to persons with allegedly communist leaning, and remarked that Mr. Jones "has brought clear thinking, dignity, and courage to that body (the Commission)."

RADIO AND CIVILIAN DEFENSE—Communications, particularly radio in both its broadcasting, television and mobile telephone services, bulks as the key mechanism in the plans for the mobilization of civilian defense which have been implemented by Secretary of Defense Forrestal. It is realized by the National Defense Establishment, under which the Army, Navy and Air Force are unified, that civilian defense preparations must be completely worked out in advance so that they can be placed in immediate effect in event of a national emergency, especially atomic bombing threats.

The paramount role of communications in the civilian defense picture was recognized with the appointment of a Bell System top executive, Northwestern Bell President Hopley, as Director of Civilian Defense Planning. Within the past month representatives of the broadcasting and radiocommunications industries were called to Washington to pool their recommendations for operation in the event of a national emergency and atomic warfare.

One of the first key civil defense officials named by Director Hopley was a communications chief, assistant vice-president Herbert J. Schroll of the New York Telephone Co.

ROLAND C. DAVIES
Washington Editor

High Vacuum... make it,

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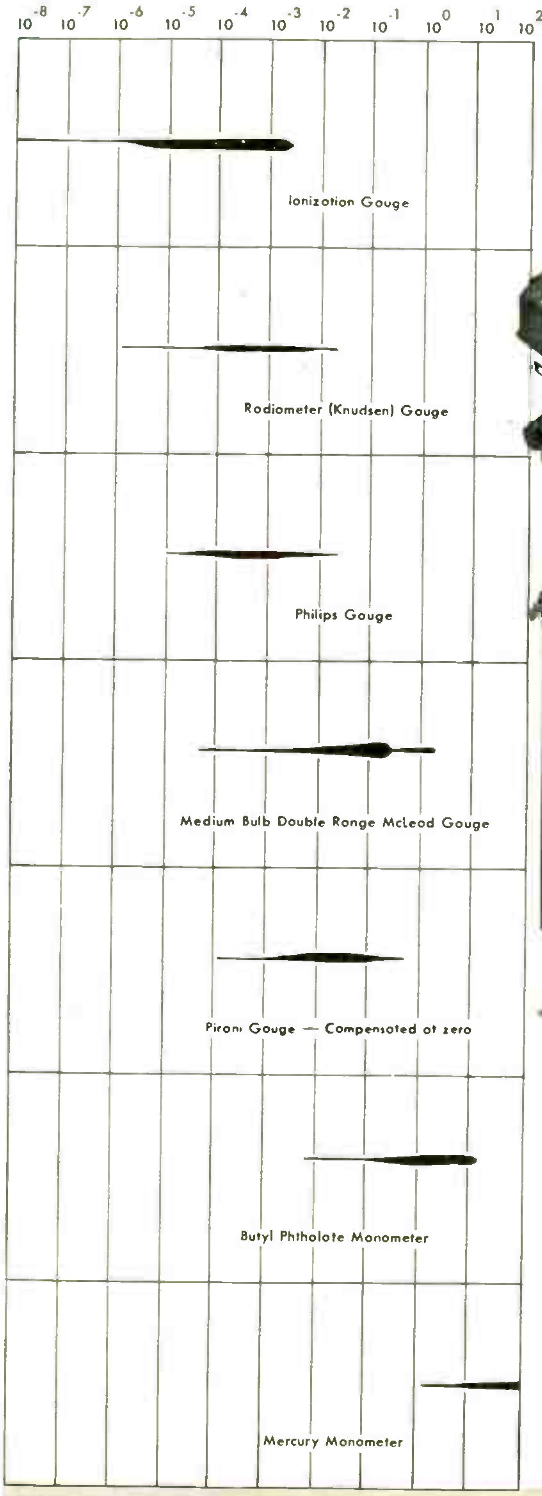

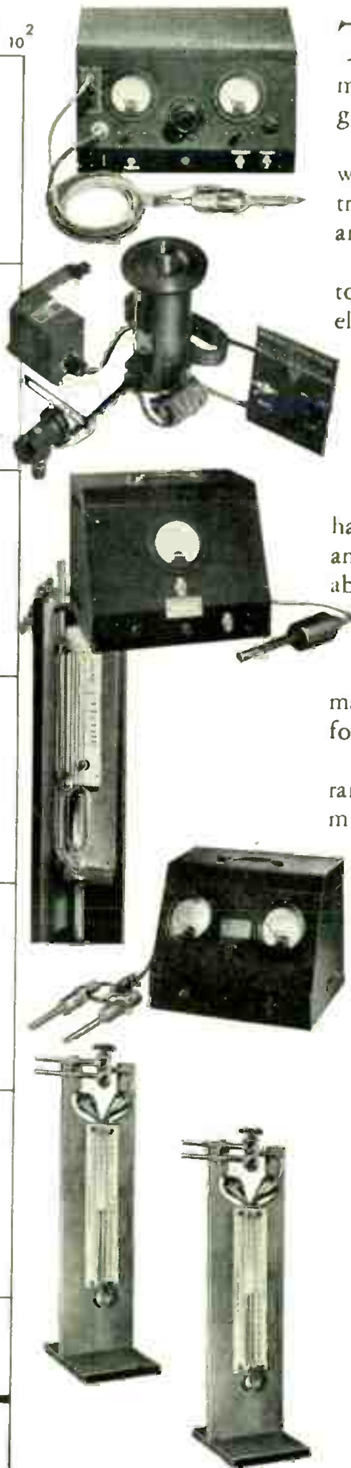

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Channel 1 Deleted; FCC Action Precedes Television Hearing Sept. 20

When the FCC issued its long-awaited decision on television channel No. 1 in May, it made the following determinations:

1. Deleted channel 1 (44-50 mc) and assigned it to non-government fixed and mobile services;
2. Abolished sharing of all remaining 12 television channels by non-broadcast services;
3. Allocated the band between 72 and 76 mc to the fixed services on condition that no interference will be caused to television;
4. Set Sept. 20 for a public hearing to study the whole problem of television channels; particularly in the matter of utilizing frequencies in the 475-890 mc band for monochrome or color television broadcasting;
5. Proposed revision of the table of allocations of the 12 channels to serve more areas throughout the nation.

The proposed revision of the allocation table will be heard before the Commission on June 14. Insofar as FM is concerned, the FCC proposes to modify its rule to permit inter-city relaying by ST link on the 940-952 mc band, thus denying the 44-50 mc band for that purpose. At the same time, it pointed out that there was no rule against the use of the 88-108 band for rebroadcasting FM programs.

The Commission also proposes rules to provide for new station and service classifications in the 25-30 mc band. It contemplates (1) grouping geophysical, power, petroleum, provisional, press relay and motion pictures; (2) deleting certain channels now allocated to flight test and flying schools now on 118-132 mc band; (3) shifting amateur service 200 kc lower on the band; (4) assigning 27.120 mc to industrial, scientific and medical services; (5) provide for public and aeronautical fixed services; (6) realign channels for land mobile services with 20 kc widths in lieu of previous 25 kc.

Chicago IRE Meet

Approximately 400 attended the Chicago Section of the Institute of Radio Engineers' third annual one-day IRE conference at the Illinois Institute of Technology, April 17.

This year the Meetings and Papers Committee deviated from the traditional formal paper presentation type of program by somewhat of an innovation. In addition to standard panels on Management & Research, Quality Control and Magnetic Recording, there were also 3 panels termed "Sales Engineering." These panels were made up of 29 short engineering sales presentations and demonstrations by well-known engineers on components, products and processes, extemporizing the manufacturer's product.

Karl Kramer, Chairman of the Chicago Section, presided. The address of welcome was delivered by Dean W. A. Lewis of the Illinois Institute of Technology, and Benjamin E. Shackelford, national president, delivered the keynote address.

WCEMA Elects New Officers

At the annual directors' meeting of the West Coast Electronic Manufacturers' Assn. in San Francisco in April, new officers were elected for 1948-49. James L. Fouch, general manager of the Universal Microphone Co., Inglewood, and chairman of the Los Angeles Council of WCEMA, was elected president. William Hewlett of the Hewlett-Packard Co., Palo Alto, was elected vice-president and Ed Grigsby, sales manager of Altec Lansing, Hollywood, was elected treasurer. Noel Edward, sales manager of Hewlett-Packard, continues as secretary.

Zenith Phonevision

Zenith intends to be on the market this year with combination television-phonevision receivers according to an open letter to the company's franchised dealers by E. F. MacDonald, Zenith Radio Corp. president. He said that the incorporation of phonevision units should add only $10 to the retail price of the television receiver and will make television possible in small towns not within TV station areas.

NEW NAMES AND ADDRESSES

Hillburn Electronics Products Co. has moved to larger quarters at 74 Guernsey St., Brooklyn 22, N. Y. The company makes video and sound transformers known as the "ZV" series.

* *

Harlyn Products Co., with offices at 60 E 42nd St., and factory at 6 Bond St., New York, N. Y., has been established for the manufacture of loop antennas and other radio components. Principals of Harlyn organization are Arthur W. Roberts, Leo Flamm, and Harry Meyer.

* *

Ben Lehman, former vice-president and general manager of Radio Wire Television, Inc., and Hy Davis, purchasing agent at Radio Wire, have formed the Davis Electronics Corp., located at 204 Main St., Hempstead, N. Y. The new company will handle complete lines of radio parts, public address systems, and television equipment.

* *

Standard Arcturus Corp. has moved to a new and larger plant at 54 Clark St., Newark, N. J. This move provides sufficient expansion space for its affiliates, the Arcturus Electronics, Inc., the tube division; Kotron Rectifier Corp., the Selenium Rectifier Production division, and the Arcturus Radio and Television Corp.

* *

Emeloid, Inc., manufacturers of plastic products, formally began operations in its new plant at Hillside, N. J., on April 17. Emeloid's former home was Arlington, N. J.

Equipment for N. Y. Rural Radio Network Shipped

Over half the equipment for a chain of 6 FM radio stations which will serve 118.000 farms in 40 upper-New York state counties has been shipped by General Electric. The 6 stations operating as a network expect to be on the air early this summer.

Weather forecasts, market reports, farm talks, and other programs may originate from any of the 6 stations but all will broadcast the same programs during most of the program day. Stations will be located at Ithaca, DeRuyter, Cherry Valley, Turin, Bristol Center, and Wethersfield.

TELEVISION-RADIO PRODUCTION BOX SCORE

(RMA Members)

Receiver Production	Jan.	Feb.	March	April	Postwar Totals
Television	30,001	35,889	52,137	46,339	349,413
Consoles	13,261	10,295	15,304	12,536	115,449
Table M.	16,740	25,594	37,833	33,803	234,964
AM & FM	1,339,256,	1,379,605	1,633,435	1,182,473	36,534,769
AM-FM	136,015	140,629	161,185	90,635	1,834,464

CONVENTIONS AND MEETINGS AHEAD

June 10-12—Symposium on Electron and Light Microscopy, sponsored by Illinois Institute of Technology, Stevens Hotel, Chicago.

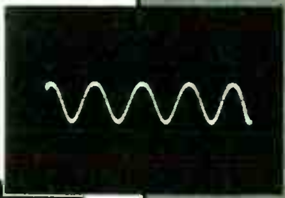
August 20-29—First Annual All Electronic Exposition, Southern California Radio and Electrical Appliance Exposition, Pan Pacific Auditorium, Los Angeles.

Sept. 30-Oct. 2—Fourth Annual Pacific Electronics Exhibit, West Coast Electronics Mfgs. Assoc., Biltmore Hotel, Los Angeles.

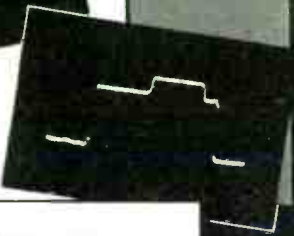
Oct. 2-3—Southwestern Division, ARRL, Annual Coast Convention, Alexandria Hotel, Los Angeles.

November 4-6—National Electronics Conference, Annual Technical Forum, Edgewater Beach Hotel, Chicago.

Output of one of the marker oscillators used in setting sweep speeds to known values. This case represents 0.2 microsecond/inch.



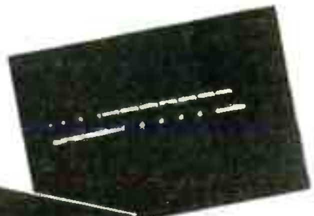
1.2 lines of television signal. Horizontal synchronizing and blanking pulses at each end. Video modulation in center.



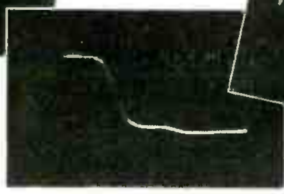
Fractional part of a line. Horizontal synchronizing and blanking are shown.

Television waveforms selected even to the scanning line and fraction of that line, for critical study or recording, with the <u>new</u>

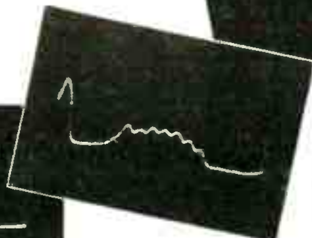
DU MONT
Type 280
Cathode-ray
OSCILLOGRAPH



Vertical synchronizing and equalizer pulses as seen with 60-cycle-sweep repetition rate; used for checking interlace.



Fractional part of line near center of line. Video modulation produced by wedge, is shown.



Fractional part of line near center of a test pattern where wedge elements are more closely spaced. Note loss in amplitude of modulation.

Trailing edge of horizontal synchronizing pulse.

OTHER FEATURES . . .

Provisions for attaching recording camera. Fine, clear focus over entire length of trace.

Y-axis: Any degree of attenuation between 1:1 and 1000:1; great expansion of negative polarity signal; undistorted deflection of at least 2"; frequency response within 3 db. from 10 cps. to 10 mc.

X-axis: Time-base duration variable from 1 to 15,000 microseconds. Horizontal deflection of at least 4".
5RP-A Cathode ray Tube. 12,000 volt accelerating potential.

Time-base can correspond with any horizontal line in either or both interlaced fields. Calibrating generator for calibration of sweep-writing speeds by signals of 10, 1, and 0.2 microsecond/cycle.

Wide range of sweep-writing speeds; continuous variation between 0.25 and 3000 microseconds/in.

Delay ranges of 100 or 1000 microseconds selectable for linear time base.

Indication as to exact occurrence of time-base with respect to overall television picture.

Interval of 0.25 microsecond may be measured to plus/minus 0.01 microsecond.

DU MONT proudly announces the new Type 280 Cathode-Ray Oscillograph especially designed for television studio and transmitter installations. Here at last is a means for accurately determining the duration and shape of the waveform contained in the composite television signal, as well as the character of the picture-signal video in conjunction with transmitter operation, according to FCC standards and practices.

Excellent for research on all television equipment. Also for study of wide-band amplifiers. Well suited for industrial use wherever high-speed single transients are studied. Consists of four units mounted on standard relay-rack type panels and chasses, and installed on mobile rack. Removable side and rear panels. Grouped controls for easy operation.

By virtue of its great range of applications, Type 280 becomes a "must" for television studio and research laboratory.

Further Details on Request!

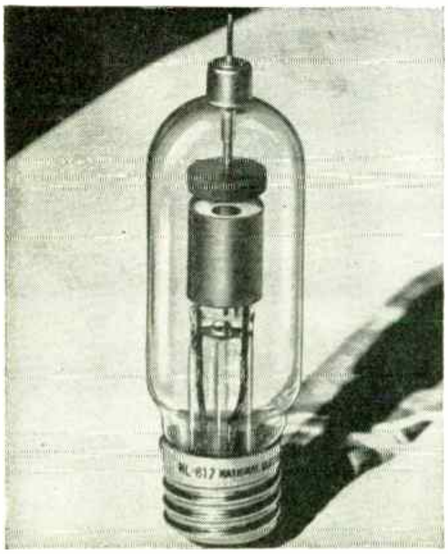
DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: ALBEEDU, PASSAIC, N. J., U. S. A.

Tubes and Communications Components

Bantal Tube

Incorporating all the desirable features of conventional glass, metal and lock-in tubes, the Bantal tube is directly interchangeable with its equivalent metal or GT type because it requires no extra shielding. Structural strength is achieved with 8-pillar support construction. Permanent vacuum is assured by the glass-to-glass seal and the standard octal base is interchangeable with metal. Bantal construction is available in the following types: 6SA7GT, 6SJ7GT, 6SK7GT, 6SQ7GT, 12SA7GT, 12SJ7GT, 12SK7GT, 12SQ7GT.—**Raytheon Mfg. Co., 60 East 42nd St., N. Y., N. Y.**

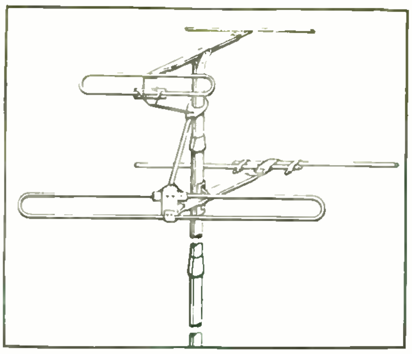


Industrial Rectifier

A quick-heating, 5-amp mercury vapor rectifier tube has been designed for heavy-duty industrial rectifier applications at voltages up to 600 dc. Known as the NL-617 it is more compact than tubes previously available for this rating. Lower condensed mercury temperature is provided which makes possible a peak inverse voltage rating of 1,000 volts. Filaments are rated at 2 volts, 12 amps; dc ampere output is 5; peak inverse output is 20.—**National Electronics Inc., Batavia Ave., Geneva, Ill.**

Broad Band Antenna

All television channels, FM bands and high frequency amateur bands (a range of 40 to 225 mc), can be picked up by the Kolster broad band antenna. Throughout this 185 mc spread, the standing wave ratio in a 300 ohm line is low. At most frequencies it is less than 3 but does not exceed 4 at any point in the frequency range. The coil housing consists of a strong, lightweight, plastic tubing which is fitted to the upper and lower members by aluminum collars. The antenna may be installed with or without reflectors.—**Skyring Thorne-Smith, Vienna, Virginia.**



TV Antenna

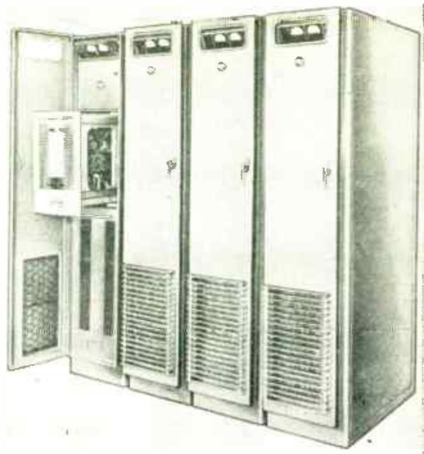
"Telebeam," a long-range, high-gain television antenna, can be adjusted to any channel and tuned perfectly to any television transmitting station. The rugged construction of this new antenna withstood gales of 70 mph.—**Cole-Worner Corp., 11 W. Monument St., Dayton 2, Ohio**

Miniature Velocity Microphone

Smaller than a pack of cigarettes, KB-2C miniature velocity microphone has the sensitivity of the finest broadcasting microphones and fits comfortably in the palm of the hand, making it ideal for use at remote pickups. The diminutive size of the KB-2C is attributed to designing the magnetic structure as a part of the case. New highly efficient magnetic materials have also contributed to the unit's reduction in size. Bi-directional characteristics provide uniform frequency response between 80 and 8,000 cycles.—**RCA Victor Div., Radio Corp. of America, Camden, N. J.**

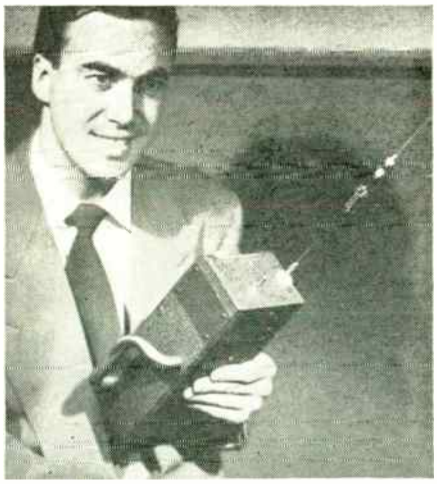
Tv Picture Tube

Approximately twice the light afforded in previous models, and improved image detail and contrast are presented in the latest GE 10-in. direct view television tube. An aluminum-backed fluorescent screen prevents loss of light and stray reflections inside the tube, improving the brilliance of the pictures.—**General Electric Corp., Syracuse, N. Y.**



Transmitting Unit

Telepak is a new transmitting unit with a series of separately removable cells designed to fit in a basic frame. The cells are standardized in size, ranging from 1/3 of the basic frame to a full stack. Because each cell is independently mounted, removal from the frame for servicing or replacement is simple. The cells are individually ventilated.—**Radio Receptor Co., Inc., 251 West 19th St., N. Y., N. Y.**

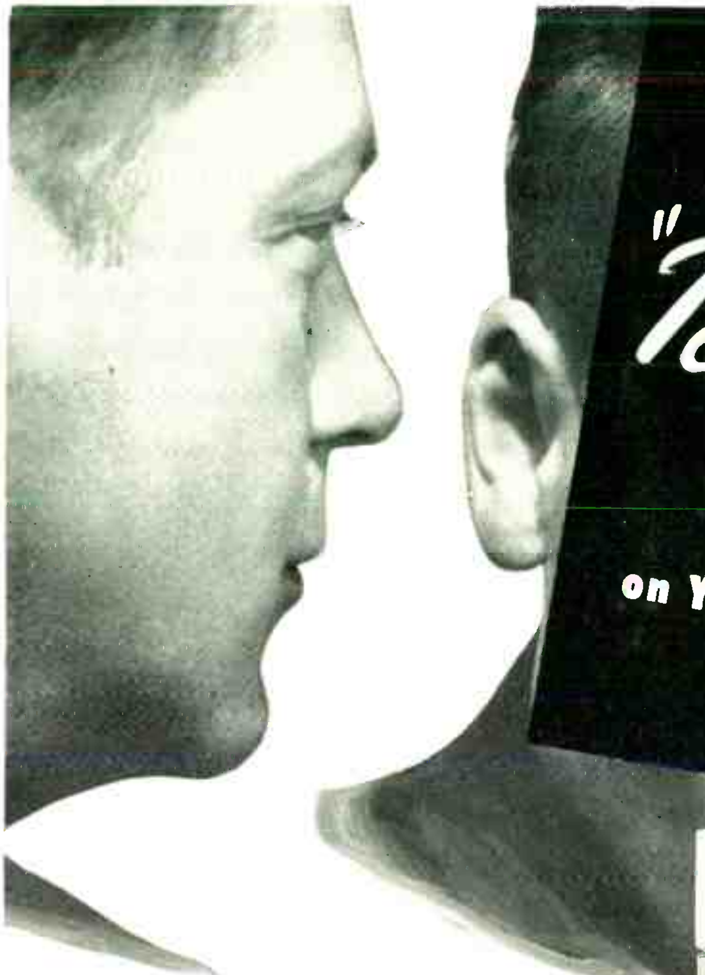


Radio-Microphone

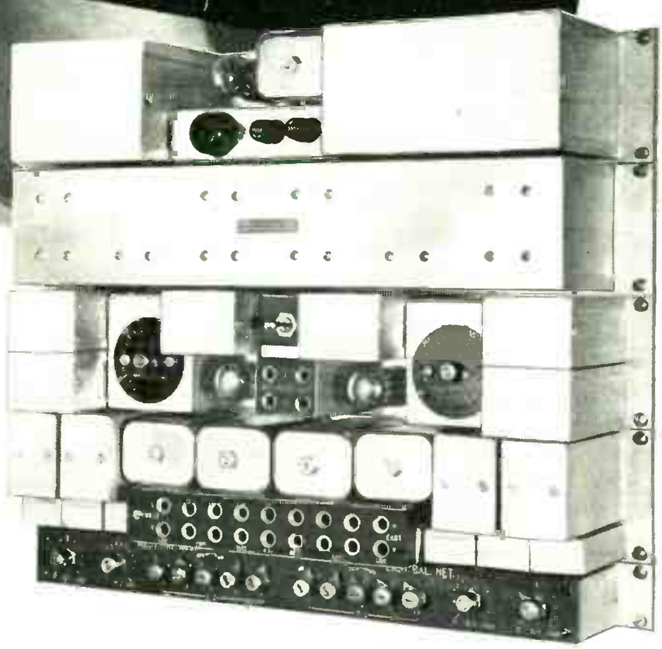
A crystal controlled portable UHF transmitter and microphone, the BTP-1A, is especially adapted to broadcasts in locations where wire connections are difficult or impractical. The transmitter section of the BTP-1A operates at any frequency between 25 and 28 mc; maximum power output from the rf amplifier is approximately 0.25 watt. Powered by batteries with a continuous service life of 4 hours and intermittent service life of 8 hours the unit has a carrier frequency stability of ±.01% deviation. Total weight is 6 lbs.—**Radio Corp. of America, Camden, N. J.**

Lighting Plant

Powered with a new engine which develops 2.6 hp at 1800 rpm, the Katolight lighting plant is able to generate 1000 watts. The engine's governor limits frequency variations to less than 1 cycle between partial load and full load. Breaker points are mounted outside of the crankcase making it unnecessary to remove the flywheel to service them. A magnematic ignition system results in improved spark at starting speeds. The Katolight is available with gravity carburetor and 1 gallon fuel tank or it can be supplied with mechanically operated fuel pump.—**Kato Engineering Co., Mankato, Minn.**



FOR THAT "Person-to-Person" TOUCH on Your Long-Distance Calls



Does your long-distance reception have that "personal" sound of a friendly confidence, spoken close to your ear? Is it clear and distinct? Communications engineers everywhere find that where long-lines reception is weak and noisy, a repeater boosts transmission level, provides a quiet circuit. Avoids confusion in telephone conversations, saves time and money for the operating company.

The Kellogg Repeater is easy to install, simple to maintain. (You don't need tools or soldering irons for adjustments. Accurately-calibrated controls allow quick, easy changes from the equipment side of the unit when line conditions vary.) It consists of two vacuum tube amplifiers that amplify voice signals in both directions on a two-wire circuit. Improved filter design permits maximum gain, and a quiet telephone circuit. Kellogg Repeaters are assembled and wired on a "unit" basis for greater flexibility. Each unit mounts on a standard 19" relay rack, or in a cabinet.

Contact Kellogg for complete details *today!*

KELLOGG Repeater

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
6650 SOUTH CICERO AVENUE CHICAGO 38, ILLINOIS

Send for our Repeater Booklet NOW!

Kellogg Switchboard and Supply Company
6650 So. Cicero Avenue
Chicago 38, Illinois

NAME: ______________________

ADDRESS: ______________________

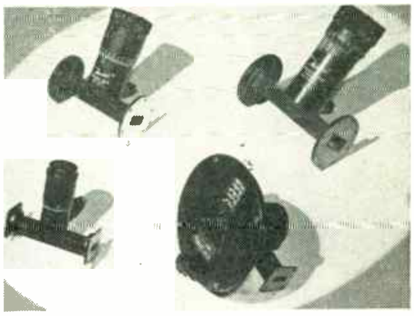
CITY: ______________________

STATE: ______________________

New Test Equipment

TV High-Voltage Meter

A high-voltage meter designed for television projection systems is now being offered with a range from 0 to 30 kv. it draws 20 microamps. The meter's bakelite panel with a 4-in. scale is housed in a solid oak cabinet.—**Spellman Television Co., Inc., 130 W. 24th St., New York 11, N. Y.**



Cavity Meters

High accuracy and resolution is achieved with these high-Q tunable cavities which measure microwave frequencies to absolute accuracies between 1/10,000 and 1/20,000. They can be used as transmission or absorption cavities that provide continuous frequency coverage from 2575 to 3750 and 4500 to 10,500 mc. Calibration is made against a frequency standard accurate to one part in 100,000. The tuning plungers use a double wavetrap instead of sliding contact fingers to develop an efficient and stable short circuit. Short coupling distance used between the cavity and the main line reduces the reaction of frequency upon coupling.—**Industrial Dept., Sperry Gyroscope Co., Great Neck, N. Y.**

Gamma Radiation Meter

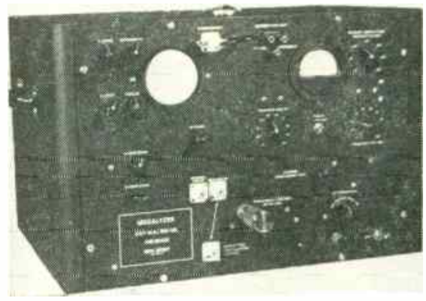
Four ranges of sensitivity are provided in the portable 247A gamma ray survey meter which is calibrated to read in roentgens over full scale readings of 2.5, 25, 250, and 2500 milliroentgens per hour. The case is water tight and the meter and ionization chambers are hermetically sealed. Weight of the instrument is 11¾ lb.—**Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.**

Automatic Wattmeter Bridge

Directly indicating microwave power over a range of 10 milliwatts down to a few microwatts, model 123A wattmeter bridge has a range which can be extended to 100 watts by directional couplers or attenuators. Accuracy is better than 5%. No operating adjustments except zero standardization are necessary because this bridge is automatically self-balancing. Three ranges, 10, 1.0, and 0.1 mw. are selected by a 3-position switch. Input rating is 115 volts, 60 cycle ac.—**Industrial Dept., Sperry Gyroscope Co., Great Neck, N. Y.**

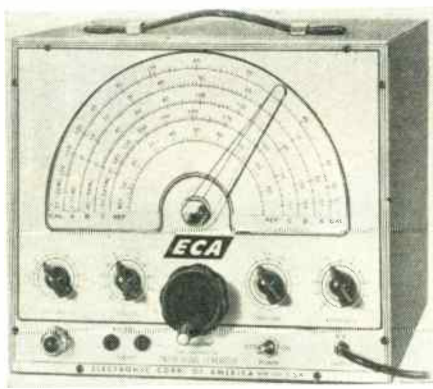
Milliammeter

Affording plenty of space on its dial for a multi-range scale, model 56 motor has a 100° arc and a 5½ in. scale length. It is housed in a rectangular bakelite case with extra heavy cross sections to stand up under rough handling and measures 6½ x 5¼ in. **Marion Electrical Instrument Co., Manchester, New Hampshire.**



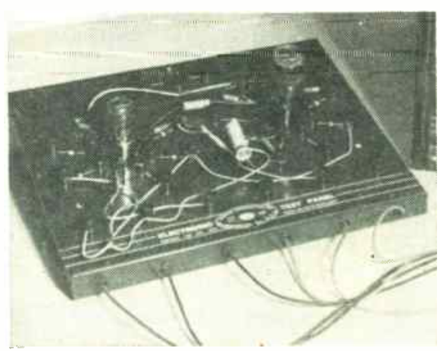
VHF Spectrum Analyzer

As well as being a monitoring instrument for communication systems analysis, the Megalyzer can be used by television stations for display of transmitter output frequency distribution. All signals within a frequency sweep band 30 mc wide anywhere within the vhf range of 30 to 300 mc can be observed simultaneously. The Megalyzer has a sensitivity of better than 200 microvolts and a frequency resolution of 100 kc. A self-contained power supply is incorporated and operation is from 117 volts, 60 cycles.—**Kay Electric Co., Pine Brook, N. J.**



Sweep Signal Generator

A sweep width of 500 kc to approximately 10 mc has been incorporated in the 3 frequency-range bands of model FMT FM and television sweep signal generator. The A, B, and C ranges are: 2—77 mc; 40—154 mc; 151—227 mc. Model FMT has high frequency insulation throughout and a maximum output of ½ volt. **Electronic Corp. of America, 353 W. 48th St., New York, N. Y.**



Electronic Test Panel

A versatile and inexpensive electronic tube and circuit demonstration unit, the model MS-100 test panel provides 2 standard octal sockets with each terminal brought out to a binding post. The unique radial binding post arrangement facilitates the insertion in series of standard circuit components with any tube element. Interconnections between elements as well as connections to supply leads are quickly made with short jumper prods and without soldering.—**Moulic Specialties Co., 1005-7 W. Washington St., Bloomington, Ill.**

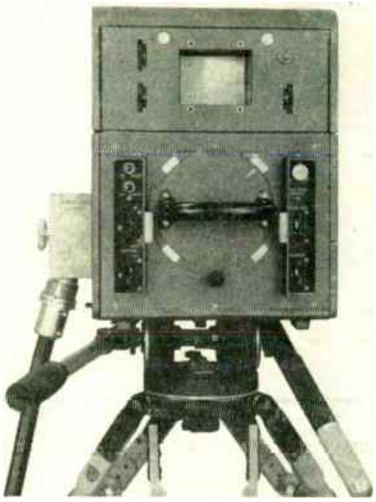
Raytheon Offers 4 TV Packages

Raytheon Mfg. Co., whose complete line of television equipment was shown for the first time at the NAB convention in Los Angeles last month, is offering 4 new television "packages."

The first "package" for repeater station operation, and costing between $50,000 and $55,000, includes a 500-watt video transmitter with station monitors; a 250-watt audio transmitter; high gain antenna and diplexer; video line amplifier, switching unit, distribution amplifier, picture monitor; two microphones and consolette.

The second "package" consists of all the above items but with the addition of a single camera chain, a 16 mm film projector and slide projector and hence permits limited program capabilities. Its cost is from $75,000 to $80,000.

The third "package" is for the broadcaster who wishes to avail himself of the programming possible with the equipment outlined above but who in addition desires dual camera performance to stage shows in large scale television studios. The cost of $95,000 includes all the above equipment, and duplicating the camera layout with the addition of lighting and mixing equipment affords such special features as fades and lap dissolves.



Rear View of TV camera and finder

"Package" four is Raytheon's de luxe TV package for direct remote pick-ups with two sets of dual camera chains, microwave relay equipment, and costs approximately $135,000.

Raytheon's new 5KW transmitter will change any of the preceding "packages" to a video carrier output of 5000 watts for use in larger metropolitan areas. The company also showed its new FM antenna which features high gain, short height and eliminates need for de-icing equipment.

Magnetic Storms Forecast

Magnetic storms originating from sunspots now can be forecast over short periods dependably to within 15 minutes of the start of their destructive effects on radio communication. The prediction of solar disturbances was described to a joint session of the IRE and the International Scientific Radio Union by H. E. Hallborg and Miss Audrey Nelson, of RCA Communications, Inc., at Washington, D. C., on May 3.

Investigations proved that the size of sunspots is a "meaningless criterion" in predicting havoc to radio circuits. Composition of the spots, their polarity and their position on the face of the sun were declared to be the determining factors of lethal bombardment. Moreover, it was established that a "critical zone" existed on the sun's face — an area with a radius of 26° from the optical center of the sun, on its eastern hemisphere. The position of sunspots in relation to this critical zone was discovered to be of utmost importance; damaging effects on world radio communications occur when sunspots are within this zone.

RMA Industry Mobilization

A new RMA-Government Liaison Committee has been organized to secure information on government-industry mobilization and military production plans as they affect the radio-electronic industry. The committee will also provide coordination between the government and manufacturers in the industry.

Fred R. Lack, vice president of the Western Electric Co., New York, was named chairman. Other members are Frank M. Folsom, executive vice-president of the RCA Victor Division, Camden, N. J., and W. A. MacDonald, president of Hazeltine Electronics Corp., New York.

SOUND MEASUREMENTS IN BC STUDIOS

(*Continued from page 41*)

signal. The use of a warble tone excites several natural frequencies of the room, lessening some of the experimental difficulties. After about 5 seconds the sound energy in the room has risen to a steady state condition. Any time after that, the tone is stopped and the decay of the sound pressure at the microphone position is obtained graphically by means of a high speed level recorder. After taking 10 decays at one frequency, adjust to the next test frequency. Other speaker microphone positions may be used. Various technics have been used, such as spotting 6 microphones around the studio and bringing them to the recorder in all combinations of twos. Straight lines representing average slopes are drawn on the wavy records, and the times in seconds to drop 60 db are computed from these. The studio characteristic of decay time vs. frequency is usually given as a plot. Much work remains to be done in clarifying this technic.

Given a single speaker position, what are the decay curves with different single microphone positions? How shall we interpret the wavy line of the actual decay curve? Is the time taken for the pressure level to drop 20 db, say, the most important part of the decay?

There have been very good reasons in the past for measuring decay time. The first broadcasters found that drapes were satisfactory for the early stages of the art. At a later date more critical listening showed these studios to be boomy at low frequencies and muffled at high frequencies. Measurements of decay times quickly indicated the trouble. Ordinary absorbing materials when used in thin layers are effective primarily in the middle and high frequency ranges and are relatively inefficient in the frequency range below 256 cps.

Studio engineers have various working rules relating the desired decay time at a certain frequency to the volume of the studio. The decay time at other frequencies is given as a ratio of that at 1000 cps. The Morris-Nixon data gives ratios which do not change for different size studios. It should be emphasized that these are practical methods. Working in a difficult field these engineers have tried to summarize in such data their experience in relating measured decay times to studios judged to be satisfactory.

For studio decay times of less than 2 seconds, the reverberation over the average receiver in the home is not particularly apparent. Decay time is important, however, as a general indication of a studio's usefulness because of the several aspects of the room acoustics problem brought out previously. The musical director wants a full tone, with each instrument developing those overtones so important to the musical ear. To use a pipe organ phrase, presumably a studio is desired which "speaks" readily. We hazard a guess that to do this the studio should have many normal modes, evenly spaced over the frequency range, with minimum absorption to permit rapid build up of sound energy.

A more searching technic is needed. A step in this direction uses a graphic level recorder for steady state measurement.[2] For a fixed speaker-microphone pair of positions, the signal to the speaker is varied slowly over the frequency range and the microphone-recorder system gives a plot of the frequency response. It is advisable to use a high resistive acoustical impedance at the speaker so that the source looks into a fairly constant impedance independent of frequency or position in the room. With this constant source the variations in pressure level as the frequency is changed are measures of the acoustical characteristics of the room.

With the graphic level recorder a related test can be made by obtaining a plot of pressure level vs. position in the room for various source positions, over the frequency range. For the steady state condition this shows the point-to-point variation. Future tests may show a definite correlation between this type of variation, ease of microphone replacement, ease of obtaining tonal balance and amount of departure above and below a straight line slope in the decay curve. It is possible that variations in placement of absorbing material and the use of diffusing surfaces may show significant changes in the studio when investigated this way. The decay time test represents too average a condition to be of more than general value.

Preliminary work on delivering pulses from an oscillator to a speaker has been encouraging. By using a triggered sweep circuit on an oscilloscope it is possible to show the direct-pulse to the pickup microphone as well as the pulse after one reflection. It is possible that changes in wave form caused by room acoustics can be investigated by refinements in this method.

Sound absorption coefficients and acoustical impedance values can be obtained by laboratory tests on most of the materials that go into a studio. These tests furnish information useful in predicting studio performance. Overall decay time tests on a studio should be made, but it is becoming obvious that this technic is not always enough to differentiate between two studios judged different by those who work in the studios. Mathematical analysis has pointed out the true nature of the acoustical problem, although the problem is too complicated to allow a complete solution by mathematical means.

We believe that a better understanding is required of the waveform itself during its buildup, steady-state period and decay at the various important points throughout the studio. We must learn to correlate results from the various measurements it is possible to make, with the demands of the musician, the director and the studio engineer. We have at hand means of specifying a wide variety of wall and ceiling treatments as well as methods of breaking up the room surfaces themselves. It is time to consolidate this information, use new technics and meet the demands of the problem more specifically.

[2]Tele-Tech, Oct. 1947, p. 44

WOW Tester Circuit

(*Continued from page 29*)

transmission at 375 cps, while the other has zero transmission at 540 cps. Thus, the former has a rising transmission characteristic above 375 cps, while the other has a falling transmission characteristic up to 540 cps. Both are quite linear, and with opposite slopes between 375 and 540 cps. These two voltages are amplified (T16, T17) and rectified separately (IN34's), then mixed to give a balanced output at 450 cps.

The output of the balanced discriminator is monitored on the deviation meter (M2) which reads plus and minus 50 cps from center. Slow variations in frequency are read on this deviation meter. It is also used as a tuning indicator in final setting of the FM tuning. A balanced dc amplifier (T13, T14) is required between the output of the balanced discriminator and the meter movement of the deviation meter (M2). A jack is provided for operating an Esterline-Angus graphic ammeter, Model AW, 1 milliampere full scale.

The output of the balanced discriminator is passed through a bandpass stage of amplification (T12) before going to the output terminals. This stage passes components between one-half and 40 cps but greatly attenuates the IF components. A deviation of plus and minus 75 cps will produce 5 volts rms at the output terminals.

Amplitude modulation measurements are obtained by switching the rectifier and the monitor meter (T11, Type 1N34, M1) across the output of the input amplifier and passing the rectified components through the bandpass amplifier (T12) to the output terminals. When the AM gain control (R3) is set to give 150 microamperes on the monitor meter (M1), 25% amplitude modulation will produce 5 volts rms at the output terminals.

The second unit is a VTVM and a frequency component analyzer used to measure the output of the first unit. Its input impedance is about 2 megohms. The voltmeter has 3 ranges: (1) 5 volts, (2) 1 volt, (3) 0.5 volt rms. The analyzer has an additional sensitivity of 10 times over that of the broadband voltmeter in order that small amplitude components may be measured. The frequency range is from one to 32 cps.

The input passes through a cathode loaded amplifier (V3) to the stepped attenuator controlled by the voltmeter range selector switch (S2). A low-pass filter in the form of a degenerated stage of amplification (V4), is inserted after the attenuator so that the voltmeter will be insensitive to frequency components above the desired band.

The signal passes through a coupling stage (V5) to a cathode loaded driver stage (V6), which operates two rectifiers (type 1N34). The outputs of the rectifiers are filtered and applied to a balanced amplifier (V12 and V13) which operates the meter (M1). In addition to the dc component, this output has a component with a basic frequency of twice that of the frequency of the signal instead of being equal to it as in the case of a halfwave arrangement. Also, for any given dc output current (meter reading) the peak value of the ripple is only one-half as great for the balanced system. These two factors aid materially in reducing meter-pointer vibration at the lower frequencies without necessitating the use of excessively slow time constant filters which would make the meter action slow in responding to voltage changes.

The analyzer consists of a selective amplifier (V7) and a vacuum tube voltmeter (V10, V11). The selectivity of the amplifier is obtained by the use of a double-T network in a degenerative circuit. A coupling tube (V8) is inserted in the feedback circuit in order to eliminate loading on the double-T network. A control (R6) in the output of the coupling tube serves as a means of adjusting the selectivity from the maximum as shown in Fig. 2 to any desired lower value.

The frequency setting of the analyzer is accomplished by two selector switches. The range of the small increment switch is from 1.0 to 2.0 in 0.1 steps. This represents 1.0 to 2.0 cps when the multiplier switch is set at X1. The other ranges on the multiplier switch are X2, X4, X8 and X16, thus the complete range is from 1.0 to 32 cps.

(The writer wishes to thank A. E. Birr, Robert Carlson and Frank Landis for their cooperation in the design and construction of the equipment described.)

Rieke Diagrams

(*Continued from page 36*)

coupling may no longer be critical. In fact the oscillator may now be effectively under-coupled or over-coupled to its load, the extent depending on the magnitude of the standing wave ratio introduced by the impedance mismatch and on the phase of the standing wave minimum. Hence, it is inferred that if the oscillator at some time is likely to operate with heavily mismatched loads, it may be wise to under-couple it deliberately in order to minimize the probability of operation in the over-coupled region. The extent of the de-coupling must be dictated, of course, by the requirements of power output, economical operation of the oscillator, and reduction in power variation with impedance mismatch.

(2) Consider the line running diametrically through the Smith chart and orient it with the zero on top. If we agree to talk about reactance instead of susceptance, the semi-circle to the right of this line is a region of positive reactance and that to the left one of negative reactance. The orientation of the power contours with regard to the line is a function of the kind and degree of coupling, the feedback condition in the oscillator and where the reference zero position falls on the slotted line. Thus, the curves in Figs. 2, 3, and 4 were taken with a capacity probe as the coupling element. It is noted that there is a slight shift of the pattern in the counter-clockwise direction in going from less to greater than critical coupling. On the other hand a similar set of measurements taken with an iris or loop coupling might be expected to alter considerably the location of the contours.

(3) In going from 70% to 128% coupling, the curve of maximum power output passes from a positive to a negative reactance region. This may be explained as follows. In order to deliver maximum power, the oscillator must see an impedance equal to the resonant impedance of its equivalent tank circuit. The coupling, in this case a capacity probe, acts as an impedance transformer whose action is a function of its physical position with respect to the plate line. Thus, for loose coupling

it requires a positive reactance at its load terminals in order to properly match the oscillator, and for over-coupling it requires a negative reactance for match.

Frequency Contours

We said earlier that the presence of conductance and susceptance in the load would introduce an equivalent susceptance in shunt with the oscillator circuit itself. The effect of this is to detune the oscillator so that it oscillates at a slightly different frequency. The shift in frequency caused by the equivalent susceptance loading is referred to as frequency pulling.

The points to observe about frequency pulling on Rieke diagrams are:

(1) f_o is the resonant frequency of the oscillator for a matched load.

(2) The amount that the frequency is pulled for a given value of coupling and a given standing wave ratio is at once evident from the diagram. One can select a power contour representing a percentage of coupling and then read along it obtaining the pulling figures for various VSWR's. Furthermore, it is seen that the pulling figures for a given VSWR increase sharply with coupling.

(3) Finally, it will be noted that the region beyond critical coupling is one characterized by a relatively large amount of pulling as well as large power variation. Hence, from the point of view of sound operation, one should regard this region as forbidden.

It may be mentioned that in the case of ultra-high frequency coaxial cavity oscillators it has been possible to make notable improvements in frequency stability by capacity-loading the oscillators in accordance with the information contained in Rieke diagrams. They may be used to determine the proper coupling between an oscillator and a transmission line in that once the allowable power variation or frequency drift from pulling has been assigned and it is known what the maximum VSWR is likely to be, the percentage of critical coupling is at once determined and thereby the power output from the oscillator.

The author is indebted to Mr. Leigh Kimball, formerly of Naval Research Laboratory, for the data used in the Rieke plots.

PERSONNEL

Dr. Douglas H. Ewing has been named manager of Advanced Development Engineering of the RCA Engineering Products Dept., Camden, N. J. **C. M. Lewis,** who joined RCA in 1934 as transmitter design engineer, has been appointed sales manager of broadcast and industrial equipment.

F. D. Meadows has been named merchandise manager of the Broadcast Audio Group.

Louis S. Danko, newly appointed sales manager of the special products dept., Acme Electric, Cleveland, will be in charge of transformer sales.

N. F. Shofstall has been placed in charge of all engineering for General Electric's Receiver Div. His new title is division engineer. He succeeds C. G. Fick who has transferred to the company's research laboratory, located in Schenectady, N.Y.

Lawrence F. Black and **Charles B. Hull** have been appointed assistant chief engineer and assistant division engineer of construction respectively, of the American Steel and Wire Co.

E. D. Cooper has become sales engineer of the Steatite Corp. of Keasbey, N. J., and will handle the company's new line of coaxial cable and wave guide equipment.

Roland D. Payne, former sales manager of service equipment for General Electric, has taken over the sales managership of Air King Products Co., Brooklyn.

Paul Meissner has been named production manager of Marion Electrical Instrument Co., Manchester, N. H.

Frederick D. Ogilby has assumed the newly created position of manager of television sales for the Philco Corp.

Leonard Hole has been appointed general manager of television station WABD, New York. He was formerly with CBS as assistant director of television.

R. B. Rennaker has been appointed sales manager of the Mobile Radiotelephone Division of Federal Telephone and Radio Corp., Clifton, N. J.

Flying Spot for Scanning

(Continued from page 43)

than for other standard phosphors but a complex network is nevertheless needed because the decay characteristic is not a simple exponential curve but a curve of a complex function. When used with a filter to pass only the ultraviolet radiation, the P15 effectively has a persistence so extremely short that the small amount of equalization needed can be supplied by a single network. As a result, circuits and adjustments are simplified and substantially the same signal-to-noise ratio is obtained, in spite of filter absorption, as with the arrangement using the total radiation from the phosphor.

The screen of the 5WP15 has radiation in the visible blue-green region and in the invisible near-ultraviolet region. The blue-green radiation decays hyperbolically to about 30% of its initial value in 1.5 microseconds. The ultraviolet radiation has an equivalent exponential decay with a time constant less than 0.05 microseconds. The frequency response of the ultraviolet radiation is substantially constant for a range of 3 megacycles and then decreases exponentially toward zero at approximately 100 mc.

Resolution of better than 700 lines at the center of the reproduced picture can be produced by the 5WP15. To obtain such resolution in the horizontal direction, it is necessary to use a video amplifier having a band-width of about 10 mc.

The dc power supplies for the 5WP15 should consist of high-voltage (20 kv) for recommended operation supply (preferably of the limited-peak-energy type) and a negative supply of about 100 volts, depending on equipment design, for grid No. 1. Voltage for anode No. 1 is obtained by means of a voltage divider, as is usual.

By the use of the control grid in the 5WP15, a modulation pattern can be superposed on that from the transparency. A great many unusual artistic effects and double-image effects are possible by this addition. Studio directors, after a few experiments using simple equipment, can devise many spectacular background effects without preparing extensive artwork.

TV Convention Pool

(Continued from page 23)

all sound requirements for CBS, MBS, NBC, ABC and the television pool. The pool will, of course, avail itself of the AM mikes spotted about the hall in the vicinity of each state delegation. The 4 main audio pickup locations will be the speakers' rostrum, the floor mikes, the TV announce booth and the No. 5 camera outside.

One program director, during his particular tour of duty, will select the final picture appearing on the 4 screens in the master control room and switch it to the distribution amplifiers located in the TV equipment room directly opposite on the left of the rostrum. This room will contain the test equipment and maintenance facilities as well as the distribution amplifiers (see drawing). The fifth camera operated in the pool by ABC outside the auditorium will be the only pool camera not feeding directly to the master control room. It will feed to the distribution amplifiers with a feedback to the master control room so that the program director can watch its picture and switch it into the pool feed if desired.

About 20 outlets from the distribution amplifiers will feed the final pool picture to its destination. Two will go to the AT&T station in the building for transmission north and south. Two outlets will go to NBC, CBS, ABC, DuMont, Bell and others, such as the receiver manufacturers who will have receivers on display and will want to receive the pool picture. Availability of individual outlets will enable NBC, for example, to pick up the pool picture in its own studio in convention hall and switch to it if desirable during the limited period when NBC has exclusive use of the north and south share cable.

In the master control room there will be complete sets of video equipment to parallel the cameras being used by each of the 3 nets operating inside the hall (NBC, CBS and DuMont). Consequently, images from the DuMont cameras will show up on DuMont's monitors; images from NBC cameras will show on RCA monitors, etc. Since the nets will rotate at camera position No. 3 atop the control room, carrying their own camera with them, they will also alternate using 2 cameras each. In other words, if on Monday NBC operates camera position No. 3, it will have two cameras in operation for the pool—at Nos. 2 and 3 positions. On the same day, NBC will operate two monitors in the control room. The next day DuMont might operate a camera at No. 3 position, or two cameras for the day and hence two monitors in the control room.

The monitors will be handled by 3 video-control engineers, one each from NBC, CBS and DuMont. Each engineer will watch 2 monitors on every third day; that is, on the day his own net is operating 2 cameras in the hall.

Similarly, an audio engineer from each of the nets will take charge each day, in rotation, with the engineer from the net on duty on the same day that his net is responsible for two cameras in the hall.

One technical director will be in control of the switching each day. He will come from each of the three nets on rotation. Similarly, each net will take turns in supplying a technical supervisor responsible for the overall pool engineering and signal distribution. Add to these the 4 cameramen, and the total pool operation inside the hall will require 13-men shifts, 2 shifts a day, or a total of 26 men daily. Camera No. 5 side of the hall will be operated by WFIL-TV personnel for ABC.

Finally, a program director, who will call the shots, will be supplied in rotating order by each of the 3 nets on the same day that each net is responsible for 2 of the inside cameras.

Cameras will be equipped with multiple turrets and lenses for wide-angle, closeup and long shots. DuMont will supply the distribution amplifiers for use by the pool; CBS will supply the audio control equipment and one sync generator, and NBC will supply an alternate sync generator, as mentioned previously, while each net will supply 2 cameras.

LOCAL STATION PROGRAMMING

Local Philadelphia television stations, besides having available pickups from the network pool, will

(*Continued on next page*)

TV Convention Pool

(*Continued from page 69*)

operate individual studios for special programming for local interest. Local station pickups will be available to the station's affiliated network for network telecasting. For instance, programs televised by WCAU-TV will be available to CBS but not to NBC or DuMont. Thus, local stations can televise their own programs, the affiliated net can televise the local station's programs and the local station can televise the pool's programs.

While the method which local stations will use to relay its video signal from the individual booth in convention hall to its transmitter has not been fully worked out at this time of writing, microwave relays are expected to be used where possible. WCAU in direct line of sight with the convention hall is scheduled to use microwave.

WPTZ and WFIL-TV will operate in a manner similar to that described for WCAU, with their own programming and facilities.

INDEPENDENT TV OPERATIONS

Independent television stations, such as WPIX, New York Daily News station, will have individual television studios for special programming but will also have available the network pool pickups. These will be received by the AT&T lines to New York and will be picked up from the AT&T transmitter by ST link. Independent stations, however, will have to rely on their own ingenuity for transmiting independent programs from Philadelphia to their transmitters when cable time is not available. For this purpose the Philco, Western Union and Bell microwave systems might be available.

TV NEWS OPERATIONS

Plans call for some spectacular coverage of events by newsreel for distribution to television stations beyond the range of coaxial facilities. High-speed, efficient film processing equipment is being setup for shooting and development on the spot. These will be flown by plane to stations not served by coaxial cables or microwave relays. It is expected that West coast set owners will be seeing convention events not more than a few hours old.

TELE-TECH

Advertisers June 1948

TELE-TECH'S TV TIMETABLE IN GREAT DEMAND

First comprehensive schedule of dates when new television stations will go on the air, the Television Timetable published as a loose insert in the May issue of TELE-TECH supplied information widely needed in TV planning by manufacturers and telecasters.

Although reprints were necessary and orders for large and small quantities keep pouring in, a limited supply is still available. Single copies, 25¢; ten or more, 10¢ each. Check or stamps may be sent to TELE-TECH, 480 Lexington Avenue, New York 17, N.Y.

Military Equipment Needs Discussed at AFCA Meet

The anticipated needs of the United States' armed forces for electronics equipment and the steps taken to gear the nation's production facilities to meet any war mobilization emergency, were given a thorough airing by top Air Force, Army and Navy officers at the Armed Forces Communications Association's second annual convention, at Dayton, O., May 10-11.

Nearly 300 civilian and military electronics-communications leaders who attended the convention were given as thorough a presentation of expected future needs in the electronics-communications field as time and security requirements permitted.

In addition to 3 top Air Materiel Command officers, headed by General Joseph T. McNarney, AMC commanding general, the assembled delegates heard Chairman Thomas J. Hargrave of the Munitions Board, Brig. Gen. David Sarnoff, AFCA president and president and chairman of the Radio Corporation of America, Rear Admiral Earl E. Stone, Chief of Naval Communications, Maj. Gen. Francis L. Ankenbrandt, Air Communications Officer, and Maj. Gen. Harry C. Ingles, retired Chief Signal Officer who now heads RCA Communications, emphasize the pressing need for civilian-military cooperation to keep the communications-electronics preparedness of the nation at a high level.

Brig. Gen. H. A. Shepard, Chief of the Materiel Command's Procurement Division, who remarked that the AMC has discovered that electronics-communications is the "meat of the whole problem," laid particular stress on electronics procurement in his statement that the command is getting away from thinking in terms of airplane deliveries and is accenting component parts production. In this connection, both General Shepard and Maj. Gen. F. O. Carroll, of the AMC staff, said the Air Force expects to have considerably more money for such equipment as a result of Congressional appropriations actions.

General McNarney, in his comments, informed that typical of Air Force communications trends is a new experimental long-range radio set designed to operate in the two to 25 megacycle frequency band with 20 preset channels. This may be remotely tuned to any of 44,000 other frequencies. With power output of 100 watts, this system will be capable of serving as the communication link for the radius range of any aircraft now in development.

Mr. Hargrave said that within a month, the Board will have for the first time in history uniform procurement regulations for all the services—covering contracts, auditing, pricing policies, and other factors. The Board also is assigning single-service procurement wherever possible, he said, noting that, using the highest 12 months' output in World War II as a basis, if war came now 77% of procurement would be on a single-service basis.

General Sarnoff read a message from President Truman emphasizing the AFCA's "program for maintaining close relations between the armed forces and the communications, electronics and photographic industries is an important contribution to the industrial preparedness which must buttress the future security of our country."

"The day may come, Gen. Sarnoff said, "when, through television, the Commander-in-Chief in Washington will be able to watch distant military activities an maneuvers, even overseas."

Audio Society Meets

Audio Engineer Society approved further plans in its organization at a general meeting of members last month in New York and plans were laid for a full-scale membership drive, dues schedules and an annual meeting in the Fall. A new audio sweep frequency generator was described to the group by Hershel Toomin, Instrument Electrical Co. The society plans to meet on the second Tuesday of every month hereafter at a place to be designated later.

Correction

TELE-TECH erroneously credited WPIX, the new Daily News television station, with having the first RCA turnstile antenna in its area. WABD reminds us that its 3-bay antenna has been in use since Feb. 24, 1947. We stand corrected.

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