HUGO GERNSBACK, *Editor*

RADIO CRAFT

In this issue—

Switching and triggering

Multi-station intercoms

Experiments on 420 mc

LIGHTWEIGHT RADAR FOR SAFE FLYING

SEE PAGE 22

MAR 1947

25¢

CANADA 30¢

RADIO-ELECTRONICS IN ALL ITS PHASES

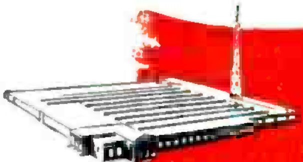
hallicrafters PRESENTS THE SX-42

Another first! Greatest continuous frequency coverage of any communications receiver — from 540 kc to 110 Mc

This is the long-awaited Hallicrafters SX-42, a truly great communications receiver. The tremendous frequency range of the SX-42, *greater than ever before available in a receiver of this type*, is made possible by the development of a new "split-stator" tuning system and the use of dual intermediate frequency transformers. Packed with advance features that every ham and every other radio enthusiast desires, the SX-42 clearly lives up to the Hallicrafters ideal of "the radio man's radio."

From now on watch Hallicrafters — the name that's remembered by the veteran, preferred by the radio amateur. See your distributor for demonstration of the SX-42 and for colorful literature describing this great set in complete technical detail.

Because of the precise and thorough engineering that must be done on the SX-42 and because the parts supply has not been continuous, top production peaks have not yet been reached. In the immediate future deliveries will necessarily run behind the demand, but the SX-42 is definitely worth waiting for.



hallicrafters RADIO

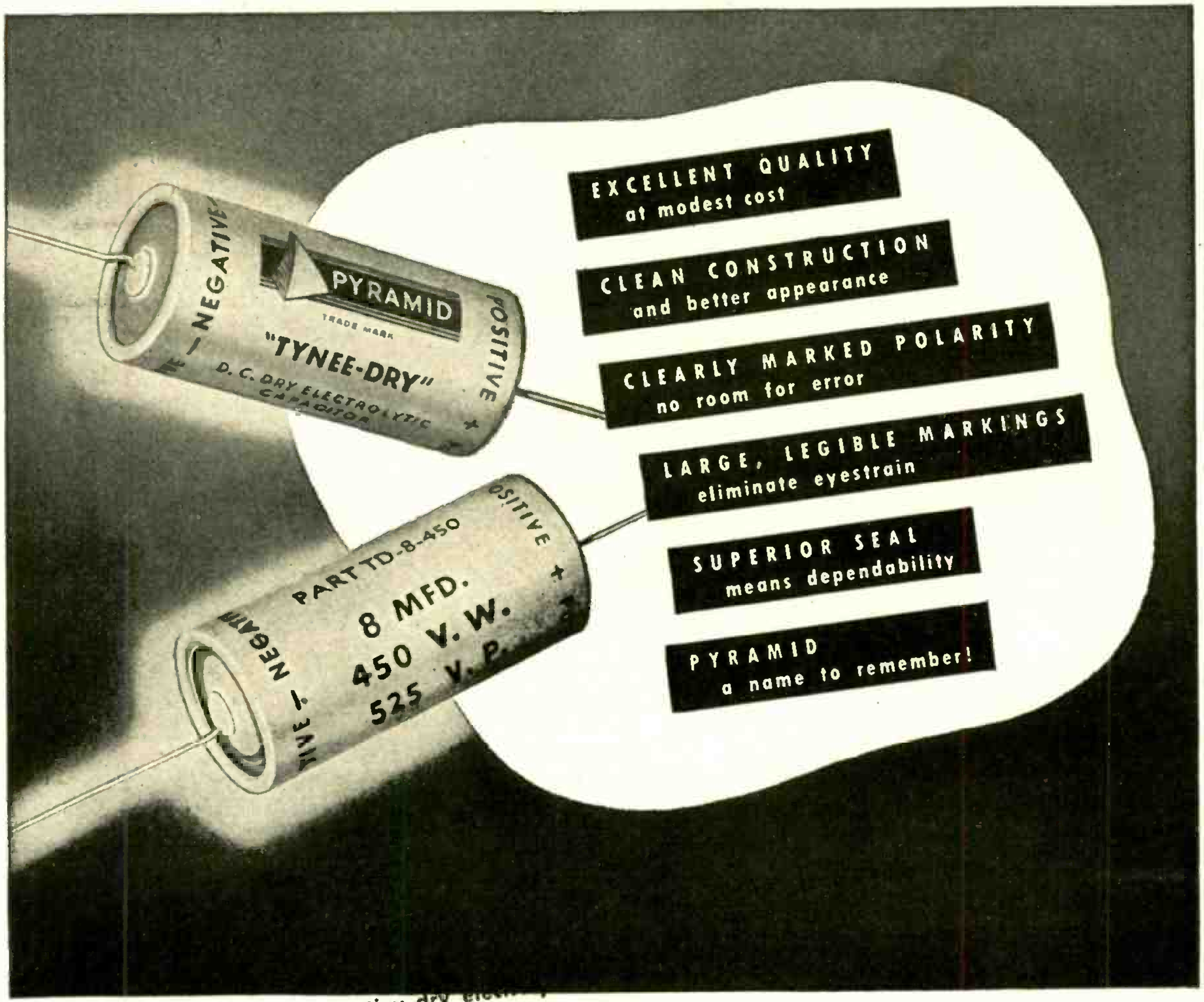
THE HALLICRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

Sole Hallicrafters Representatives in Canada: Rogers Majestic Limited, Toronto-Montreal

BUILDERS OF Skyfone AVIATION RADIOTELEPHONE

Save SPACE, TIME and MONEY!

with the PYRAMID "TYNEE-DRY"



tiny dry

engineering and production controls provide maximum quality within minimum space—and at modest cost! Write for literature.

PYRAMID ELECTRIC COMPANY
JERSEY CITY 6, N. J.

PYRAMID "LONG-LIFE" Dry Electrolytic Capacitors

Writing with your voice

Years ago Alexander Graham Bell dreamed of "a machine that should render visible to the eyes of the deaf, the vibrations of the air that affect our ears as sound." He never realized that dream, but his researches led to the invention of the telephone.

Today Bell Telephone Laboratories have turned the dream into a fact — translating the spoken word into readable pictures.

By this new invention of the Laboratories, the talker speaks into a microphone. Vibrations of the voice are unraveled through electronic circuits, and then are reassembled as luminous patterns which travel across a screen. Each syllable of sound has a distinctive shape and intensity.

Science unravels speech

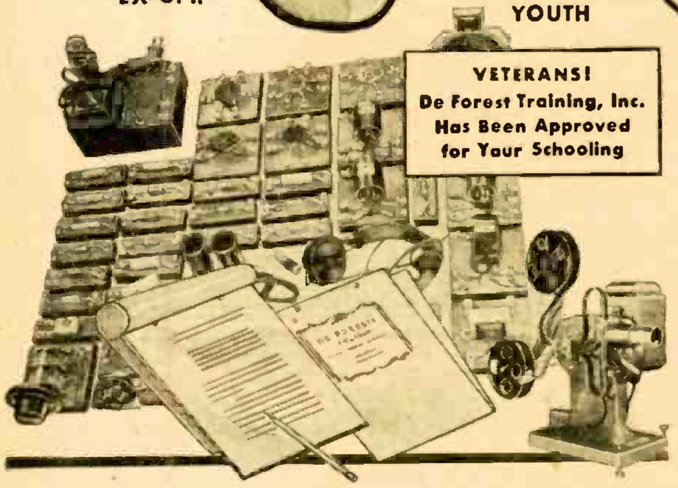
Visible speech is still in its infancy, and is not yet available to the public. But educators of the deaf are now evaluating it. Indications are that the deaf can learn to read the patterns and, by comparing the patterns their own voices make with the patterns of correct speech, can improve their diction.

Patterns of visible speech also provide a means for analyzing and recording sound in the study of phonetics and of languages. Eventually, visible speech may make possible visual telephony for the deaf.

This is but one of many contributions by Bell Telephone Laboratories to the understanding and control of sound.

BELL TELEPHONE LABORATORIES *EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE*

Let Us Show You How to Prepare TO MAKE REAL MONEY QUICKLY!!



Whether you are an ex-G. I., a teen-age youth, or an older man eager to earn real money...There can be a place for you in The Billion Dollar Field of Electronics and Radio

You will probably find no greater variety of money-making opportunities than in the fields of Electronics and Radio. Hundreds of men, who today either successfully operate their own businesses or hold important jobs in these fascinating fields, are graduates of DeFOREST'S TRAINING, INC.

Our Home Study or Residence courses, thorough in every detail, offer a unique combination of training advantages. We furnish you with a 16 millimeter Motion Picture Projector and 12 reels of valuable movie film. You also use 8 big kits of Radio-Electronic parts as shown on this page, enabling you to work out 133 MODERN EXPERIMENTS for valuable practical experience.

When you prepare to enter the exciting fields of Electronics and Radio, you will want every necessary home study benefit. DeFOREST'S TRAINING, INC. gets you off to a brighter future by supplying these major benefits at home: (1) Learn by Seeing from movies showing radio circuits in action as well as other clearly animated illustrations (2) Illustrated Loose-leaf lessons with handy fold-out diagrams help make our training easy to understand. (3) Learn By Doing . . . in your home laboratory you have the opportunity to get real "SHOP METHOD" experience from the many commercial type Radio-Electronic parts you receive. (4) Employment Service . . . after you complete your training, our effective employment service helps you GET STARTED.

DeFOREST'S TRAINING, INC. offers the only Home Study or Laboratory training in the nation endorsed by the New York Museum of Science and Industry, Radio City, New York City.

NATIONALLY KNOWN RADIO STATION CONSULTING ENGINEER RECOMMENDS COURSES OF DeFOREST'S TRAINING, INC.

"Now is the time . . . to prepare to enter the fields of Radio and Electronics . . . no greater opportunity is afforded the high school student . . . the war veteran . . . or the man who is eager to make more money," says Ellery L. Plotts, nationally known Radio Station Consulting Engineer and former Special Research Associate at Harvard University's Radio Research Laboratories. "A study of the DeForest Training, Inc. courses enables me to highly recommend either the Home Study or Residence course."

EX-G. I. STUDENT LAUDS DeFOREST'S EMPLOYMENT SERVICE

"Dear Sir: Due to the fact that I am enrolled in your school, I am now employed by the Westinghouse Manufacturing Company instead of a steel mill. This is a great opportunity for me because this is a new branch opening in this territory and there is a great chance for advancement.

Elmer H. Havens
Lancaster, New York"

DeFOREST'S
TRAINING, INC.
CHICAGO, ILLINOIS

Without obligation, send for our valuable, information-packed book, "VICTORY FOR YOU." MAIL COUPON TODAY.

DeFOREST'S TRAINING, INC.
2533-41 N. Ashland Ave., Dept. RC-D3
Chicago 14, Illinois, U. S. A.

Send me your big book "VICTORY FOR YOU," showing how I may make my start in Radio-Electronics with your modern home training plan. No obligation.

Name . . . . Age . . . . .

Address . . . . Apt . . . . .

City . . . . Zone . . . . . State . . . .

☐ If under 16, check here for special information.
☐ If a discharged veteran of World War II, check here.

MARCH • 1947

Electronics

Amateur Radio

Servicing

Sound

Construction

Departments

RADIO CRAFT

▼ AND POPULAR ELECTRONICS ▼

Incorporating
SHORT WAVE CRAFT TELEVISION NEWS
RADIO & TELEVISION

On THE COVER:

Carl Yearian, General Electric engineer, and the Army's AN/APS-10, a light airborne radar.

RADCRAFT PUBLICATIONS, INC. Hugo Gernsback, President; M. Harvey Gernsback, Vice President; G. Aliquo, Secretary

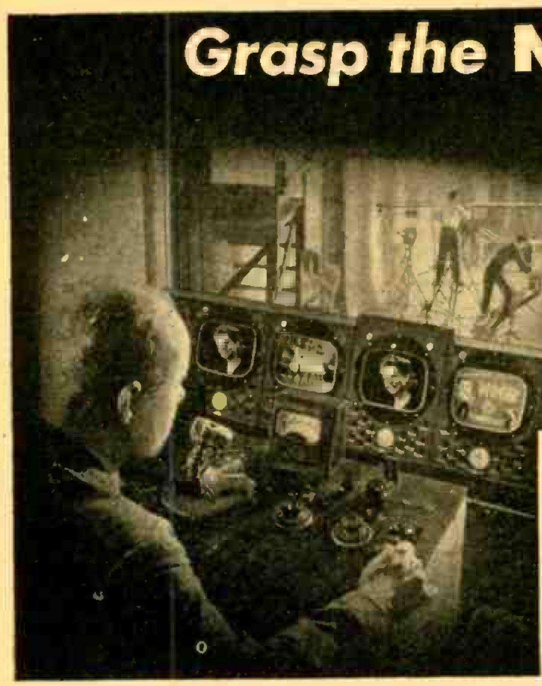
RADCRAFT PUBLICATIONS, INC. • PUBLICATION OFFICE 29 Worthington Street, Springfield 3, Mass. • EDITORIAL AND ADVERTISING OFFICES 25 West Broadway, New York 7, N. Y. Telephone REctor 2-9690.

BRANCH ADVERTISING OFFICES: Chicago: 308 W. Washington Street, Suite 1413, Chicago 6, Ill. Tel. Randolph 7363. Cleveland: Burdette Phillips, Manager, 405 Erie Bldg., Cleveland, Ohio. Tel. Main 9645. Detroit: Frank Holstein, Manager, 307-8 Boulevard Bldg., Detroit, Mich. Los Angeles: Ralph W. Harker, Manager, 606 South Hill St., Los Angeles 14, Calif. Tel. Tucker 1793. San Francisco: Ralph W. Harker, Manager, 582 Market St., San Francisco 4, Calif. Tel. Garfield 2481.

RADIO-CRAFT, March, 1947, Volume XVIII, No. 6. Published Monthly on 28th of month preceding date of issue. Allow one month for change of address. When ordering a change, please furnish an address stencil impression from a recent wrapper. All communications about subscriptions should be addressed to the Circulation Manager, Radio-Craft, 25 West Broadway, New York 7, N. Y.

SUBSCRIPTION RATES: United States and possessions, Mexico, Central and South American countries, $2.50 a year; $4.00 for two years; $6.00 for three years. Canada, 3.00 a year; $5.00 for two years; $7.50 for three years. All other foreign countries, $3.25 a year; $5.50 for two years; $8.25 for three years. Special rates for members of the Armed Forces in U.S., or those addressed by A.P.O. or F.P.O. mail, $2.00. Entered at Post Office, Springfield, Mass., as second-class matter under the Act of March 3, 1879.

FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, Fleet St., London E.C.4. Australia: McGill's Agency, 179 Elizabeth Street, Melbourne. France: Brentano's, 37 Avenue de l'Opera, Paris 2e. Holland: Technisch Bureau Van Baerle, Bemelmans & Co., Heemsteedsche, Dreef 124, Heemstede. Greece: International Book & News Agency, 17 Amerikis Street, Athens. So. Africa: Central News Agency, Ltd., 369 Smith Street, Durban, Natal. Universal Book Agency, 70 Harrison Street, Johannesburg. Middle East: Steimatzky Middle East Agency, Jaffa Road, Jerusalem. India: Magazines Distributors, 5 Bombay Mutual Annexe, Gunbow Street, Fort, Bombay 1.



Grasp the NEW OPPORTUNITIES in RADIO ELECTRONICS AND TELEVISION NOW!

Modern Radio — FM Broadcast and Reception — Television — Industrial Electronics; Power, Control, Communications — new equipment and methods demand new technical ability and experience. Keep up to date with the latest.

MODERN RADIO EQUIPMENT FOR YOU TO USE AND KEEP

The very essence of National Shop Method Home Training is EXPERIENCE. You get actual experience by working with modern Radio and Electronic equipment—building many types of circuits. You may build a fine, long distance MODERN SUPERHETERODYNE, signal generator, miniature radio transmitter, audio oscillator, etc.—many other standard actual operating pieces of equipment—conduct cathode ray and other experiments. This practical work advances with your training—YOU LEARN BY DOING!

Shop Method Home Training

By a Real Established Resident School with its own FM Studios, Shops and Laboratories.

TRAIN WITH ADVANCED TECHNIQUE

The good jobs in Radio Electronics now go to the men who are equipped to handle them. It takes training and experience. National Schools, one of the oldest and largest trade schools in the country, makes it possible for you to get this training right in your own home IN YOUR SPARE TIME.

National maintains modern resident training Studios, Shops and Laboratories where instructors and engineers are working constantly to improve training methods. SHOP METHOD HOME TRAINING is a logical extension of this practical system.

A FREE lesson that shows you how practical and systematic this new training method is will be sent you without obligation. You may keep and use this lesson to prove to yourself just how practical National Training really is.

Get one of the many NEW JOBS that demand new techniques and methods in Modern Radio. Get your share of the NEW BUSINESS that servicing the new sets and equipment demands. Experts agree that Radio, Television and Electronics present opportunities much greater than ever before!

Radio is expanding with far-reaching improvements in reception. No one knows yet how great the Television market will be. Electronics will touch almost every walk of life—in industry and in the home.

TURN YOUR INTEREST IN RADIO INTO A CAREER THAT WILL ASSURE YOU SUCCESS AND SECURITY.

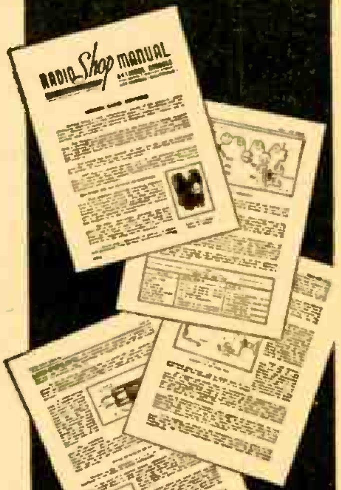
FIND OUT WHAT NATIONAL TRAINING CAN DO FOR YOU

Where do you stand today in modern industrial progress? What does the future hold for you? You owe it to yourself to investigate this opportunity. With National Training YOU GET AHEAD FAST—you may step into a good position or start a business of your own, with little capital, even before you complete your National Course.

Fit yourself for a career of independence, good earnings, success and security in one of the fastest growing fields in industry. For full information, just send your name and address on the coupon and mail it TODAY.

APPROVED FOR TRAINING UNDER GI BILL

FREE LESSON



Get This Book FREE

This big book presents the facts about the field of Electronics and your opportunities in it together with full information about the advanced National Training. Read it and make up your own mind that National Training will equip you for a great future. No salesman will call on you from National. The book is FREE with your sample lesson. Clip and mail the coupon TODAY!

See What National Training Has Done For These Men

National Shop Method Home Training wins good jobs, independence and security. Take the word of National men who have established records in their favorite Radio, Television, or other branches of Electronics.

From O. K. Icey, Washington, D. C., comes this endorsement: "I believe National offers the best course to be had . . . Keep up the good work."

Here's a statement from R. R. Wright, Blackfoot, Idaho: "Due to my training at National I was selected to instruct in the laboratory work of Navy and Marines."

Clifford Hannah, Portage La Prairie, Manitoba, Canada, writes: "My training has brought results as I'm in line for another raise thanks to National's encouragement and thorough training."

Joseph Michel, Jr., Granite City, Illinois, writes: "I am enthused with National training. I am now earning $225 a month as a radio operator and technician and $20 a week more in my shop at home.

Read what other enthusiastic students have written about National Training in the big 40 page book we will send you.

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA EST 1905

MAIL OPPORTUNITY COUPON FOR QUICK ACTION

National Schools, Dept. 3-RC
4000 South Figueroa Street, Los Angeles 37, California

(Mail in envelope or paste on penny post card)

Mail me FREE the two books mentioned in your ad including a sample lesson of your course. I understand no salesman will call on me.

NAME .... AGE ....

ADDRESS ....

CITY .... STATE ....
Include your zone number

☐ Check here if veteran of World War II

POWER TRANSFORMERS

3200 volts. AC 150 M.A. 115 volt. primary, 60 cycles. Designed for half wave operation with 150 M.A. output each. two transformers hooked up with secondaries in series and primaries in parallel will give 3.000 volts. output at 300 M.A. from a full wave rectifier. These are conservative. continuous commercial ratings! $7.25
Jefferson power transformer 115v 60c/660 vct -85 ma/6.3v @ 7.3a/5v @ 2a/6.3v @ .3a $3.50
Power supply transformer made by Sub-Sig Pri: 115v 60c. Sec. No. 1: 750VCT @ 113ma. Sec. No. 2: 6.3VCT @ 5 a Sec. No. 3: 5v @ 3a 2500 v test voltage. Specially priced at $5.95

CHOKES

2 hy @ 160 ma. Made by GR .... 2 for $1.00
12 hy @ 200 ma. Made by Thordarson 2.00
12 hy 12 hy @ 150 ma.. each price 3.75
59 hy @ 100 ma 850 ohms DCR made by Jefferson. Price 2.00
2.6 hy @ 800 ma stud and terminals at bottom. Made by G.E. 2.00

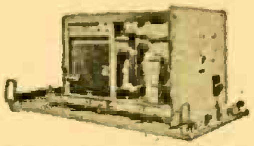
Audio Transformer, Modulators, etc.

Modulation xfmr: typical for 211's cl. A50W ..$1.35
Modulation xfmr: 807 to pr 807's 1.00
Modulation xfmr: pr. 811's to 813 .... 5.00
Input xfmr: single but mike to grid. 20:1 ratio 1.00
Audio output transformer Split pri. 1500 OHMS each side. Secondary impedance 85 ohms center-tapped -6:1 ratio, 100 watts output 5.50
Line to Voice coil transformer. Pri 600 ohms Sec 6 ohms. 1200 Test volt 1.25

Hi-Volt Mica Condensers

F3L .0003 mfd 8000V list $29.00.. $3.75
Solar type SX .0015 mf 3000V list $9.95 .... .75
C-D 110 mmf., 10.000 VAC peak. Ceramic. Type No. 26921 .... 2.00
Sangamo G-3 .006 mf 10 kv list $87.50........ 19.50
.0008 mf 5000 vdc C-D No. 599-6H .... .80
.0002 mf 5000 vdc Aerovox .... .75
.0004 mf 3000 vdc Faradon .... .70

PREFERRED POWER PARTS



POWER UNIT RA58-A $116

RA-58-A Hi-Voltage Power Supply

Ideal for breakdown insulation testing, or as a source of power for a pulse transmitter. This unit supplies continuously variable voltages between 500 and 15,000 volts DC at 35 ma. A voltage Doubler circuit using two 705a rectifiers and two 1 mf condensers is employed. BMS ripple voltage at maximum power is 6%. THIS UNIT OPERATES FROM 115 v/60c. Variable voltage is obtained by means of a Variac in the primary circuit of the high voltage transformer. Size is 21"x17½"x29" deep. Net weight 814 lbs.

B-29 Computer Amplifier, containing 8-JAN6SN7 amplifier tubes. 1—6x5 GT. 8-relays, 5-neon glow lamps, completely wired amplifier circuit with many components. This fine amplifier was designed for use with remote-controlled guns. This buy sells for $14.75
Power Supply for AN APS-10, using 3-6x5 GT's, and 1-9006, complete with 6 chokes, 1 power transformer, and filter condensers $6.50

Sonar Sound Detection Unit!

Ideal for detecting underwater sounds, such as fish swimming in schools, within a 15 mile area. Using a Rochelle salt crystal, which is about 1000 times more sensitive than quartz, as the active unit the sound is transmitted up a 60 ft. length of cable. It is completely enclosed in a solid rubber sheath whose physical size is: 16½"L x 2½" dia. This sound detector was originally used in harbor defense. Coupled to an audio amplifier, this can be found to have many valuable applications. Ask for SD-1 ..... $9.95

Oil Filled Condensers

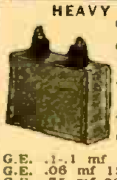
G.E., C-D. W.E.. and other well known brands

1 mf 300 vdc	$ .25	6 mf 600 vdc pyr..	.95
2 mf 300 vdc	.30	8-8 mf 600 vdc	1.49
4 mf 300 vdc	.35	15 mf 220 ac/600dc	1.50
4 mf 400 vdc	.55	1 mf 1000 vdc	.85
5-5 mf 400 vdc	1.15	2 mf 1000 vdc	.98
2 mf 550 vdc	.30	1 mf 1500 vdc	1.05
.25 mf 600 vdc	.25	.4 mf 1500 vdc	.20
.85 mf 600 vdc	.30	2 mf 660 ac/1000 .	.95
1 mf 600 vdc	.35	4 mf 1500 vdc	1.33
2 mf 600 vdc	.40	1 mf 2000 vdc	1.10
3 mf 600 vdc pyr..	.65	.1 mf 2500 vdc	.98
4 mf 600 vdc pyr..	.70		

DRY ELECT. COND.

.500 mf 200 vdc. $1.95
2000 mf 50 vdc 2.00
4000 mf 30 vdc 2.25

HEAVY DUTY OIL FILLED COND.



G.E. Pyranol 23F49 1 mf-5000v (list $27) $4.75
G.E. TC-50010 1mf 5000v 4.50
.15-.15 mf 6000 vdc GE pyranol 26F435 .... 4.50
.1-.1 mf 7000 vdc GE pyranol 25F435 .... 2.00
In lots of 50 .... 1.50
.15-.15 mf 8000vdc Sprague Vitamin Q 5.25
G.E. 14F191 .1 mf 10,000v (list $37) 6.75
G.E. .1-.1 mf 7000 vdc pyranol 25F774 .... 4.95
G.E. .06 mf 15,000vdc pyranol 26F585-G2 .. 5.00
G.E. .75 mf 20,000vdc pyranol 14F136 .....18.00

CATHODE RAY TUBES

Made by North American Phillips

Tube Type	Your Cost
3BP1	$3.95
3FP7	2.98
5BP1	4.95
5BP4	7.95
5CP1	4.95
5CP7	6.00
5FP7	3.50
5JP1	9.45
5JP2	8.95

HI POWER XMTR TUBES

837	1.50
872A	2.98
705A	6.75
241B	40.00
861	85.00

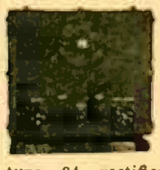
Sockets for 5BP1, 5BP4, 5CP1, 3BP1, 705A, 829B and similar types....95c

NEW U.S. NAVY MODEL RAK-7 SHIP RECEIVER $69.95

15 kc to 600 kc. 6-tube receiver with: AVC-Band pass filter-Audio filter—Noise limiter—Precision tuning with a Vernier dial — Voltage regulated power supply. with three tubes. for 60 cycle. 115 volts. Can be battery operated. Complete with spare parts box weighing 73 lbs., tubes and inst. book.

Ohmite Wire Wound Rheostats

Model H 250 ohms 25 watt ....$ .89
Model H 125 ohms 25 watt..... .89
Model J 225 ohms 50 watt..... .98
Model J 1800 ohms 50 watt.... .98
Model K 3000 ohms 100 watt.... 1.25
Model L 250 ohms 150 watt.... 1.98
Model N 22 ohms 300 watts.... 2.75
Model P 1200 ohms 225 watt.... 2.25



NEW POWER SUPPLY for LM-18 freq. meter. Output: 290 v @ 20 ma; 13 v. @ 600 ma. Input: 105-125 v. @ 60 cps; 260 ma; 27.6 W. type 84 rectifier tube; shock mounted. Complete with input and output plugs, tube included............... $14.75

RELAYS

A. S. P. D. T. Leach 1353. 115 V/60 cps. Coin silver contacts. 10A rating. This relay is actually D.P.D.T. with a bridge between the two poles. EASILY CONVERTED TO D.P.D.T. $1.59
B. SPDT contacts; coil rated 115v/60 .... 1.39
C. SPST Latching relay made by Kurman. Make coil 115v/60cps; DCR 1500 ohms. Break coil 115vdc 10ma; DCR 5000 vdc 2.95
D. DPST Telephone type; 2p, 1 cl; 1 open; cont. rating, 5a at 50v, coil rating 3.5 ma (at 12K ohms). 1000 vac. 1.05
E. DPDT Steatite insulated 10 amp silvered contacts, made by Leach 1.95
F. SPDT Struthers-Dunn sensitive keying relay, 5 MA-DC Coil. 110v/60 cycles—2 Amp contacts.. 1.49

Cardwell Split-Stator type PK-200-QD. 200-30 mmf per section. Special Hi-Volt with .2" spacing $9.95 Johnson type 500D35. 500-35 mmf .08" spacing. (Listed at $11.75)..$4.75

SPECIAL ITEMS

Tube shields for 2AP1 .... .98
Helmholtz phase shifting coil. (360° phase shift) 2.25
Hook-up wire. stranded. 100 ft. .95
Mycalex strips. ⅛"x¾"x14½", ea. .10
12 for $1.00. Minimum order.. .60
Hand generator type GN-45B. Output: 6v-3a/500v-.14a. rated speed 60 cps. 5.95
Visor for 5" scopes .... .75
Broadcast band push-button tuning units. Inductive and capacitive types 1.98
Mushroom earphones to fit any light weight set. Two pairs for .98
Completely punched chassis for 2-inch scope. with some sockets 1.50
Microphone element T-30-K for throat mike. Selling 2 for ....$ .50
Microphone unit MC-419 for lip mike .... .98
140 mmf split stator variable midget condenser 1.49
Silver button mica condenser: 175-180-185 mmf, each............ .05
In lots of 100 .... 4.50
Silver button mica condensers: 400 and 500 mmf, each............ .10
In lots of 100 .... 9.50
Feed-through glass insulators 7½" long. Beehive outside section .. 1.10
Black crackle finished cabinet for relay rack mounting. 19"W x 25"H x 15"D with hinged door in back 6.00

CW3 Relay Rack Receiver

This superhet receiver will operate on any fixed frequency from 1900 kc to 16.500 kc. Uses 7 tubes. Operating frequency is determined by crystal. With 2 coil groups 5.6-10 mc; 9.5-16.5 mc. Less crystals. Price New at $27.00

WAVE GUIDE PARTS

MAGNETRONS!! Type 2J32 (JAN.) just released. The 2J32 is designed for 10 cm. operation. Rated at 300 kw peak pulse power. Complete information supplied. Brand new, packed in individual protective cartons. The 2J32 is listed at $200. Our Price $25.00.
3J31's just received. One cm. magnetron listed at $95. OUR PRICE $20.00
Magnets for magnetrons. Each $12.00
KLYSTRON oscillator tubes 2K25/723ab designed for 3 cm operation. New. with complete data. Listed at $38.00, reduced to $7.75
Duplexer using 1B24 for 3 cm $10.00
30 mc oscillator-amplifier with 2 6AC7's. Uses 723ab. Waveguide input, xtal detector. With 6AC7's $10.00
With 6AC7's and 723ab $16.50
Thermistor Beads (D-170396), for use with UHF and Micro-Wave Equipment (List $3.00). In separate sealed containers .... .95

3 CM wave guide sections

Silver Plated Directional Couplers with a 20 DB drop with:
A. 90° bend wave guide 15" long $4.00
B. 15° bend in wave guide 15" $4.40
C. 30° bend in wave guide 10" long $3.95
D. 90° bend in wave guide 15" long also 90° bend in coupler $5.00

SECTIONS

E. 2½ foot silver plated with 180° bend (2" radius) $5.00
F. 150° bend with 90° twist 3¼" radius with pressurizing nipple and coax coupler ..$3.95
G. 2½ foot 3 cm wave guides choke to cover fitting $4.50
H. 5 foot 3 cm wave guide section per foot $1.95
J. Slotted dipole antenna 3 cm $4.00

Send for List

XTAL FILTER

I-F Crystal filter for BC-312, BC-342. Resonant at 470 kc. Crystal included.

$6.95

All merchandise guaranteed. Mail orders promptly filled. All prices F.O.B. New York City. Send Money Order or Check. Shipping charges sent C.O.D.

COMMUNICATIONS EQUIPMENT CO.

131-C Liberty St., WH 4-7658, New York City 7, N.Y.

TELEVISION–

Does it Hold A Future For You?

SPECIAL INVITATION TO WAR VETERANS

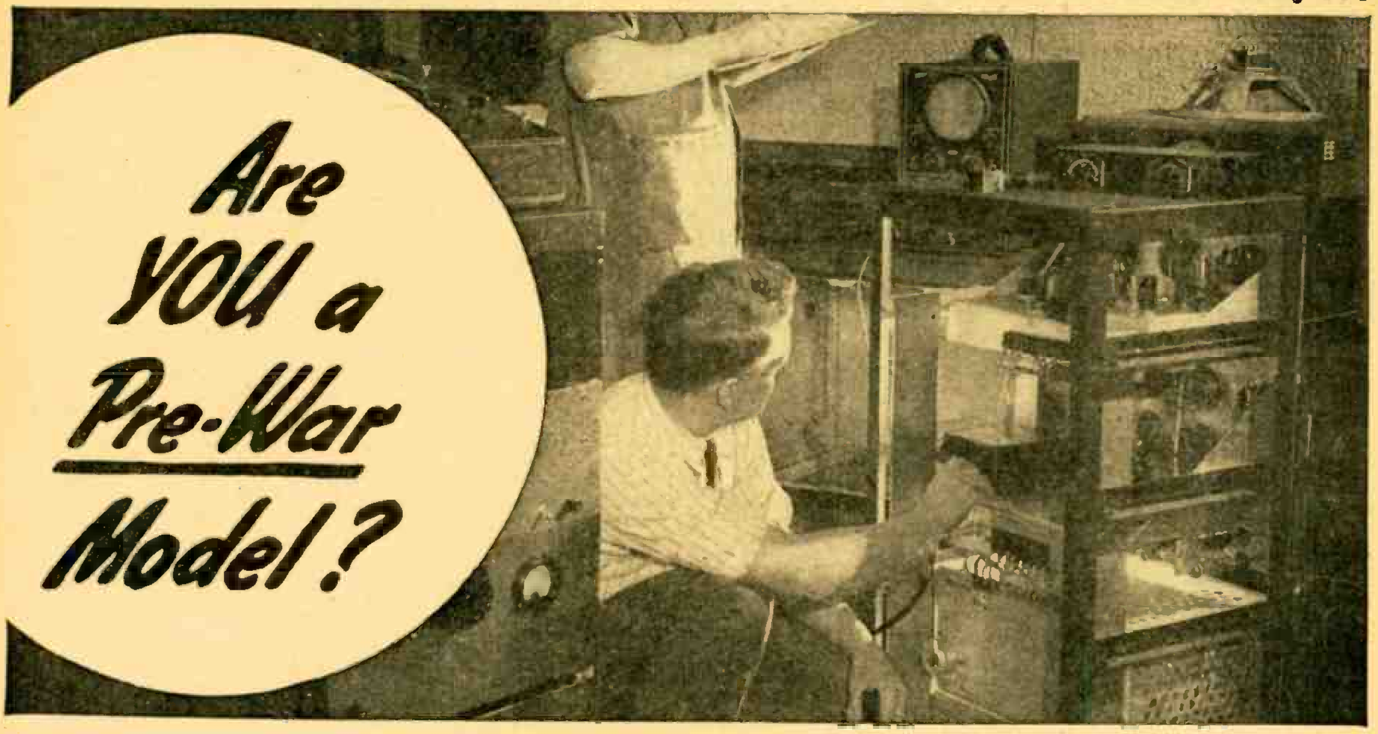
With extensive new training facilities under the personal supervision of the famed inventor of the radio vacuum tube, Dr. Lee de Forest, we are able to accept additional applications from Veterans for Television training under the G.I. Bill of Rights. For qualified men who are seriously considering entering a residence school, we have a limited number of Home Study Courses which are available free of charge. Your success with this course will not only help you to decide your own future in Television but will also aid us greatly in qualifying you for residence training.

Send your name and address for your Eligibility Questionnaire. If you qualify under the simple rules, you may start your Home Study Television Course at once and entirely without cost or obligation to you.

American Television Laboratories, Inc.

5050 BROADWAY · CHICAGO 40, ILLINOIS

CAPITOL RADIO ENGINEERING INSTITUTE—*Where Professional Radiomen Study . . .*



Face the Facts! You Must Keep Up--or Be Left Behind

It's up to you to do something about your future in radio—TODAY! The fight to HOLD good jobs is on . . . . the opportunities to ADVANCE are here.

Remember, this new world of radio-electronics demands a vastly increased technical knowledge. No matter what your past or present radio experience has been, you must continue to add to your store of technical knowledge. You must keep up with the new developments and keep ahead of increasing competition, if you expect to get ahead to the better-paying jobs and the comforting security that goes with them.

CREI technical home study training is geared to keep you abreast of the time . . . to provide you with more advanced technical training and the ability to go after and get the better paying job you want.

CREI offers you professionally accepted program of home study training with individual guidance and supervision from a trained instructor. This is the basis of the CREI method of training for which many thousands of professional radiomen have enrolled during the past 20 years, and which has resulted in a large number of promotions to more responsible positions and larger incomes.

It costs you nothing but a moment's time to send for the interesting facts . . . to learn how CREI can help you obtain the security you want . . . the better-paying job that can be yours.

F. M.

(*Forward March*)

1947 is but a few months old, but already many of the predicted progress signs have been passed. With FM and Television making extraordinary strides, the demand is greater than ever for adequately trained engineers and technicians. Let CREI be your first step toward getting the better job that is waiting for you.

E. H. Rietzke

President of CREI

(CREI training for Veterans is available under the G. I. Bill)

Capitol Radio Engineering Institute

An Accredited Technical Institute

Dept. RC-3, 16th and Park Road, N.W., Washington 10, D. C.

Branch Offices:

New York (7): 170 Broadway   San Francisco (2): 760 Market St.

If you have had professional or amateur radio experience and want to make more money, let us prove to you we have the training you need to qualify for a better radio job. To help us intelligently answer your inquiry—PLEASE STATE BRIEFLY YOUR BACKGROUND OF EXPERIENCE, EDUCATION AND PRESENT POSITION.

THIS FREE BOOK CAN HELP YOU-SEND FOR IT!

CAPITOL RADIO ENGINEERING INSTITUTE RC-3
Dept. RC-3, 16th and Park Road, N.W., Washington 10, D.C.
Gentlemen: Please send me your free booklet, "Training for Your Better Job in Radio-Electronics," together with full details of your home study training. I am attaching a brief resume of my experience, education and present position.

NAME ....

STREET ....

CITY .... ZONE..... STATE..........

OCCUPATION ....

☐ I am entitled to training under the G.I. Bill.

SUPERIOR IS AT YOUR SERVICE-

with a COMPLETE LINE of TEST INSTRUMENTS

IMMEDIATE SHIPMENT—

Please place your order with your regular radio parts jobber. If your jobber does not handle our line, kindly write for a list of jobbers in your state who do distribute our instruments, or send your order to us.

SUPERIOR SICO INSTRUMENTS CO.

Now you can SEE and HEAR The Signal with the new

CA-12 SIGNAL TRACER

Always ready for instant use it takes less than five seconds to begin using this versatile unit. No maze of special cables—the Model CA-12 uses only one connecting cable. No line cord—the CA-12 operates on self-contained batteries. No tuning controls of any kind are used in this model.

Features:

* COMPARATIVE INTENSITY of the signal is read directly on the meter—QUALITY of the signal is heard in the speaker.
* Simple to operate—only one connecting cable—no tuning controls.
* Highly sensitive—uses an improved vacuum-tube voltmeter circuit.
* Tube and resistor capacity network are built into the detector probe.
* Built-in high gain amplifier—Alnico V. speaker.
* Completely portable—weight 8 pounds—measures 5½"x3½"x9".

THE MODEL CA-12 comes complete with Detector Probe, test leads, self-contained batteries and instructions. Comes housed in heavy gauge crystalline cabinet with beautiful two tone etched front panel. NET PRICE **$34.85**

The New Model 450 TUBE TESTER

Speedy operation—assured by newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

SPECIFICATIONS:

* Tests all tubes up to 117 volts.
* Tests shorts and leakages up to 3 Megohms in all tubes.
* Tests both plates in rectifiers.
* New type line voltage adjuster.
* Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
* Noise-Test—detects microphonic tubes or noise due to faulty elements and loose internal connections.
* Uses a 4½" square rugged meter.
* Works on 90 to 125 volts 60 cycles A.C.

EXTRA S^FRV'CE—May be used as an extremely sensitive condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute. **$39.50**

The New Model 670 SUPER METER

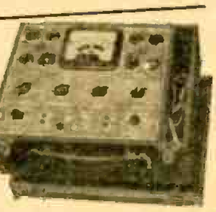
A Combination VOLT - OHM MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS

SPECIFICATIONS

D.C. VOLTS: 0 to 7.5/15/75/150/750/1.500/7.500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1.500/3.000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1.500/3.000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes
RESISTANCE: 0 to 500/100.000 ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27.000 Ohms 13.000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8.000 Henries
DECIBELS: -10 to +18, +10 to +28, +30 to +38

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½"x7½"x3" .NET **$28.40**

The New Model 600 SET TESTER



A NEW COMBINATION TUBE TESTER AND MULTI-METER

A complete testing laboratory all in one unit. Test tubes. Reads A.C. Volts, D.C. Volts, D.C. Currents, Resistances and Decibels.

TUBE TESTER SPECIFICATIONS:

* Speedy operation—assured by newly designed rotary selector switch.
* Tests all tubes up to 117 Volts.
* Tests shorts and leakages up to 3 Megohms in all tubes.
* Tests leakages and shorts of any one element against all elements in all tubes.
* Tests both plates in rectifiers.
* Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
* New type line voltage adjuster.

MULTI-METER SPECIFICATIONS:

* D.C. VOLTS: (At 1.000 Ohms Per Volt) 0 to 7.5/15/75/150/750/1.500 Volts.
* A.C. VOLTS: 0 to 15/30/150/300/1.500/3.000 Volts.
* D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes.
* RESISTANCE: 0 to 2.000/20.000/200.000 Ohms 0 to 20 Megohms.
* DECIBELS: (Based on zero decibels equals .006 Watts into a 500-Ohm line.) -10 to +18 D.B., +10 to +38 D.B., +30 to +58 D.B.

$62.50

The New Model 650 SIGNAL GENERATOR

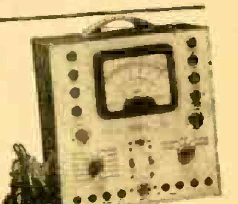
RANGES:

100 Kilocycles to 35 Megacycles on Fundamentals.
25 Megacycles to 105 Megacycles on Harmonics.

* RF obtainable separately or modulated by the Audio Frequency.
* Audio Modulating Frequency—400 cycles pure sine wave—less than 2% distortion.
* Attenuation—3-step ladder type of attenuator (T pad).
* Uses a Hartley Excited Oscillator with a Buffer Amplifier.
* Tubes: 6J5 as R.F. Oscillator; 6SA7 as modulated Buffer and Mixer; 6SL7 as audio oscillator and rectifier.

Complete with coaxial cable, leads and instructions. **$48.75**

The New Model 400 ELECTRONIC MULTI-METER



A COMBINATION VACUUM-TUBE VOLTMETER AND VOLT-OHM MILLIAMMETER PLUS CAPACITY, INDUCTANCE, REACTANCE AND DECIBEL MEASUREMENIS

Specifications:

D.C. V.T.V.M. VOLTS: (At 11 Megohms Input Resistance) 0 to 3/15/30/75/150/300/750/1500/3000 Volts.
D.C. VOLTS: (At 1.000 Ohms Per Volt) 0 to 3/15/30/75/150/300/750/1500/3000 Volts.
A.C. VOLTS: (At 1.000 Ohms Per Volt) 0 to 3/15/30/75/150/300/750/1500/3000 Volts.
D.C. CURRENT: 0 to 3/15/30/75/150/300/750 Ma. 0 to 3/15 Amperes.
RESISTANCE: 0 to 1.000/10.000/100.000 Ohms; 0 to 1/10/1.000 Megohms.
CAPACITY: (In MFD) .0005—.2, .05—20, .5—200.
REACTANCE: 10 to 5M (Ohms, 100—50M (Ohms), .01—5 (Megohms).
INDUCTANCE: (In Henries) .025—14, .35—140, 35—14.000.
DECIBELS: -10 to +18, +10 to +, +30 to +58.

NET **$52.50**

SUPERIOR INSTRUMENTS CO.

Dept. RC 227 FULTON ST., NEW YORK 7, N.Y.

SPRAGUE TRADING POST

SWAP - BUY - SELL

FOR SALE—No. 19 Mark II (Zenith) 15-tube Xmtr-Receiver. Compl. with dynamotor, antenna, 5 sets 'phones and mikes, key, spare parts, mtg. rack, spare set tubes. T. J. Geiselhart, 318 Laurel Place, E. Rutherford, N. J.

WANTED—New or used HT-6 xmitter in good condition. W. O. Eden, 10508 N. Island Ave., Apt. 6302, Portland 17, Ore.

FOR SALE—National 1-10 receiver with home-made supply and tubes. Almost new. Sidney Warren, W3GFW, 2550 S. Darien St., Philadelphia 48, Pa.

SELL OR SWAP—185 QST's 1921-1945; relays, meters, tubes, etc. What have you? What do you need? W8BSS, 14904 Alder Ave., E. Cleveland, Ohio.

SALE OR TRADE—One original Vibroplex bug, new. One new 100th. One Instructograph Sr. with two international tapes and five Morse. A-1 Radio Service, Selah, Wash.

WANTED—Past issues of Radio News, Radio-Craft, Radio & Television. Write for list. Will exchange current British books or postage stamps. A.W.J. Marsh, 16 Lugley St., Newport, J.O.W., England.

FOR SALE — Stromberg-Carlson marine amplifier, 50-watts output. H. Payne, 2640 W. 56th St., Seattle 7, Wash.

SWAP—Emerson BM-206 5-tube; Philco Jr. Superhet model 80 4-tube; and I.C.A. Short Wave 2-tube converter. All Okay Will trade for short-wave receiver ranging from 5 meters up. Mr. & Mrs. Chas. F. Senker, Sr., 4301 Forest View Ave., Baltimore 6, Md.

SELL OR SWAP new Gen. Electric dynamotor, never used, 28v DC input, 1050v DC at 350 ma. output. Want ham gear. What have you? F. Schachtely W91FS, 606 So. 94th Place, Milwaukee 14, Wisc.

FOR SALE—Signal Corps R-100 receiver AC-DC-Batt., 115/230 V. 550-1500 KC. 3.6-8.5 MC. 8.5-19 MC. speaker & phono output. $75. Thomas F. Stenson, 520 E. 77 St., New York 21, N. Y.

FOR SALE—G-E tube tester TCP-3 new, portable, tests all tubes. $50. Howard No. 430 comm. receiver, 5 bands, $35; Federal recorder, semi-pro model, dual speed, radio tuner, 2 mike inputs, 10" Jensen speaker, portable, $250. All F.O.B. F. U. Dillion, 1630 N. La Brea Ave., Los Angeles 28, Calif.

FOR SALE — Italian Phillips miniwatt EF9 and Fivre Italia 6AW9 tubes, one of each. L. Wheeler, 710 W. 21st St., Vancouver, Wash.

FOR SALE—Amertran precision deluxe reactors, L244CB. 350 henries at 5 ma. Triple alloy cases. $2 ea. Also UTC, LS94 reactors @ $3 ea. M. S. Schaefer, 280 Wadsworth Ave., New York, 33, N. Y.

FOR SALE—Wire recording unit, compl. with motor, wire, head and erase coil. Less amplifier. $15. D.M. Cox, 203 N. West Ave., Kankakee, Ill.

FOR SALE—Entire radio shop stock. Most go at less than net. Also other items at bargain prices. Write for details. Eddie Howell, Route No. 2, Dillon, S. C.

FOR TRADE—6AC7, 6SJ7, 6L6 tubes; 10", 7" and 5" dynamic speakers for wind-up type portable phonographs. Paul Dyer, 120 Spring St., Newton, N. J.

FOR SALE—Latest model RCA Chanalyst; Hickok No. 18 sig. generator; Triplett 666S V.O.M., Philco V.O.M. and over 600 hard-to-get tubes in sealed cartons. Also RCA 16mm sound projector and AC ¼, 1/3 and ½ h.p. motors. Write for details. Joe's Radio Lab., 30 Wall St., Passaic, N. J.

WILL SWAP—NC 81X, C-Brengle Bridge, Precision EV 10 VTVM less meter, Triplett 666S, all types new meters, EL inverter, xmitting and receiving tubes, etc. Want wire or professional recording eqpt., scope or hi-fi amp. George Hoffer, 1275 Nelson Ave., Bronx 52, New York.

WANTED—Rider's manuals 1-9 incl. Any or all. All replies answered. J. M. Francis, 1660 Larchmont Ave., Lakewood, Ohio.

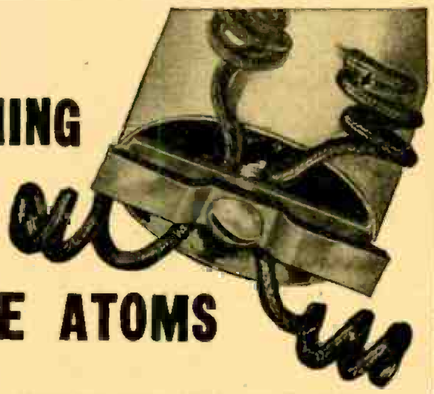
FOR SALE — Dynamotor F/BC 312 at $2.25; PE103 dynamotor F/SCR 284, $8.50; PE73 dynamotor f/BC191, $6.25. Write for list. Mrs. Joyce Sellati, 613 W. Spring St., Lima, Ohio.

WANTED—Oscilloscope, Dumont or RCA; UTC trans. LS 55, HA 107, commercial transcription turntable, relay racks, Variac, Powerstat, Sola or similar AC control or regulator, Lab C/R bridge 1%. Will buy or swap. George Fried, 1015 Washington St., Hoboken, N. J.

FOR SALE—New Triplett No. 2314 tube tester, $45; No. 900 Vomax, $50; No. 203 Hickok electronic volt ohm capacity milliammeter, $70. Used very little. Also Rider manuals, tubes, parts. Write for list. Henry W. Hubbard, 1300 D St., Baker, Oregon.

FOR SALE—Used comb. tube checker and set tester No. 1280 (Superior). $25. Randell Paul, Box 73, Killeen, Texas.

WANTED—Good used signal generator, also a watt meter. Gus A. Dulumback, 409 N. Adams St., West Frankfort, Ill.



SOMETHING NEW IN SPRAGUE ATOMS

The Handiest Dry Electrolytic Capacitors for Vertical Chassis Mounting

These unique Sprague Type LM Atoms with their universal mounting feature are just the thing for replacing inverted can, spade-lug or other types of vertically-mounted capacitors. They fit any chassis hole from 3/16" to ⅞" diameter. Special clamps fasten securely to the chassis in an instant. Separate positive and separate negative leads can be connected together to get common positive or negative sections. Ideal for replacing old common positive section capacitors because section-to-section electrolysis is eliminated. Available in popular capacities at leading jobbers. *Ask for them by name—Sprague Type LM's!*

FOR TRADE—Have Thordarson 2099 power choke and ditto 2098 power transformer over 600-600v with 7.5v filament; also 3 General Radio double impedance couplers No. 373. Want AC amplifier of 6F6 push pull or gas engine. 1 to 2 h.p. W. Oswald, 1431 Englewood St., Philadelphia 11, Pa.

FOR SALE—New G-E Oscilloscope CRO-3A, $75; Latest model Meissner analyst, $100; Radio City counter tube checker No. 312 checks up to 117v tubes, $40. Frank Frasca, 13 N. Bond St., Mount Vernon, N. Y. Make all inquiries by mail.

FOR SALE—New Hickok No. 203 electronic v-o-m. $75 cash or will trade for new tubes and parts of equivalent value. E. Sujak, 4209 Elston Ave., Chicago 18, Illinois.

FOR SALE—Back issues of QST: 1-1926; 4-1927; 1-1928; 3-1929; 12-1930; 11-1931; 5-1932, total 37 issues. Also have 1930 and 1934 Handbook. $4.75 takes all. Good condition. Dave's Radio, 1316—42nd St., Brooklyn 19, N. Y.

FOR SALE—Wurlitzer console with set of records & name tabs, $275; Remington Rand dry shaver with case, $17.50; Stark battery type tube tester, $40; Automatic record player, $35. Want recording eqpt. or what have you? Send for list. Pleasant Valley Radio Service, Armstrong, B.C., Canada.

WANTED—Hallicrafters SX-25 or SX-32 used or new, without speaker. R. A. McNeill, Cowley, Alberta, Canada.

WANTED—Radio receiving tube 25B8. Cash. Ernest Cook, South Fallsburg, N. Y.

FOR SALE—Navy model LM frequency meter. Makes good V. F. O. or signal generator. John W. Meyers, R. D. No. 6, Applegrove Road, North Canton, Ohio.

FOR SALE—Radio parts, new or like new, such as condensers, sockets, dials, knobs, rheostats, transformers, chokes, jacks, all first quality material. A bargain for $15 cash or express C.O.D. Cecil R. Hockenberry, P. O. Box 205, Slippery Rock, Pa.

FOR SALE—SX-28A Hallicrafter receiver in A-1 condition, with PM speaker, $195. S. Palasek, 62 Main St., Port Washington, N. Y.

BUY, SELL OR TRADE hard-to-get radio parts. Let me know what you have to trade or want. Peter Wnukowski, 334 Ridge Ave., Kingston, Pa.

FOR SALE—Million model DF tube-tester, good condition (chart worn, but included) $15. Readrite multitester No. 710-A in good shape, $10. C.O.D. or cash. Cheney Electric Service, Box 108, Nora Springs, Iowa.

FOR SALE — Echophone, $20; Coyne Troubleshooter Manual; Coyne Reference Encyclopedia (3 vols.); Audels Electrical-Mechanical Dictionary; Marine Radio Manual; Reichs Tubes; Speed Signal Tracer; RCA 171 Station Allocator, etc. B. Rosenberg, 1346 Park Rd. N.W., Washington 10, D. C.

FOR SALE—Racon giant units, genemotor, 300 used tubes. John J. Levine, Carr Elec. Products Co., 15-17 Kelley Square, Worcester 4, Mass.

FOR SALE OR TRADE—Radiart Vibrapack Type 4200 D.F., 12v input, about 100 ma. output 250v., less tube, used little, $4.50. Also reflex projector horns less drivers. Walter Blondek, Wickatunk, N. J.

WANTED—N.R.I. tester, all-wave, all-purpose tester Model 1175A or 1175B made for National Radio Institute. Also want other test eqpt. Wilson Radio Service, Bedford City, Va.

YOUR OWN AD RUN FREE

The Sprague Trading Post is a free advertising service for the benefit of our radio friends. Providing only that it fits in with the spirit of this service, we'll gladly run your own ad in the first available issue of one of the six radio magazines in which this feature appears. Write CAREFULLY or print. Hold it to 40 words or less. Confine it to radio subjects. Make sure your meaning is clear. No commercial advertising or the offering of merchandise to the highest bidder is acceptable. Sprague, of course, assumes no responsibility in connection with merchandise bought or sold through these columns or for the resulting transactions.

Send your ad to

Dept. RC-37, SPRAGUE PRODUCTS COMPANY, North Adams, Mass.

(Jobbing distributing organization for products of the Sprague Electric Co.)

ASK FOR SPRAGUE CAPACITORS and *KOOLOHM RESISTORS *by name!*

*Trademark Reg. U.S. Pat. Off.

By HUGO GERNSBACK

WHY RADIO SPECIALIZATION?

Generalization Must Be Thorough Before Specialization

YOUNG men—today as of old—are puzzled how best to proceed in their chosen field in order to succeed in a minimum of time.

For many years a continuous stream of young men—college men and others—have come to me in person, or have written me for a formula to success, to apply to their own individual problem.

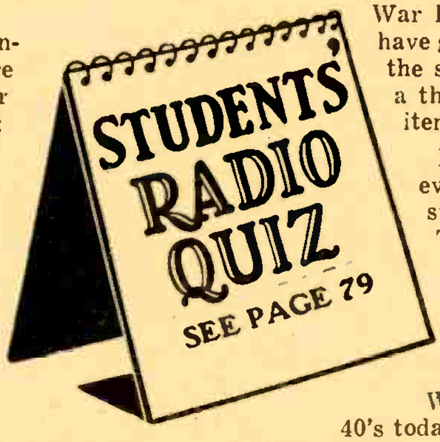
Frequently, I have advised—speaking in a broad manner—that in my own estimation, the best way to succeed today lies in specialization in a given endeavor.

This advice sometimes leads to misinterpretation. For that reason I print here the letter of a young college student for a better understanding of the problem:

Rutgers University
New Brunswick, N. J.

Dear Mr. Gernsback:

In your letter of the 9th you stress the fact that, "in order to succeed these days, people must be specialists." I recall that after our first talk, some time ago, I left you, deeply impressed by what you had said regarding specialization.



There is, however, another school of thought, and that is, generalization. Today, educators maintain that for a man to succeed in the *engineering profession* his schooling should be as general as possible and cover the different branches of engineering. Thus, I, who am enrolled as a student of Electrical Engineering, am taking courses in Mechanical and Civil Engineering. This teaching procedure is believed to be the best one because men who are in industry say that the engineer constantly meets problems which necessitate a knowledge of all the branches of engineering and therefore the engineer should have a wide scope of knowledge. In essence, the engineer should be able to cope with any problem he meets.

It appears that the large companies such as General Electric and Westinghouse, for instance, realize the impossibility of teaching a student all he should know. These large companies have established their own schools where the subject matter directly connected with Electrical Engineering is taught. However, young men who are employed by smaller firms become specialists *only* after a long time working at one thing.

I believe I have presented the other side of the case, and while I lean towards your side, that is, specialization, I should like your views on the solution of the problem of "Specialization or Generalization as it Concerns the Student."

THEODORE BAER.

Here we have an ambitious young man who—according to a previous talk with me—wants to get into the radio profession after his graduation. In our talk, I mentioned the fact that the men most apt to succeed these days are those who *specialize.* I pointed out that the term "radio" today is so vast that there is not alive a single individual who can truthfully say that he fully knows every last ramification of the art. Radio, or Electronics—they are almost identical—have grown so rapidly, particularly during World War II, that even the best radio engineers have great difficulty in keeping abreast with the subject. This does by no means imply a thorough study of each and every new item, but rather a hasty reading of it.

I went to some pains to point out that even in a single branch of radio, the subject has grown to large dimensions. Take any branch—tubes, radio receivers, public address, television—all are vast domains of learning and research. You *have* to be a specialist to succeed in any of them. Take even a sub-branch—microphones. We knew a man—he's only in his early 40's today—who once told us he'd specialize in "mikes" only. That was twenty years ago. He said that in due time "he'd know as much or more about mikes than anyone else ever did." He kept that promise. He is today one of the most successful microphone manufacturers in the field. It is still his first love and while he makes one or two other radio items, the microphones manufactured under his patents and designs are by far the bulk of his business.

A former editor of mine chose to manufacture variable condensers. His name is Samuel Cohen. Today he is the chairman of the board of the General Instrument Corp. —the world's largest variable condenser producers, doing a business of many millions of dollars annually. We could name many others similarly successful manufacturing "single" items only—public address, tube sockets, inductance coils, resistors, etc.

This is what is meant by specialization. We also realize that a young radio man who has no financial backing does not very often embark upon the manufacturing business at the age of 21. Nevertheless, specialization applies to him too.

Given a *THOROUGH* education in electricity and radio, sooner or later he discovers that he has a penchant for a certain radio or electronics branch. Continuously we see young men who excel in radio set building, sound, servicing instruments, amateur transmitters, aerial design, microwaves, and dozens *(Continued on page* 78)

RADIO-ELECTRONICS

Items Interesting

MAGNETIC DISC RECORDS on paper no thicker than ordinary typewriter bond were demonstrated by the Brush Development Co. last month. Known as *Mail-A-Voice*, the new equipment is designed chiefly for business correspondence between firms equipped for it, but has a host of non-communications uses, among which may be included study of foreign languages, recording one's own voice for speech culture, and logging parts of radio transmissions.

The record may be mailed like any other piece of paper, but the folding must be done *before recording*. Records may be erased and re-recorded several thousand times, if desired, or may be filed for permanent reference. Each of the records plays for three minutes. Cost is about 7 cents each.

Magnetic paper disc recorder, portable model.

Fidelity of the machine is suitable for speech only. A single crystal unit acts both as microphone and receiver. Three tubes are used in the amplifier. Recording is at 40 lines per inch, *inside-out*, and the recorder operates at 20 revolutions per minute.

Spectators at the demonstration wondered what means were used to keep each line of recording within its own "groove." The answer is simple. No means are used. The magnetic field spreads to both sides of the recording line, but falls off in strength on each side so rapidly that with ordinary amplification, "adjacent-channel interference" is inaudible.

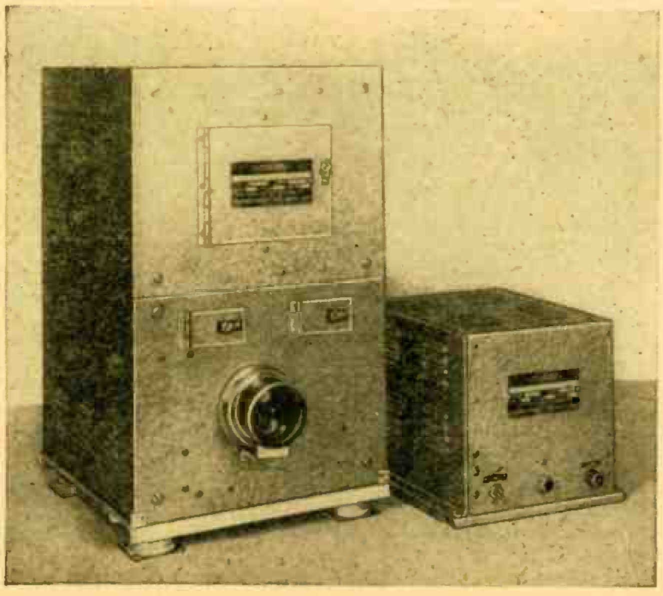
TELEVISION was used by President Truman to view the opening session of the House of Representatives January 3. A televisor was so installed that the President was able to view the proceedings from his White House desk. The President's look-in on Congressional activities was only a part of a larger broadcast, in which viewers in Washington, Philadelphia and New York were able to see and hear the opening session and pre-opening interviews with House leaders. This was the first time that any Congressional event has been televised.

INDUSTRIAL TELEVISION has been successfully used for the first time, in the Hell Gate Station of the Diamond Power Specialty Corporation of Detroit, Michigan. The television instrument is a *Utiliscope*, which shows an exact picture of some remote or inaccessible point on a screen similar to that of a home television receiver.

According to a report issued last month by Farnsworth Television and Radio, manufacturers of the instrument, the Utiliscope has been in practical operation for the last nine months, and has been proved a practical success. It is used to show the water level in a boiler remotely located from the main control room. A photo-electric camera focused on the water-level gauge continuously transmits the picture to the associated control panel where the 200-line image is reproduced on a television screen.

This permits observers in the control room to keep a constant check on the boiler 325 feet away. Not only are the boiler and main control room separated by a distance greater than an average city block, but also by eight floors, a building wall and various other obstructions.

Gauges on large boilers such as the one at Hell Gate must be under direct visual surveillance at all times, because expensive damage can be caused if water in the boilers rises too high or drops too low. Lofty heights of the boiler drums and line-of-sight obstructions such as galleries and piping often make direct surveillance of gauges difficult for workers, but the Utiliscope has solved this problem in a completely satisfactory manner.



A practical industrial-type television equipment, the Utiliscope.

TWO MILLION FM RADIOS will be manufactured in 1947, stated R. C. Cosgrove, president of the Radio Manufacturers' Association, to a meeting of marketers in New York City last month. This would be a tenfold increase over 1946 production.

Stating that radio prices were too high, he said. "With or without FM, good table models will sell for an average of $50 and consoles will run from $175 to $200."

The Cosgrove statement came almost simultaneously with a report that FM broadcasters in new areas are hard hit by the shortage of receivers, and are broadcasting to audiences which approach zero. The new FM association is attempting to secure the co-operation of manufacturers in channeling sets to cities where FM stations are suffering from a lack of audiences.

CONSOLE RADIOS continue hard to get. The demand still far outruns the supply, a check-up last month by *The New York Times* revealed. Table models, says the report, have made considerable gains in stocks and are available for immediate delivery in many types.

Console radios were bracketed with electric refrigerators, washing machines and other large household equipment as being in short supply, while electric irons and clocks compared with small radio receivers in increasing availability.

IONOSPHERIC RESEARCH carried on by the Bureau of Standards will receive considerable assistance from amateur radioists at widely-scattered points on the earth, according to a release from the Bureau last month.

The amateurs, 130 in number, will participate in a project to collect data on high-frequency transmission and reception, which is especially concerned with the study of "sporadic-E" phenomena. They will make regular reports on conditions in the ionosphere. Necessary equipment will be supplied by the Bureau. The observers are well spread out over the globe, covering even such out-of-the-way spots as the Aleutian Islands and the Malay Peninsula.

MONTHLY REVIEW

to the Technician

RALPH R. BEAL, vice president in charge of engineering of RCA Communications, Ltd., died suddenly January 24, 1947, at the age of 59.

Mr. Beal was a pioneer in radio, television and electronics. As a field engineer in the early days of radiotelegraph communication, he participated in the first investigations into high-power point-to-point radio transmission and contributed toward the development of the art into a dependable means of world-wide international communication. Later, as Research Director of the Radio Corporation of America, he was given the responsibility of coordinating research and advanced engineering development activities of the company and its subsidiaries.

Serving as Research Director from 1934 to 1943, Mr. Beal originated and supervised programs of research which constantly broadened the field of radio products and services.

ATOM-SIZE TRANSMITTERS of radio waves were described last month in a report on a new system of radio analysis by Drs. Felix Block, William Hansen and Martin Packard of Stanford University. In the new technique the nucleus of an atom is turned into a miniature radio transmitter, sending out a signal that identifies the atom.

Amplified radio frequencies reproduced on an oscillograph screen show the observer what frequency the atom responds to. Each element has a characteristic frequency to which it resonates in a magnetic field under the influence of radio-frequency current.

Test materials are first placed in tiny glass vials in the field of a powerful electromagnet. Spinning the vials in the magnetic field induces a radio-frequency current into the nuclei of the atoms. When the nuclei are spinning at right angles to the field, the frequency of the signal from the atom can be determined by a sensitive receiver, revealing the identity of the element.

The nucleus of a hydrogen atom, a proton, will whirl as fast as 42,500,000 times a second in a powerful magnetic field. Dr. Bloch has been using protons in his testing which has revealed the hydrogen in solution or in paraffine.

The technique is not yet considered ready for practical scientific work.

This method of analysis contrasts with that described in RADIO-CRAFT last month, in which material to be analyzed is bombarded with microwaves and absorbs power from the transmitter at the resonant frequency of its atoms. The atoms act as receivers rather than as transmitters in that system.

DR. LEE DE FOREST was presented the Edison Medal of the American Institute of Electrical Engineers on January 28. In the words of the citation, the award was made: "for pioneering achievements in radio and for the invention of the grid-controlled vacuum tube with its profound consequences."

The medal, one of the two high annual awards of the Society, was first presented in 1910, to Dr. Elihu Thompson. Since then it has been presented to many leading figures in both the electric and the radio-electric fields. Among recipients of the honor during the last few years, radiomen will recognize E. F. W. Alexanderson, Edwin Armstrong and Vannevar Busch.

Dr. de Forest's acceptance speech follows. Since part of it parallels his article in the January RADIO-CRAFT, it is reproduced in condensed form:

In my youth I learned a Bible verse which read, "If ye have faith, all these things shall be added unto thee," which in my case I found should be thus supplemented—"faith, *plus* longevity!"

I am happy, indeed, today to be so fortunate as to have lived to realize one prize to which I had long aspired, the great honor which your Committee has bestowed upon me, the Edison Medal. The Laurel is better late—than posthumous.

From early boyhood, Thomas A. Edison was my ideal, my living inspiration, my idol. My ever present ambition was to be able to achieve something, sometime, which might be compared with his incandescent lamp or his phonograph, a thing revolutionary in nature, applicable to the needs of a continually unfolding, and an ever-developing society.

Commencing almost with the beginning of the wireless telegraph, I sought to apply to that new enterprise my newly acquired knowledge of Hertzian waves, their generation and reception. Because I had to build my own equipment, I perforce concentrated on a new wireless detector for it was cheap to construct, and for experiment.

I became firmly convinced that the Hertzian waves, or their derived currents, could be made to affect the conductivity of gases, with electrodes heated to incandescence therein. Three years later I proved that my idea was well founded when wireless telegraph signals were received with a Bunsen burner detector in whose flame were two platinum electrodes, one of them incandescent. A slow evolution from this stage brought me, in 1906, to the so-called Audion, described in a paper presented that summer before a New York session of the Institute.

In the summer of 1906 the Audion (as my assistant, Babcock, cleverly named it) embodied the elements of the flame detector, heated cathode, relatively cold anode, local battery, and signal indicator. The control electrode was next added, first in the simple form of a strip of tin foil wrapped around the tube. This was primarily to increase the sensitivity of the device by preventing any shunting of the received energy through the anode-to-earth path. Prior to that the antenna lead, or its equivalent, had been connected directly to the anode.

This crude control electrode proved a definite improvement. Successive steps in increasing sensitivity of this new detector: placing the control electrode in the form of a plate, like the anode within the envelope, but on the opposite side of the filament cathode; next this electrode located between the cathode and anode in form of a perforated plate; and finally, for simplicity of construction, a short piece of platinum wire bent in the form of a grid. This last step was late in 1906.

The Audion until 1912 remained only a detector of wireless signals, happily by far the most sensitive detector existant, as proven by the ever-increasing eagerness of the then "hams" to acquire one of these coveted bulbs by hook, crook —or purchase if need be—at a fabulous cost of $8.00, with filament life unguaranteed, but hopefully of the order of thirty hours!

(Continued on page 75)

Very recent photograph of Dr. Lee de Forest, taken as he and Hugo Gernsback look over the Audion Anniversary number of Radio-Craft.

SUCCESSFUL SERVICE SHOP

By

C. J. WHITTON

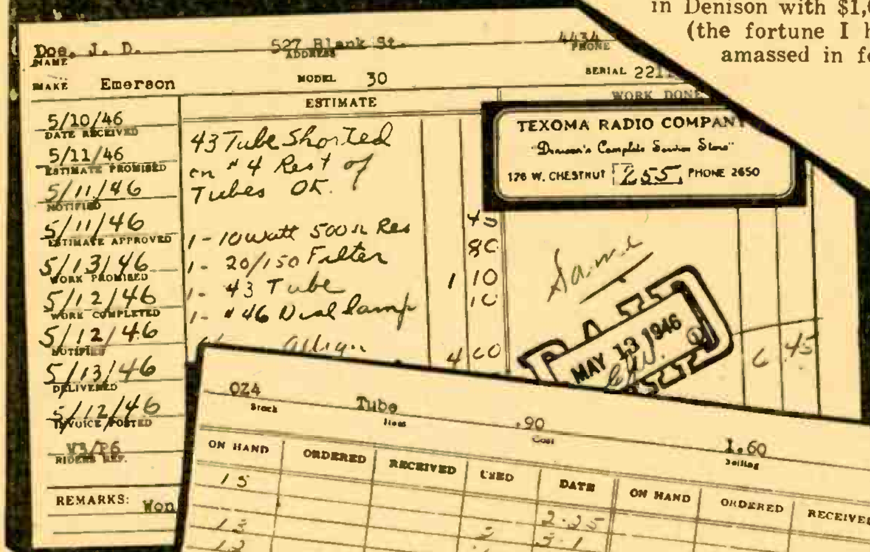
RETURNING servicemen have not been the only ones hard hit by the dislocation following the war. When war was declared, I closed up my shop, sold my equipment, and went into an aircraft plant. No, I wasn't dodging the draft—I was too old to make a good soldier but not too old to work. In mid 1945, when I decided to venture again into the business world, I determined to try virgin territory and set sail for Texas.

My wife and I arrived in Denison with $1,000 (the fortune I had amassed in four years of aircraft work) and a 1936 automobile. We could not find an unoccupied building in town, so we presented our plans and an outline of our methods of doing business to one of the local banks and requested financial aid in constructing our own building. The bank was willing to finance not only the building but also agreed to advance part of the money necessary for our proposed stock and equipment.

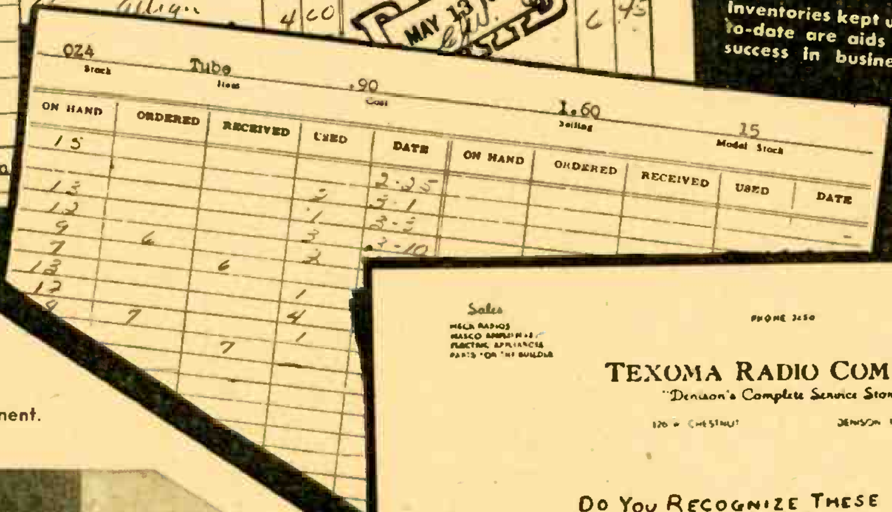
The result was the little building shown in the photo. Small enough to be built within our available means, it was purposely designed so that future additions could be made if expedient. The building is unique in that it was designed from floor to roof for the sale and service of radio.

As soon as construction on the shop was started, we contacted a local printer and had the letterhead illustrated here prepared. We then wrote to each of the distributors and suppliers in our locality and explained that we were in the process of building and would need cer-

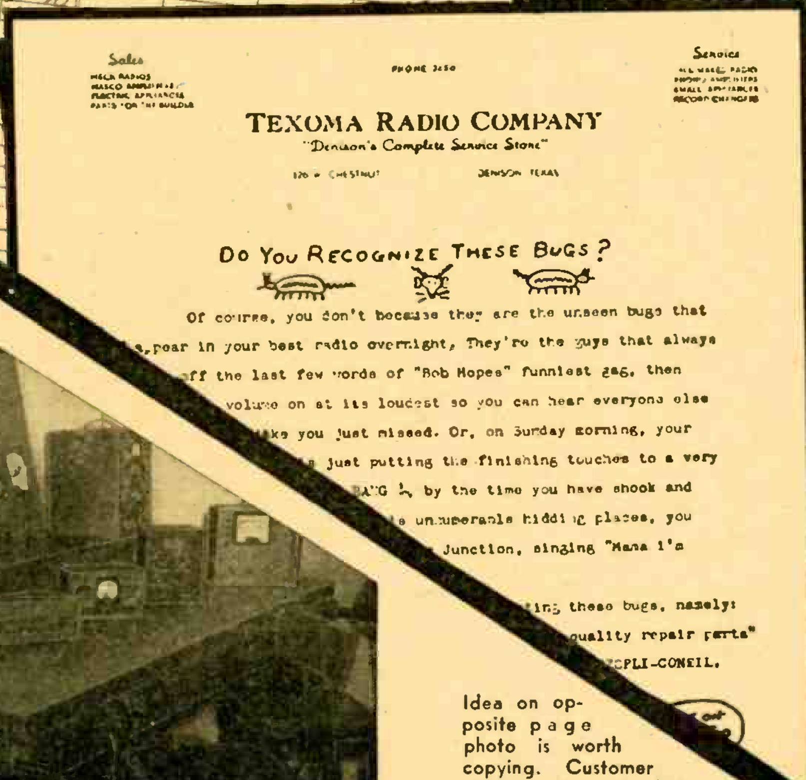
Below is a sample of the job sheet. Sticker shown is pasted inside the radio and refers to sheet series number



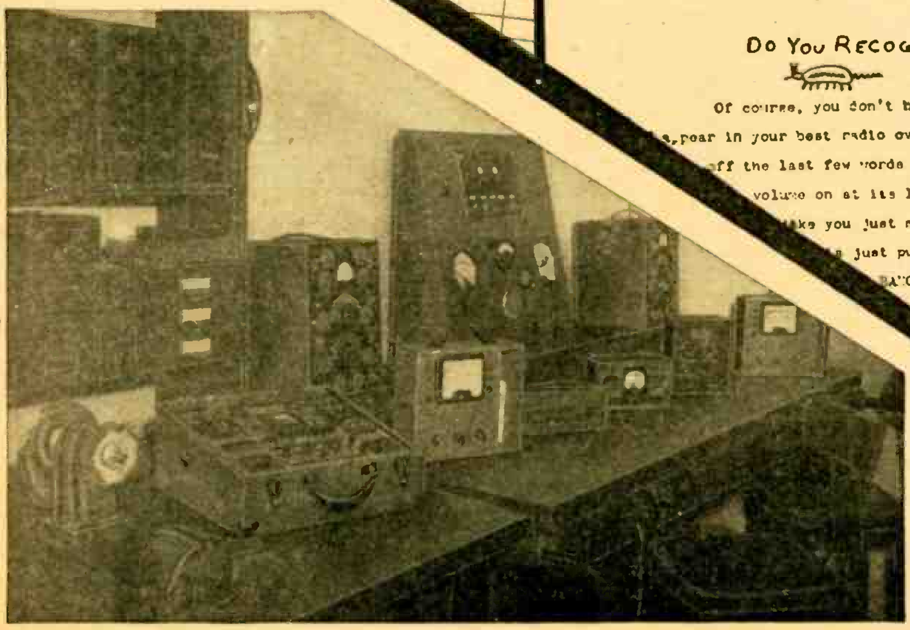
Inventories kept up-to-date are aids to success in business



Sample circular as mimeographed on the regular letterhead



Corner of the service bench, showing the shop's equipment.



Idea on opposite page photo is worth copying. Customer can see his radio but cannot breathe down back of serviceman's neck.

The Texoma shop is a rarity in architecture, built especially for radio service

tain specified parts and equipment on or before our opening date. As a result, *we had new equipment throughout and a representative stock of tubes and parts* valued at $600 when we opened on March 1, 1946. Within three months this stock was approximately doubled. Much of this early success was due to the "good, first-class letterhead" (RADIO-CRAFT editorial, November, 1945) and, of course, reasonably well-written letters.

We felt that a neat letterhead would be as impressive to our customers as to manufacturers or distributors, and had our printer duplicate the letterhead on cheap mimeograph paper. We then purchased a typewriter for $6.00 down and $6.00 a month (they're available if you keep plugging) and a used mimeograph machine for $12.50, and put out 350 direct-mail letters every two weeks to a mailing list compiled from the roster of the local Chamber of Commerce and other civic organizations. These letters are varied and intended to appeal to all the different tastes of the various recipients. The few examples shown here give a good idea of how a little rough "art" can liven up an otherwise dull circular.

Here's the payoff: We did *a gross service business of $739 our first month* (we were strangers in town, too). For a one-man unestablished shop, that's not chicken feed! Advertising alone is not the whole story (and we *did* advertise, in the local paper as well as by direct mail). The customer must be impressed by your layout and your business methods if he is to bring you his radio for repair, and he must feel that he got a *good job* and a *good deal* if he is to say a good word for you among his friends and acquaintances. This is how we do it:

When we repair a radio set, we not only replace the definitely defective part or parts, but also any that show any electrical or physical deviation from normal. True, this results in a higher repair bill, but we make a 90-day *unconditional* guarantee that more than offsets the impression the customer may get from the slightly higher bill. Any radios that are returned under the guarantee are given priority over new jobs. To facilitate their speedy handling, we use a red job card to indicate they are to be worked on *first*. Reason for the return, time, and parts used are listed on the card. The parts are charged out of stock each week on a book used for that purpose. The cost of maintaining our guarantee has been less than one-half of one percent of our gross revenue so far.

My wife, who serves as receptionist and bookkeeper, also has charge of all routine operations in the shop. She can converse intelligently with customers about their radios, and she enters their descriptions of faulty operation of the receivers on the job card for serviceman's reference. She dispatches all work orders and gives the customer an approximate date when he can call for his radio.

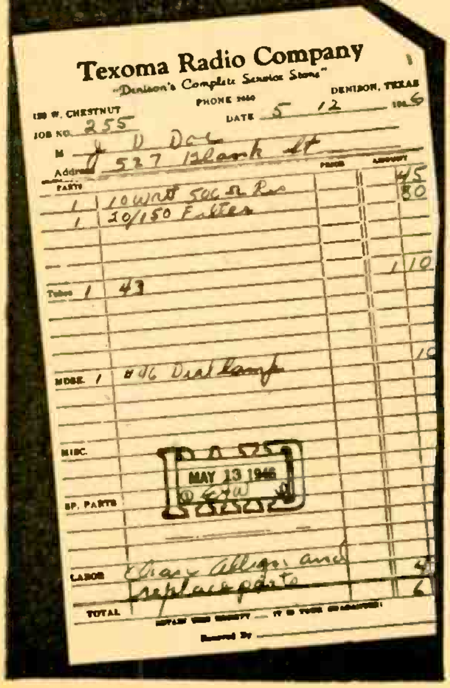
The customer's receipted bill is his guarantee. The charges are itemized under several heads (printed along the left-hand side of the bill): Parts, Tubes, Merchandise, Miscellaneous and Labor. Besides the bill given the customer, a sticker is pasted into his set. A serial number on the sticker refers to the job sheet for the set. If a set once repaired comes back to this shop, its past history can be turned up instantaneously. This is a great convenience to the serviceman, but would pay for itself by its effect on the customer alone. His confidence is greatly increased by seeing that you know all about his set, and possibly also by the fact that he sees you have a systematic way of doing business.

Customer confidence is further built up by the attractive appearance of our shop. It has the advantage of being specially designed for its purpose, and even from the outside looks like a radio shop pure and simple. Inside it is divided into a front office and reception room, and workshop. The tube tester (Model 589 Supreme counter type) is kept in the front office. A large glass window between office and workshop solves the old problem of doing the work out in the open or in a special "laboratory." The serviceman can work without having customers breathing down the back of his neck, and the strange and sometimes suspicious customer does not feel that his set is being taken away from him and hidden in a back room.

Our bookkeeping system is so set up that at the end of each day the last column of our ledger shows the exact

(Continued on page 64)

A typical bill for radio service and parts


Texoma Radio Company
"Denison's Complete Service Store"
PHONE 960 DENISON, TEXAS
DATE 5 12 1946
JOB NO. 255
Parts: 1 10 watt 500 ohm Res. .45; 1 20/150 Filter .80
Tubes: 1 43
MDSE.: 1 #46 Dial Lamp
MAY 13 1946
LABOR: Clean, Align and replace parts
TOTAL

NEW RADAR FOR AIR SAFETY

FLYING safety has taken on new importance with the sharp upswing in air transportation services, and has been drawn sharply to the public attention by the series of misadventures which featured the bad-weather period of this winter. A greatly increased number of planes is available, and more people than ever require the speedy service of air travel. But they want safety.

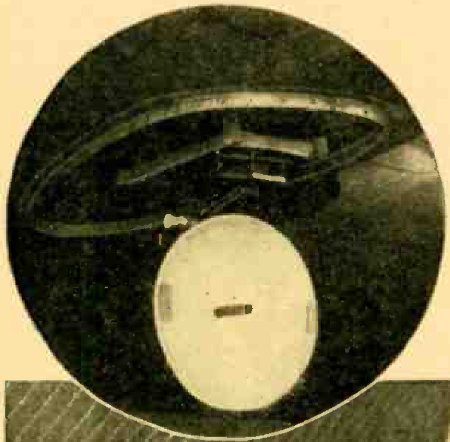
The Army and Navy have had an excellent record for safety in all-weather flying. Depending on Ground-Controlled Approach (GCA) for the fixed installations, they have worked continually toward the aim of safety at any time, anywhere, whether far from an airfield with its GCA or not. To that end, the Army has let a contract for a small simplified radar which will weigh about 100 pounds and be compact enough for use in the average medium-weight commercial or military transport plane.

The new radar would be a further improvement over military lightweight radar built for the Army Air Forces during the last few months of the war. This wartime radar, the APS-10 (illustrated on our cover) weighed about 150 pounds with auxiliary power supply and was operated by 5 controls.

These sets contrast sharply with 500-pound, 34-control radar employed by the Army Air Forces throughout most of the conflict.

Power of the new radar will be increased 8 times over the APS-10 version, and maintenance provisions will be simplified, it is claimed. Present maximum range of the APS-10 is about 90 miles. An extension in range is expected with the new version.

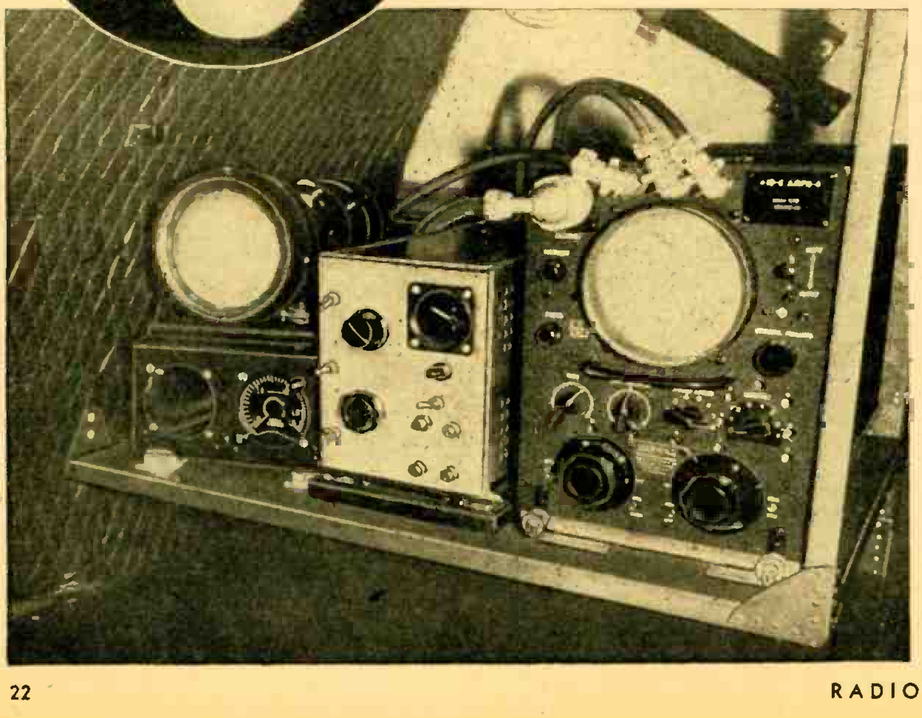
Commercial airlines, the Army Air Forces, CAA, and the General Electric Co., manufacturers of the equipment, are currently experimenting with the APS-10 radar to work out adaptations for early application for many types of air transport agencies.



Features of the Instrument

Although the APS-10 military aircraft radar was designed primarily for wartime missions and does not meet all requirements of commercial peacetime airline operators, it does perform a number of useful peacetime tasks which can be of immediate advantage.

Below—AN/APS-10 installed in an AAF C-47. At left—Antenna mounted beneath fuselage. *Official photos, Aircraft Radio Lab., Wright Field.*



The APS-10 is a plan-position indicator type of radar, adapted also to receive signals from beacons which appear as coded marks on the 'scope. Thus it is possible to obtain bearings from positively identified points or, when feasible, to "home" on the beacons as on an aviation beam.

The PPI feature does not give images of equal clarity to those of larger instruments. If two targets are close together, they blend into each other. Thus it may be impossible to identify landscape features with absolute certainty. Two islands, if close together, may appear as one. A group of islands, however, would be clearly seen as separate from the water surrounding them, and a large group of buildings would be easily identified.

Over New York, for example, the APS-10 radar tells the pilot he is above the city, points out the different rivers, the George Washington Bridge, and the general location of the skyscraper area. It will not see individual buildings. It *does* tell the pilot where he is in relation to the ground objects he can identify. With such information he can avoid such structures as the Empire State building.

Range rings are traced on the screen to indicate various distances, from four miles to fifty. Angular lines traced on a transparent plastic overlay also divide the screen into 10-degree segments. These may be seen in the cover picture. (The "V" of light is a test signal used in checking operation of the device.)

The lightweight radar can be used to indicate drift angle, to check wind velocity and direction, to compute ground speed, and to check the plane's actual altitude (terrain clearance). These uses make it a useful auxiliary to and check on other instruments carried by the plane.

A Storm Detector

This airborne radar also can locate severe storm areas over land and sea, even though it cannot see into intense storms. Pilots can either avoid such areas or fly through storm "soft spots" as indicated on the radar screen. This is regarded by electronics engineers as one function which can contribute immediately to safe flying and increase passenger comfort.

In mountainous terrain, the wartime radar can be adapted to indicate the direction and distance of mountain peaks which constitute a collision hazard. Its ability to give altitude of

(Continued on page 40)

By JORDAN McQUAY

SWITCHING AND TRIGGERING

Two Fundamental Electronic Control Circuits

ELECTRONIC control plays an increasingly important role in our everyday life.

Modern industry requires infallible, microsecond precision and completely automatic control of many manufacturing processes. Highspeed inspecting, counting, sorting, measuring, and safety-device equipment all make for fast and economical production.

Electronic control also performs similar but simpler functions in the household or radio shack—closing windows at certain temperatures, operating radio gear remotely, switching on lights at prearranged times, burglar-proofing houses, counting objects, or measuring—with four- and five-place decimal accuracy, if necessary.

The design of almost all electronic control equipment is based upon a few simple circuits, and therefore the principles of electronic control devices are not difficult to understand.

Foremost among the uses of this type of control are circuits used for *switching*, *triggering*, *counting*, *sorting*, and *measuring*. These are the functions with which this and a subsequent article are concerned.

Although the terms *switching* and *triggering* are somewhat similar in use and popular meaning, there is a distinction between them.

An *electronic switch* is a control circuit providing carefully defined electronic impulses. These pulses are in most cases converted into mechanical or electro-mechanical energy which causes some physical action or change to take place in another circuit or device. An important characteristic of switching circuits is that they provide both a start and a stop action (Fig. 1) by means of the control wave form. While their action is comparable to a mechanical on-off switch, electronic switches are capable of extremely high speeds of operation.

An *electronic trigger* is a control circuit whose output is used only *to start* an action in another circuit or device (Fig. 1), the resultant action continuing for a time under its own control and then stopping of its own accord.

Fig. 1-a shows the control impulse applied to both trigger and switching circuits. (Most triggering pulses are in fact much shorter than the square waves shown.) The resultant trigger action is shown in Fig. 1-b, and the resultant switching action in 1-c.

Counting, sorting, and measuring circuits provide impulses of certain shape and amplitude for coupling to visual or aural indicating systems. Counting circuits provide output impulses in proportion to the *frequency* of input impulses which represent the phenomenon being counted. Sorting circuits provide output impulses in proportion to the comparative amplitudes of input impulses. Measuring circuits provide output impulses proportional in amplitude to some dimension of the object under observation. Other types of measuring circuits use cathode-ray tubes to provide visual measurements *in terms of time*. These and other counting and measuring circuits will be discussed in greater detail in a forthcoming issue of RADIO-CRAFT.

Electronic Switches

The principal purpose of switching circuits is to provide a source of sharply defined control impulses (Fig. 1) which can be used to open, close, reverse, or otherwise influence the operation of related circuits or devices connected to the output of the electronic switch.

Such action may be brought about by either mechanical or electronic means, depending largely upon the required

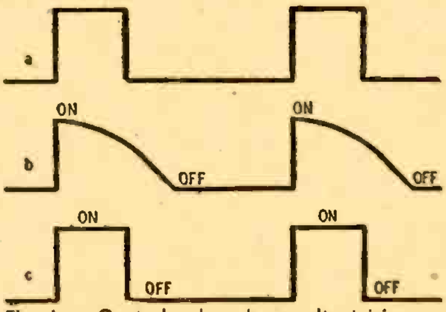


Fig. 1,a—Control pulses; b—resultant triggering action; c—resultant switching action.

speed of action but also upon the nature of the connected apparatus. For slow rates of speed—up to about 100 repetitions per minute—switching is accomplished by conventional, directly energized relays.

But for higher rates of speed—the more usual instances—electronic switching circuits are used. These consist of one or more gas-filled or high-vacuum tubes, supplying a series of control pulses. The output pulses may govern the operation of other, purely electronic circuits, or may actuate low-capacitive noninductive relays or other electromechanical devices.

An electronic switch can be arranged to generate and shape the control impulses entirely without external synchronization or control. This type of switch is used in precision regulation, where output pulses must occur according to some fixed period of time. Once adjusted, the switch functions under its own control.

However, when a control source is available or is necessary, an electronic switch is used as an amplifying, pulse-shaping, or merely an isolating circuit—connected between the control source and the relay or device to be actuated. This is the more general use of the electronic switch. But in either case—with or without external control—action of individual stages of the circuit is almost identical.

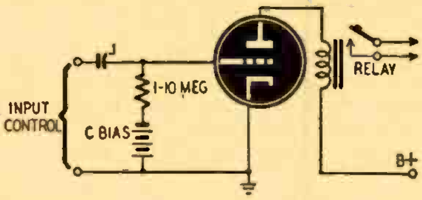


Fig. 2—A simple type of electronic relay.

The simplest type of electronic relay (Fig. 2) uses a single triode and a current-operated relay. This circuit requires external control positive voltage applied between grid and cathode—but the tube draws negligible current from the control source. The triode operates with a fixed negative bias to prevent conduction, and no current flows in the plate circuit of the tube. However, when voltage from the control source becomes sufficiently positive, the tube conducts and the relay is energized. Action of the relay is determined by the voltage from the control source, and output frequency by the input frequency of positive-going impulses above the critical operating value for the tube.

Usually the external control source is of very low power and incapable of actuating relays or other devices. The use of one or more tubes provides the necessary amplification. The principal advantage of the device is that it operates without drawing appreciable current from the control source.

Relay Control

One practical application of the basic electronic relay is a temperature control circuit (Fig. 3) using a phototube as the control source.

Many manufacturing processes are dependent upon a constant temperature during production or formation. Since temperature can be controlled electronically (by circuits similar to Fig. 3) with greater accuracy and less expense, large numbers of workers to watch

(Continued on page 70)

THE POSTWAR RADIOS

The Belmont Boulevard

The Boulevard is little longer than a fountain pen.

FIRST of all the promised postwar vest-pocket radios is the Belmont Boulevard. It is a 5-tube superheterodyne only 6 inches high, 3 inches wide and ¾ inch thick. With its earphone-cord antenna only 2½ feet long, it brings in all local stations with good volume, and when near metal carriers of r.f. current (telephones, electric wiring, antennas) picks up weaker stations. Selectivity, because of r.f. stage, is better than that of the average 5-tube small radio. The set—by actual experiment—*does* fit comfortably into a vest pocket.

Subminiature tubes of the type originally developed for the proximity fuze make such remarkable compactness possible. They include a triode-heptode (2G22) which has *nine* active surfaces between two glass walls only a quarter inch apart. The other tubes are two 2E32's as r.f. and i.f. amplifiers, a 2E42, which acts as diode detector and first audio frequency amplifier, and the 2E36 pentode in the output stage. The power output of this tube is 6 milliwatts. Small as this may sound, it means more than comfortable volume in the crystal earpiece on strong local stations. Fairly loud signals may be received without noticeable distortion. Characteristics of these tubes are given in Table I.

Variable-iron-core tuning is used in the sub-tiny receiver. The permeability-tuning units are to be seen at the top in the chassis photo. The half-extended iron cores are to the right of the cans. Smallest of all practical tuning devices, they are the i.f. coils (only slightly smaller than below). The rectangular construction of the Raytheon subminiature tube is suited excellently to close spacing. The i.f. cans between which they are placed contribute to the shielding, which is completed by the aluminum case.

The set is operated in the conventional manner, with the volume control and switch connected to one knob and the tuner controlled by a second. A feature immediately noted by the wearer of one of these sets is the extreme variability of r.f. fields in certain locations. In certain office buildings, a station may be received well at one point and entirely inaudible at another only two or three feet away.

Reception on the street is also spotty, and is better at open intersections than on sidewalks in front of certain buildings. Other structures seem to act as antennas, and reception was surprisingly better in a cage-type elevator than at other points in the same building.

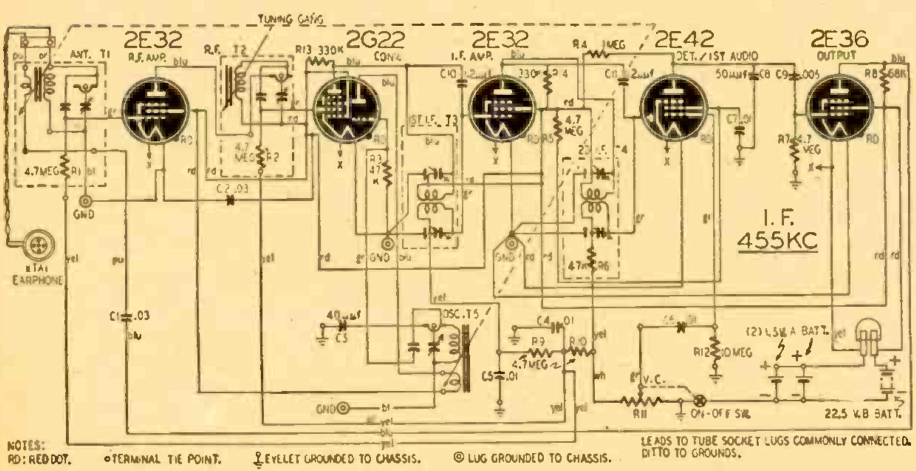
The small filament batteries are said to operate "about three hours." Actually, a set of new batteries gave 3 hours 20 minutes *continuous* service, and no doubt would have lasted longer had the radio been playing intermittently. The B-battery is supposed to run for 40 to 50 hours. Cost of operating the set would therefore run a little under five cents an hour.

A very complete folder is supplied to the customer with the set. He is instructed in its use, told what he may and may not expect from it, and given careful direction for battery removal and replacement. The very full instructions should serve as excellent insurance against disappointment in or damage to the receiver.

Servicing these little radios will present a number of new problems to the radioman. His first reaction on looking at one of them will be one of relief. Most of the parts are at least as easy to get at as those in many 3-way portables or even midget table receivers. It is their size which is disconcerting. Once the serviceman has adjusted himself to these minute components, standard test procedure may be modified to take them into account. The extreme probability that the set may not work normally when out of its case must be taken into account, and the serviceman's equipment will probably include a jig for keeping the batteries in place and sideplates to act as shields and stabilize operation.

Stripping down to the chassis is remarkably easy. The end bell over the batteries is taken off by removing the holding screw and lifting off the bell, screw end first. It is held in place by four long bosses which fit into similarly-shaped recesses in the bell. The case, which is similarly held to the top end bell, is then sprung loose in the same manner. The top end bell can be left in place for most repair jobs, but if necessary it can be removed by taking off the two knobs and taking out the two small screws which will be found under the tuning knob.

In view of the special equipment (small soldering irons and tools) needed, many repairs on this radio may possibly be handled more profitably on a manufacturer's service basis, shipping the set back to the factory to be repaired with the help of special equipment. Belmont recognizes the role of the legitimate serviceman, however, and instructs the customer to "take it (the radio) to a competent serviceman if it does not operate properly." Complete alignment instructions (Table II) are printed in the folder, which the customer is instructed to take to the serviceman with him. Few companies in the



Schematic diagram of the Belmont Boulevard. Circuit is similar to that of standard sets.

TABLE I

2G22

RATINGS

Filament Voltage	1.25	volts
Filament Current	50	ma
Maximum Heptode Plate Voltage	45	volts
Maximum Heptode Screen (Grids Nos. 2 and 4) Voltage	45	volts
Maximum Triode Plate Voltage	45	volts
Maximum Total Cathode Current	2.0	ma
Minimum External Signal Grid Bias	0	volts

TYPICAL CONVERTER OPERATION

Plate Voltage (Heptode)	22.5	volts
Screen Voltage (Heptode Grids #2 and #4)	22.5	volts
Oscillator Plate Voltage (Triode)	22.5	volts
Signal Grid Bias (Heptode Grid #3)*	0	volts
Oscillator Grid Resistor (Triode)	50000	ohms
Plate Current (Heptode)	200	μa
Screen Current (Heptode)	300	μa
Oscillator Plate Current (Triode)	1	ma
Oscillator Grid Current (Triode)	30	μa
Conversion Transconductance	60	μmhos
Conversion Transconductance at Signal Grid Bias = −3.5	2	μmhos
Conversion Plate Resistance (Approx.)	0.5	meg.

2E32

RATINGS

Filament Voltage	1.25	volts
Filament Current	50	ma
Maximum Plate Voltage	45	volts
Maximum Screen Voltage	45	volts
Maximum Cathode Current	1.0	ma

TYPICAL CLASS A_1 OPERATION

Plate Voltage	22.5	volts
Screen Voltage	22.5	volts
Control Grid Voltage*	0	volts
Plate Current	0.40	ma
Screen Current	0.3	ma
Transconductance	500	μmhos
Plate Resistance	0.35	meg.
Grid Bias for Plate Current = 10 μa	−2.0	volts

2E42

RATINGS

Filament Voltage	1.25	volts
Filament Current	30	ma
Maximum Plate Voltage	45	volts
Maximum Screen Voltage	45	volts
Maximum Cathode Current	1.0	ma

TYPICAL R-C AMPLIFIER OPERATION

Plate Supply Voltage	22.5	volts
Screen Supply Voltage	22.5	volts
Load Resistance	1	meg.
Screen Resistance	5	meg.
Voltage Gain	20	

TYPICAL DIODE RATINGS

Minimum Diode Current with 10 Volts D.C. Applied	0.5	ma
Maximum Diode Current for Continuous Operation	0.25	ma

The diode plate is located at the negative end of the filament.

2E36

RATINGS

Filament Voltage	1.25	volts
Filament Current	30	ma
Maximum Plate Voltage	45	volts
Maximum Screen Voltage	45	volts
Maximum Cathode Current	1.0	ma

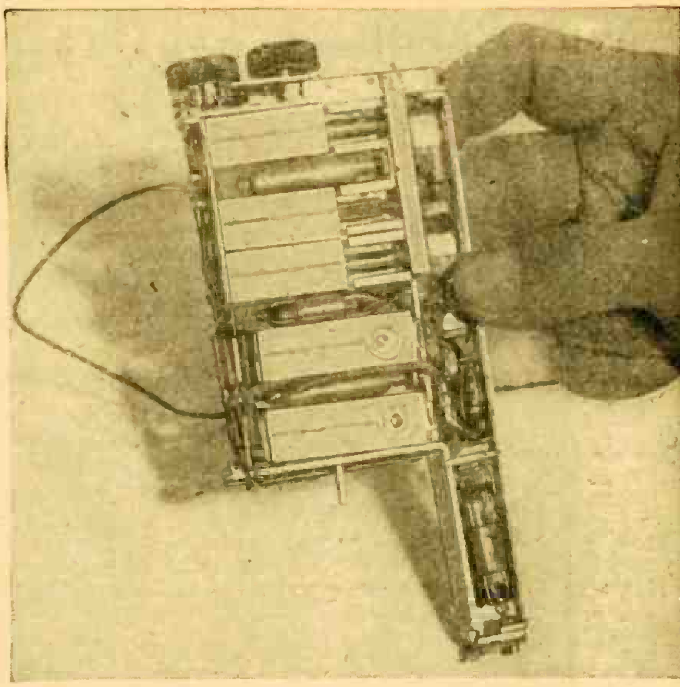
TYPICAL CLASS A_1 AMPLIFIER OPERATION

Plate Voltage	22.5	45	volts
Screen Voltage	22.5	45	volts
Control Grid Voltage	0*	−1.25	volts
Plate Current	0.27	0.45	ma
Screen Current	0.07	0.11	ma
Transconductance	385	500	μmhos
Plate Resistance	0.22	0.25	megohm
Load Resistance	0.15	0.10	megohm
Distortion	10	10	per cent
Power Output	1.2	6	mw

* Grid resistance = 5 megohms.

past have been more considerate of the repairman.

This and similar radios have an assured future as super - portables which can be carried (and packed) where a full-sized portable would be impractical. Certain types of night workers (notably nurses and night watchmen) whose work includes much lonely vigil but who for various reasons cannot avail themselves of a larger portable radio, will be a very steady market for this type of set. Music lovers may find it more suitable than the loudspeaker type of portable for outdoors use, as the latter must usually be turned up well beyond the point of tolerable distortion to be heard in the open air.



Chassis view. Layout is neat and rational in spite of small size.

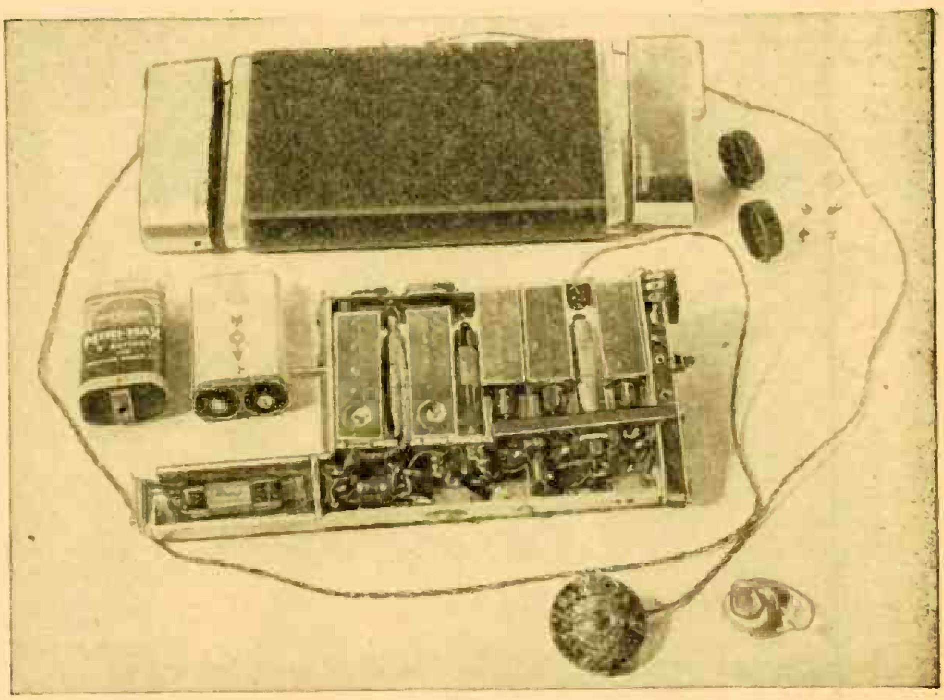
Looked forward to as a novelty, the vest-pocket radio may find itself a more practical receiver than the "standard" battery-powered portable.

TABLE II—ALIGNMENT PROCEDURE

- Output meter must give 1.5-volt deflection without loading output tube.
- Use any 1½-volt "A" battery and 22½-volt "B" battery which can be connected to set. Keep battery leads short.
- Unsolder lead between .03 mf output capacitor and purple lead. Connect one side of meter to this capacitor terminal, other side to receiver chassis. Be sure to reconnect leads after alignment is completed.
- Volume control at maximum.
- Connect ground lead of generator to chassis.
- Align for maximum output. Reduce input as needed to keep output near 1.5 volts.

Generator Frequency	Coupling Capacitor	Connection to Set	Adjust for Max. Output
455 kc	.1 mf	Converter 2G22 grid	Trimmers on both I.F. transformers
1625 kc	.1 mf	Converter 2G22 grid	Oscillator trimmer
1400 kc	.1 mf	Converter 2G22 grid	Oscillator tuning slug*
1625 kc	10 mmf	Antenna lead	Osc, ant, rf trimmers
1400 kc	10 mmf	Antenna lead	Antenna, rf tuning slugs*

*Repeat this and previous step alternately for best tracking.



Exploded view. All parts of the Belmont Boulevard are shown in this photograph of the radio.

DUTCH UNDERGROUND RADIOS

By J. MAQUERINCK

Mr. Maquerinck was unable to take photos of his radios. These underground sets were described in an article in the Philips Technisch Tijdschrift.

WHEN the Nazis, who had occupied Holland since 1940, forbade all radio listening and confiscated all receivers in the spring of 1942, radio listening was driven underground. Only by listening to the BBC and Radio Boston could we know how the war was going.

It is my purpose to tell you something about the sets we built and how we concealed them.

Let me begin with the receiver built by a friend of mine. Luckily he was the owner of a crystal, and so he built the

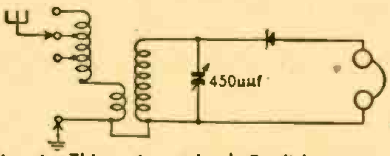


Fig. 1—This set received English stations.

set the schematic of which is given by Fig. 1. The entire assembly was placed in a cigar box, complete with headset and tuning condenser. When he wanted to listen, he opened the box, connected ground and antenna, put the headphones on his head and tuned the circuit. This set was very selective and the only disadvantage was its weak reception.

My neighbor, in a set the diagram of which is given in Fig. 2, used an old battery tube.

The plate voltage was taken from the A-battery and the results were much better than those obtained with a crystal detector.

The coil was tuned with an iron-powder core only and no condenser was used. Tuning was not very sharp, but this wasn't needed in the beginning, because the German interference transmitters did not come until later on.

In the beginning I used the set shown in Fig. 3.

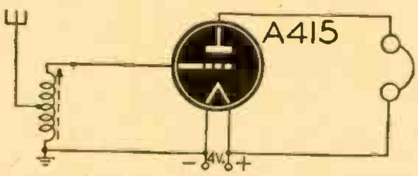


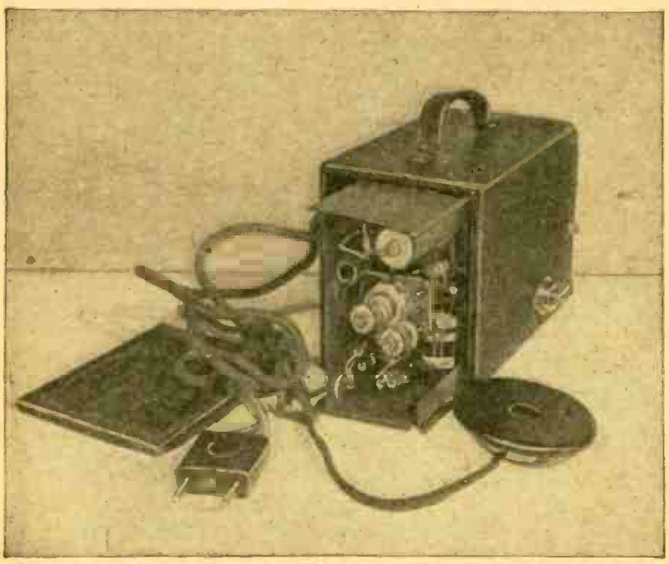
Fig. 2—One-tube radios were more sensitive.

It had a high-μ beam-power pentode, connected as feedback detector. It gave good speaker output and was sensitive enough to play on a 30-foot antenna.

It was tuned by an iron-core coil and a fixed condenser with a trimmer for just alignment. So it was fixed on 200 kc, the BBC wavelength. Tube was an EL6.

This set worked very well, but it couldn't be hidden. Besides, it needed an antenna, and an outside antenna would be seen.

I decided to build a set that didn't need an external antenna. The result you see in Fig. 4. It uses a triode - heptode tube which has three functions: r.f. amplifier, grid-leak detector, audio amplifier.



Courtesy Eastman Kodak Co.

"Brownje" receiver built by Mr. F. M. Leopold of Eindhoven, Holland.

The plate supply, being 43 volts, is obtained from the A-battery. The tube, a U.C.H. 21, operates with this heater voltage.

The coils are of the iron-core type, wound on a low-loss form with core in center. The set is tuned with a fixed condenser of 500 μμf and a 3-30-μμf trimmer across it. The coils are shielded by pieces of copper sheet, bent in the right form.

Needless to say the tuned wavelength was 200 kc.

Tube, coils, resistors and condenser, r.f. choke and A-battery—the entire equipment was put into a phone cabinet, after I had removed the phone parts. Fig. 5 shows how it looked.

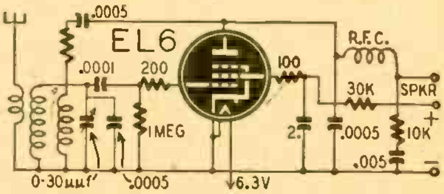


Fig. 3—One of the author's early circuits.

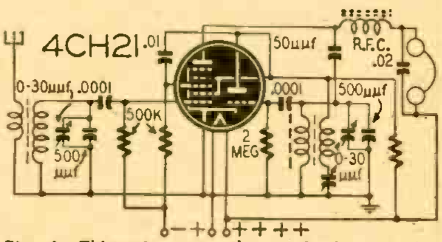


Fig. 4—This set operated on a body antenna.

This was a very satisfactory way of concealing the set and I didn't need a cabinet. That the phone was dead wasn't much loss, because it had been defective for months.

An antenna wasn't needed, because my finger was antenna enough. Maybe I have a very high body capacity, but I

(*Continued on page* 62)

By JACK KING

EQUIPPING THE SHOP

Multitester, tube checker and signal generator are necessary equipment in every service shop. ⟶

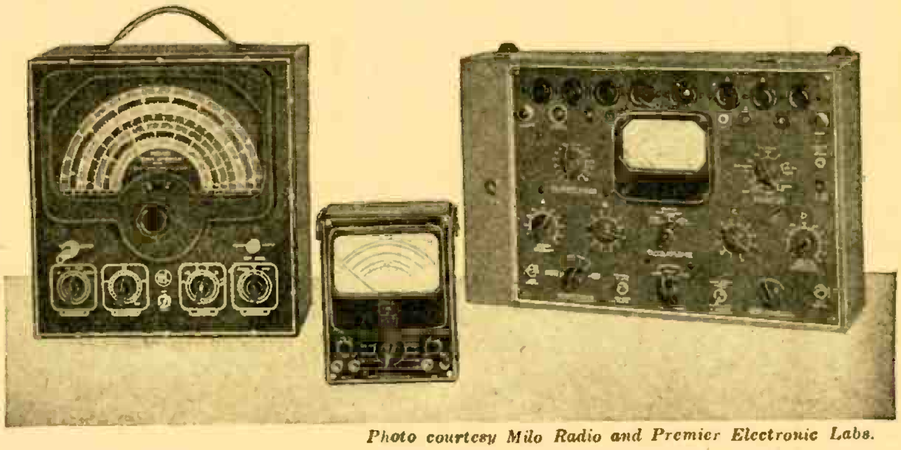


Photo courtesy Milo Radio and Premier Electronic Labs.

"WHAT test equipment should I buy" is one of the questions most commonly asked by the returning service man. Many of these men have had plenty of experience with radio repairing in the army, but civilian radio repairing is new to them, and they find it difficult to orient themselves to civilian radio service procedure. Many of these men find radio repair highly interesting, and believe they could make it reasonably profitable. They lack commercial radio servicing experience, and would like a little forehanded information to substitute for the costly and often disastrous process of "picking it up as you go along."

A complete answer to the question would involve writing a book. Three essential pieces of test apparatus are necessary: a good volt-ohmmeter, signal generator and tube tester. The apparatus selected should be made by a well-known firm of good reputation. Cheap equipment is no better in radio than in a suit.

The volt-ohmmeter should be capable of measuring resistances as high as 10 or 20 megohms and voltages, a.c. and d.c., as high as 1000. Special apparatus may be necessary for television sets, but the average service job can be handled efficiently using the above apparatus. The signal generator should be well shielded and equipped with a clear, accurately calibrated dial. It should be capable of covering a range from 100 kc to as high as 20 or 30 mc. Later, a special high frequency generator for television and frequency modulation work may be added, since high frequencies are used for FM and television in the new bands.

The tube tester should be accurately calibrated. It is particularly important that the purchaser obtain with the instrument at the time of purchase full calibration data and instructions. The tester should be capable of testing all of the latest types of tubes used in receivers, especially those having high voltage heaters, such as the 117L7. Building a tube tester is utterly impractical. You would have no means of calibrating the instrument; a manufacturer may run tests on hundreds of tubes in developing a suitable tube tester, then construct an accurate master model. Other testers sold on the market, then, are merely copies of the master model into which a great deal of research has gone. It is sheer folly to build your own instrument if accuracy is desired.

Later, a signal tracer, frequency-modulated generator, cathode-ray oscilloscope and capacity bridge may be added to the test bench. Many expert servicemen have no need for a signal tracer and scoff at the idea of using one—because they know fundamental radio principles very well and are able to use them in testing.

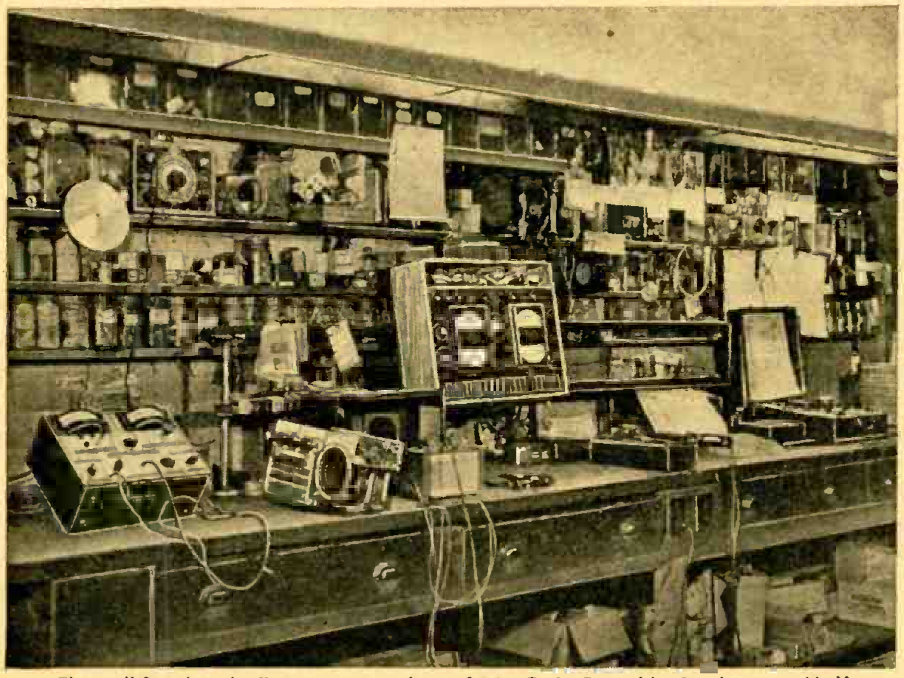
Next most important question is: "What radio parts should I stock?"

Go slowly at first—buy only what you need. After doing a few jobs you will know what to order to meet your own requirements. In general, a number of small 16-μf or 20-μf 150-volt electrolytics of the single negative, two positive type will be useful. These may be midget varieties because they will fit easily into compact sets. It is important to distinguish between common negative and common positive condensers. A number of small 8-μf and 16-μf condensers rated at 450 volts may be used to replace filters in a.c. sets having full-wave rectifier power transformers. The 150-volt electrolytics are used in a.c.-d.c. sets. Refer to the diagram of the receiver you are servicing and to the manufacturer's data. A number of 400-volt paper condensers rated at 400 volts are useful. Obtain several in the following sizes: .01 μf, .05 .006, .1, .25 μf. These will meet practically all requirements. Buffer condensers in auto sets often fail and are high voltage types rated at 1200 or 1500 volts. The higher voltage rating is desirable to minimize breakdowns.

Another question frequently asked is, "Where may I obtain radio circuit diagrams?"

The answer might be "almost anywhere," but we can be more specific. Diagrams may be obtained through radio distributors and mail order houses; they appear in radio servicing magazines available on newsstands in some cases; they may be obtained by writing directly to the manufacturers, some manufacturers have bound service

(Continued on page 66)



The well-fitted and efficient service shop of Mr. C. L. Reynolds, Binghamton, N. Y.

By SOL PRENSKY AND JESS JACOBSON

THE 'SCOPE—A REPAIR TOOL

Part II—Checks on the R.F. Portions of the Receiver

IN THE first part of this article published in the January (de Forest Anniversary) issue, an orderly test procedure was set up and a chart developed to show the use of the oscilloscope for maintenance and repair tests, starting from the power supply section and working backward through the speaker and the a.f. section of the receiver under test.

The procedure described used a signal generator to inject the appropriate signal and *quick check points* for the 'scope connections, as a method for moving rapidly through those sections that were shown to be O.K. by their satisfactory response to the injected signal—until a point was reached where the section showed evidence of trouble. That particular section of the circuit would then be covered in detail by the steps shown in the chart. This method requires a total of five quick check points, one each for the d.c., a.f., i.f., oscillator, and r.f. sections of the receiver. The first two of these sections, (d.c. and a.f.), were considered in the first part of the article. We now continue with the quick check points for the other three sections, the i.f., oscillator, and r.f. sections. The tests are assumed to be carried out on a typical 5-tube receiver, the schematic of which was printed in the first part of this article. This was an a.c.-d.c. receiver, with the "All-American" 12SA7, 12SK7, 12SQ7, 50L6, and 35Z5 tube lineup.

Two optional procedures are shown for obtaining further information if desired. One additional step tests the i.f. bandwidth response. The remaining step tests the over-all frequency response of the entire receiver.

The chart gives a condensed guide to the procedure for each step and the proper interpretation of the resulting indication. The appearance of the expected pattern is shown and numbered to correspond with each numbered step. Some additional patterns, such as would be produced by common troubles in the receiver, are also illustrated.

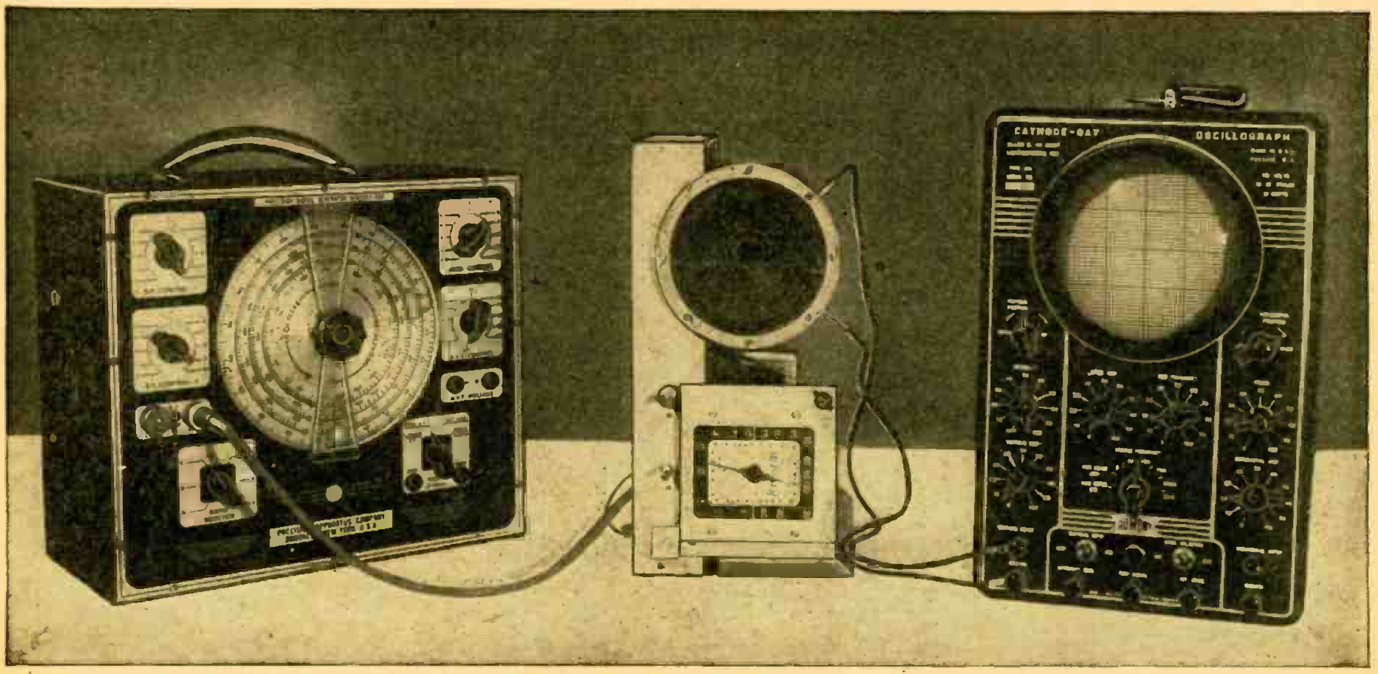
Requirements for R.F. Tests

Before proceeding with the tests for the i.f. section, it is well to consider the qualities needed in the 'scope to enable it to interpret faithfully signals in the radio-frequency range, which, of course, includes the i.f., oscillator and r.f. sections.

The qualities necessary for satisfactory oscilloscope performance will depend mostly on the type of indication that the 'scope is called upon to give for any particular test desired. Thus, if the experimenter wants to observe the r.f. wave coming into the set at the antenna terminals, so wide a response is needed from 'scope amplifier as to be entirely out of line with what can be expected from an ordinary 'scope. Even though more costly laboratory equipment is available to handle such a requirement, the cost would run into much more than a hundred dollars over the cost of an ordinary instrument. It would therefore be foolish for the serviceman to invest in such a high-priced and specialized piece of equipment for the essential applications which he needs for set servicing, even though the specialized 'scopes do have a well-established value in certain other applications.

The main question is: "What important observations do I need from my 'scope?" Since the home radio receiver is designed to receive a modulated radio-frequency wave from the broadcast transmitter and convert this so that the set can reproduce the audio portion of this wave, the serviceman finds himself in the fortunate position of needing only such a response from the 'scope as will amply cover the audio frequencies. This response, for a perfectly working set, would include the harmonics present in high-fidelity reception and so run up to about 20,000 cycles. To observe the many possibilities of a distorted audio wave, the 'scope response should reach preferably to about 50,000 cycles (with at least 50-percent response at 100 kc), combined with a corresponding associated sweep range of around 25,000 cycles. The above requirements are met satisfactorily by most of the oscilloscopes on the market,

(Continued on page 56)



A signal generator (with self-contained audio oscillator) receiver and oscilloscope set up to run the tests described in this article.

PATTERN 18a

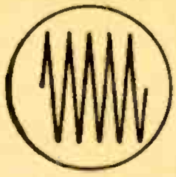
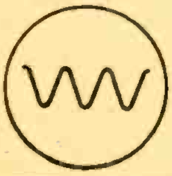
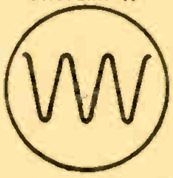
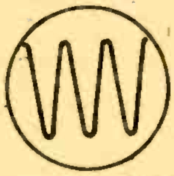
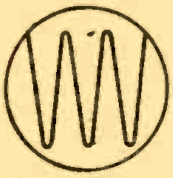
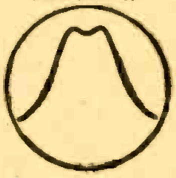
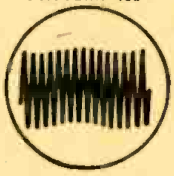


TABLE OF TEST CONNECTIONS

PATTERN 10	PATTERN 11	PATTERN 12	PATTERNS 13, 14	PATTERNS 15, 16	PATTERN 17	PATTERN 18b
						

INDICATION DESIRED	'SCOPE CONNECTIONS TO SET	'SCOPE ADJUSTMENT	PATTERN TO BE OBTAINED	INTERPRETATION
I.F. Section Test No. 10 Second i.f. transformer	I.f. signal 455 kc, modulated at 400 cycles through blocking condenser (0.05), to plate of 12SK7 (pin 8) and chassis. 'Scope to high end of volume control.	Adjust i.f. signal to lowest value that will give useful reading of audio modulation signal (400 cycles) on 'scope.	(Pattern 10) Demodulated i.f. signal through 2nd i.f. transformer.	Second i.f. transformer and diode portion of 12SQ7 operation.
Test No. 11 I.f. amplifier tube 12SK7	Shift generator signal to grid of 12SK7 (pin No. 4)	No change, except to decrease strength of generator signal if necessary.	(Pattern 11) Demodulated i.f. signal (400 cycles) after amplification by 12SK7.	12SK7 i.f. amplifier tube amplification.
Test No. 12 First i.f. transformer	Shift generator signal to plate of 12SA7 (pin 3).	No change. Align i.f. trimmers of 1st i.f. transformer for maximum peak.	(Pattern 12) Demodulated i.f. signal (400 cycles) through 1st i.f. transformer.	1st i.f. transformer operation and alignment.
Test No. 13 Converter tube 12SA7 amplification on a.v.c. operation.	Shift generator signal to grid of 12SA7 (stator of ant. tuning condenser).	Attenuate i.f. signal according to amplification of output. Then increase value of i.f. signal to obtain temporarily greater a.v.c. action.	(Pattern 13) Demodulated i.f. signal (400 cycles) through converter tube 12SA7.	Amplification of 12SA7 and a.v.c. action.
Quick Check Point Test No. 14 Over-all i.f. section from grid of converter to diode load resistance.	I.f. signal (455kc) modulated at 400 cycles, through 0.05 condenser to stator side of ant. tuning condenser; 'scope across high end of diode load resistor and chassis.	Attenuate i.f. signal to give useful reading on 'scope. Adjust i.f. trimmers for maximum output.	(Pattern 14) Demodulated i.f. signal (400 cycles) through i.f. system.	Over-all operation of extra i.f. portion.
Quick Check Point Test No. 15 Receiver oscillator section.	Same as test No. 14. Change freq. of r.f. signal to 1425 kc (mod. at 400 cycles). 'Scope across voice coil.	Attenuate r.f. signal to give useful reading on 'scope with set operating at max. volume. Adjust oscillator condenser trimmer for maximum output.	(Pattern 15) Receiver output while adjusting osc. trimmer.	Receiver oscillator functioning.
Quick Check Point Test No. 16 R.f. section and over-all receiver performance.	(a) Form loop for r.f. signal from generator (1425 kc mod. at 400 cycles). Couple this loop to receiver loop; 'scope remains across voice coil. (b) Change r.f. signal frequency from generator to 600 kc and repeat.	(a) Vary coupling and attenuation of r.f. signal to give useful reading on 'scope. Adjust antenna condenser trimmer for max. output. (b) Retrim ant. and oscillator trimmers of tuning condenser.	(Pattern 16) Receiver output while adjusting ant. tuning condenser.	R.f. alignment and over-all receiver performance.
Additional Optional Tests (for high-fidelity testing) Test No. 17 I.f. Band-width response curves.	Frequency-swept ("wobbulated") signal from generator (center frequency 455 kc) connected as in steps of Nos. 10 and 12, with sweep-rate sync signal connected to EXTERNAL SYNC. of 'scope. Scope connections at voice coil.	Adjust sweep rate for stationary forward and reverse pattern; adjust i.f. trimmers for best balanced i.f. response.	(Pattern 17) Off resonance response curve.	I.f. alignment and sideband response.
Test No. 18 Over-all frequency response of entire receiver.	R.f. Signal from generator (externally modulated by variable audio oscillator 20 to 15,000 c.p.s.), and coupled to r.f. input of receiver.	(a) With mod. at 1,000 cycles, obtain same pattern as in test No. 16, measuring audio voltage necessary. (b) Increase audio mod. frequency while maintaining same audio voltage; when response falls off, adjust i.f. trimmers slightly for improvement of high-frequency response.	(Pattern 18) Receiver output at variable audio frequencies. (a) about 1000 cycles. (b) at higher frequency.	Receiver response for mod. frequencies from 20 to 15,000 c.p.s.

By I. QUEEN

ANTENNA PRINCIPLES

Part IV—Commercial FM and Television Antennas

AN ANTENNA is a system of conductors which can radiate an electromagnetic field when supplied with r.f. power. The available power is limited by the efficiency and power input to the final r.f. stage. It cannot be increased by the antenna system, if the latter is already correctly matched to the transmitter. However, it is possible to focus the field so that most of the power is radiated in useful directions. This is done by using suitable directional arrays.

The first cost of a highly directional (and usually complex) array, and of its erection, is generally far greater than that of a simpler type. The greater expense is justified because the same useful area can be served with a fraction of the input power required by a simpler antenna.

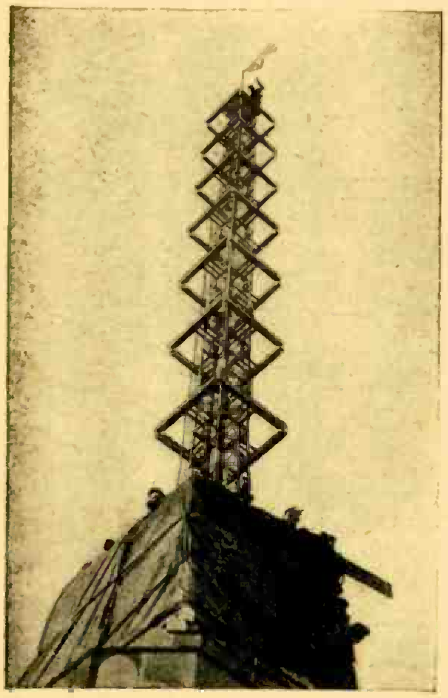


Photo A—Square Loop antenna with gain of 8.

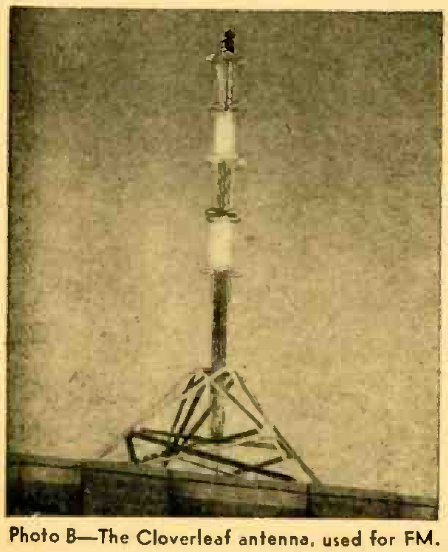


Photo B—The Cloverleaf antenna, used for FM.

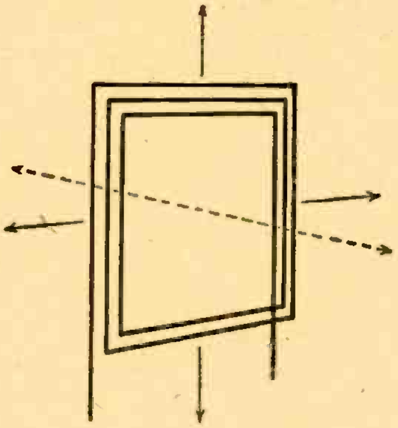


Fig. 1—Directional characteristics of loop.

Major research has therefore been directed by many manufacturers toward the design of efficient antenna arrays for FM, television, and facsimile. The two important requirements are:

1—The radiation field must be limited to the horizontal plane. It should be circular so that the same coverage is obtained in all directions toward the horizon. The transmitting antenna can then be located in the heart of the area being served, and the radiated power used with maximum efficiency.

2—The antenna must be capable of radiating the required wide modulation band. The impedance must be matched throughout the band so that no portion of the band will be attenuated or cut off. This is especially important in television. If the antenna impedance changes with frequency, not only will the output be reduced but there will be reflections of power which lead to multiple and spurious images.

The newly designed antenna systems may be grouped as follows: loops, cylinders, and turnstile types.

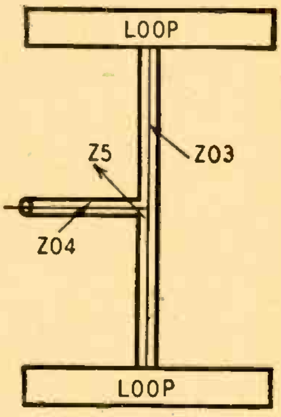
Loop Radiators

Loop antennas have been known and used since the early days of radio. Their directional characteristics, good pickup, and compact arrangement established their use with superheterodynes to receive distant signals. Later they were used in connection with direction finding and airplane communications.

A loop receives and transmits best in directions along its plane (Fig. 1). Its effectiveness decreases progressively as the angle from this optimum increases and is zero perpendicular to the plane. The null is much sharper than the maximum and is generally used in determining directions. The shape of a loop does not matter to any great extent. It may be square, circular, triangular, or any other shape. Choice depends upon simplicity of manufacture feeder arrangement, and other considerations. Loops may be used in combination to concentrate power.

The Square Loop

This antenna (Photo A) is made by Federal Telephone and Radio Corp. It was chosen because of its mechanical ruggedness and simplicity of construction. Each loop consists of 4 end-fed arms. To reduce the Q and thus flatten the frequency response over a wide band, the conductors have a large diameter. This also reduces the impedance so that it is only 1,000 ohms at each end of an arm. The main feeder (coming up



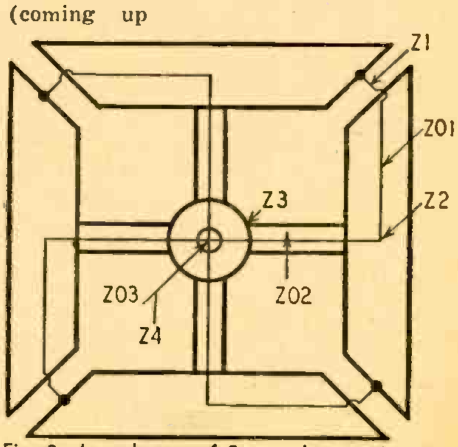


Fig. 2—Impedances of Square Loop antenna.

through the center of a loop) is designed for a standard surge impedance Zo3 of 100 ohms, therefore each branch feeder (Z3) presents an impedance of 400 ohms, since there are four in parallel.

Any impedance is correctly matched to another impedance when they are connected by a quarter-wavelength of transmission line or cable which has a characteristic impedance equal to the square root of their product:

$Z_k = \sqrt{Za\ Zb}$, where Za and Zb are the two impedances and Zk the impedance of the quarter-wave line. In the square-loop antenna the feeder problems are solved as follows. Each branch feeder (400 ohms) must match the impedance of one side of loop Z1 (1,600 ohms). This is done in two steps.

1—Zo2 is designed for a convenient and standard characteristic impedance (determined by its cross-sectional dimensions) equal to 50 ohms. Therefore Z2 should show an impedance of 6.25 ohms, since

$$50 = \sqrt{6.25 \times 400}.$$

2—Having determined Z2, the quarter-wavelength co-axial cable Zo1 must be designed to have a characteristic impedance equal to 100 ohms:

$$100 = \sqrt{6.25 \times 1,600}.$$

The square loop is mounted in a horizontal position on a vertical mast. For greater concentration of power in the horizontal plane, a number of loops are mounted on the same mast, each spaced by a full wave-length and fed in the same phase. Therefore current flows through each loop in the *same direction* at any instant, and a receiving station intercepts equal amounts of power from each loop.

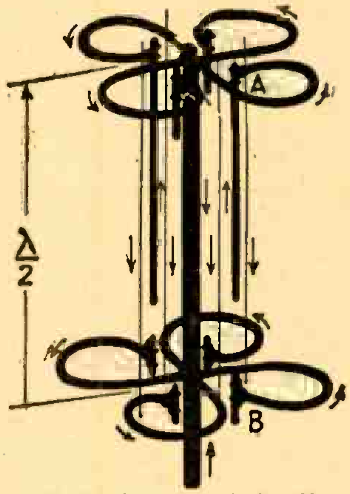


Fig. 3—Electrical design of the Cloverleaf.

The Cloverleaf Antenna

This antenna, made by Western Electric, uses radiating loops which are shaped to facilitate feeding and support. See Photo B. Cloverleaf loops are mounted at intervals of a half wave-length along the mast. Each conductor of a "leaf" is supported and fed by a centrally located 3-inch diameter co-axial cable which is clamped to it. The outer extremity of each radiating conductor is supported by vertical members which form the return feed.

It is known that current reverses at half-wavelength intervals along any wire or cable. To compensate for this effect, each adjacent cloverleaf must be physically reversed (Fig. 3) so that the current through each loop may flow in the same direction at any instant. Thus an additive field is produced.

The characteristics of both types of loop radiators (square loop and cloverleaf) are somewhat similar. Fig. 4 illustrates the gain realized from a multiple bay of cloverleafs and the horizontal field pattern of a 5-element array. Since units of a square-loop antenna are spaced twice as far apart as in the cloverleaf the square-loop's gain is approximately twice as great for the same number of units. Fig. 5 shows how the gain increases with the number of loops in a square-loop array.

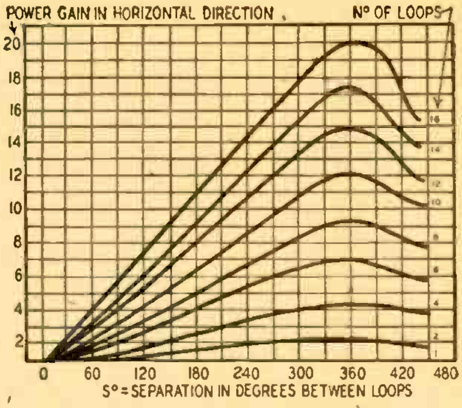


Fig. 5—Gain curves of Square Loop antenna.

Cylindrical Radiators

A mast can be used not only as a support but as the actual radiator as well. For mechanical reasons and to reduce the antenna Q (for a wide modulation band) the mast may be constructed of heavy metal tubing with a large diameter. At FM frequencies a typical resonant section of tubing has a height of 13.5 feet, a circumference of 19.5 inches, and a weight of 350 pounds.

A cylindrical antenna may be considered as composed of an infinite number of circular loops each with an opening at one point at which feeding voltage is applied. This is shown in Fig. 6. The length of each cylindrical section is approximately a wavelength and the circumference is half a wavelength. The vertical slot corresponds to a trans- *(Continued on page 66)*

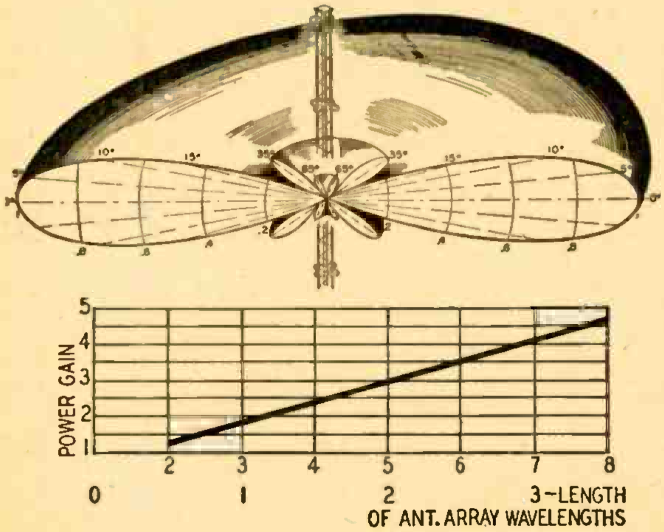


Fig. 4—Field pattern and power gain by units of Cloverleaf array.

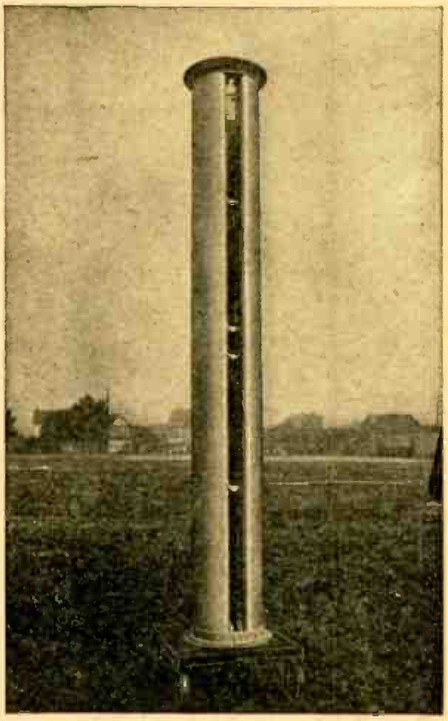


Photo C—Section of Pylon ready to install.

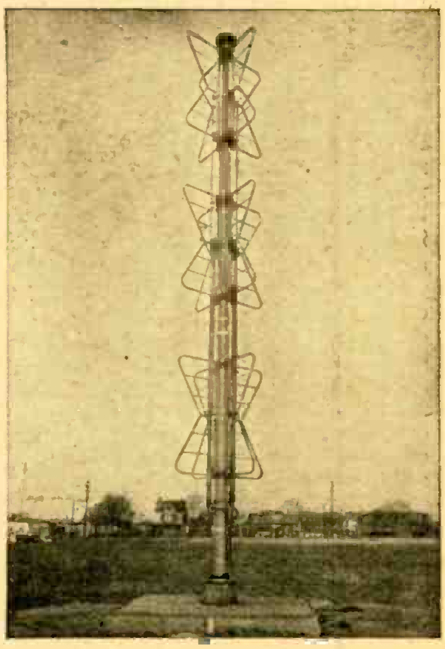


Photo D—The RCA Super-Turnstile antenna.

By ROY FREELAND

BUILDING A TELEVISER

Part II—Putting the Video Section into Operation

DATA for aligning the audio section of the televiser were given in last month's issue of RADIO-CRAFT. In this final installment, aligning and operating instructions for the video section are given along with notes on selection and installation of suitable television antennas.

To align the video i.f. stages, connect one lead of the output indicator through a 0.1-μf capacitor to the output of the video amplifier and the other lead to the chassis. The video i.f. amplifiers must be aligned so that their response curve is similar to that shown in Fig. 1. It is necessary that the response be very small at 8.25 mc to eliminate the accompanying sound i.f. signals from the picture. Similarly the response at 14.25 mc must be very small to keep out sound signals from the adjacent lower-frequency television channel. Note that the i.f. amplifier response at the i.f. frequency, 12.75 mc, is adjusted to be 50 percent of the response over the flat response portion covering most of the desired frequency range.

The first transformer to require adjustment is T4. Connect the signal generator to the grid of V5 through a 50-μμf capacitor. Apply modulation to the signal. While varying the frequency of the signal generator between 8 and 15 mc, note the reading on the output indicator at the various frequencies and adjust the trimmers on transformer T4 until the response roughly corresponds to that shown in Fig. 1. Adjusting trimmer C33 at 8.25 mc will give the high selectivity on the low-frequency side of the response curve. If desired, a rough curve may be plotted between output and frequency as the signal generator is varied from 8 to 15 mc. After transformer T4 has been adjusted, repeat the procedure with transformers T3 and T2, connecting the signal generator in turn to the grid of the second video amplifier tube V4 and then the first amplifier V3. After the rough adjustment of the transformers has been completed, connect the signal generator to the grid of mixer tube V1 and again vary the signal between 8 and 15 mc, at the same time carefully plotting a curve of the over-all response. This curve should be compared with that shown and the alignment touched up as required to make the two curves similar. Video i.f. transformers T5 and T6 are self-resonant and the only adjustment required is to tune the sound traps by adjusting C45 and C49 for minimum output of the video amplifier at 14.25 mc.

After the video i.f. amplifiers have been aligned, the mixer and oscillator stages must be tuned to the desired channel. This may be done in a manner similar to that used with the video i.f. amplifiers if a high-frequency signal generator is available. The signal should be applied to the antenna terminals of the receiver. Since the antenna circuit is balanced (center tap grounded), the ground lead from the signal generator should be connected to the chassis and the hot lead connected to either antenna terminal through a 50-μμf capacitor. The output indicator should be connected to the video amplifier as previously described. The output of the signal generator should be modulated and set to the sound carrier frequency of the channel being tuned. This will be 0.25 mc lower than the high-frequency edge of the channel. Thus for Channel 2 (44 mc to 60 mc) the signal generator would be set at 59.75 mc. After the signal generator is set, the band switch should be placed in the desired position and the oscillator tuned until the modulation tone of the signal generator is heard in the receiver speaker. Although the signal from the common signal generator is amplitude-modulated, it will be possible to hear it in the FM sound unit. The h.f. oscillator is tuned roughly by varying the spacing between the turns of the oscillator coil. Fine adjustment is made with oscillator capacitor C7. After the oscillator is set, the signal

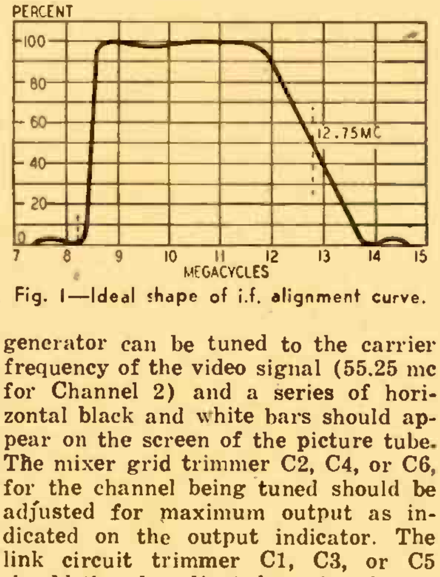


Fig. 1—Ideal shape of i.f. alignment curve.

generator can be tuned to the carrier frequency of the video signal (55.25 mc for Channel 2) and a series of horizontal black and white bars should appear on the screen of the picture tube. The mixer grid trimmer C2, C4, or C6, for the channel being tuned should be adjusted for maximum output as indicated on the output indicator. The link circuit trimmer C1, C3, or C5 should then be adjusted to give the desired input band width for the channel. Perhaps the best way to adjust both the mixer grid circuit and link circuit is to tune in a station and adjust for the best picture results. It will be necessary to adjust the mixer grid circuit and the link circuit alternately until the desired band width is obtained or for best picture results. This last method is the only possible method of adjustment if a high-frequency signal generator is not available.

Operating the Televiser

Operation of the receiver is not difficult after the deflection controls have been adjusted and the r.f. circuits trimmed, if necessary. After locating a station, usually by tuning in the sound signal, the height control R60 and the width control R86 should be adjusted so that the picture raster covers the face of the tube as previously described and has a width-height ratio of 4:3. The positioning controls R90 and R91 should be adjusted to center the picture. With the station tuned in, a maze of lines will probably appear on the screen. Adjust the horizontal hold control R76 until a single picture frame appears on the screen. This frame will probably be moving up or down. Adjust the vertical hold control R56 until the picture locks in. Once these controls have been set no further adjustment will be required unless some of the carbon resistors change value through aging.

The focus control R97 should be adjusted to give a sharp picture. Correct adjustment of the contrast and brightness controls, R3 and R44, respectively, will come through experience. The test patterns transmitted by most television stations before starting their programs will aid in the adjustment of these controls. Test patterns usually consist of a series of concentric circles, the circles varying in shades of gray with the center dot black. The contrast and brightness controls should be adjusted so that each of the various shaded circles can be distinguished.

The receiver should always be turned on and off with the brightness control in its *minimum* position. This is to limit discoloration of the screen by keeping the spot on the picture at minimum brightness when it is not being deflected. It will not be possible to eliminate entirely a spot from flashing on the screen when the receiver is turned off because of the type of d.c. restoration used.

Antenna Installation

Several different types of antennas may be used with the receiver. The lo-

(Continued on page 69)

By MILTON S. KIVER

TELEVISION FOR TODAY

Part X—Vertical and Horizontal Synchronizing Circuits

THE clipper stages produce the vertical and horizontal synchronizing pulses. These must be separated and each transferred to its proper synchronizing oscillator. Since both forms of pulses are of equal amplitudes, separation must be based upon their difference in frequency. This is done readily with R-C filters.

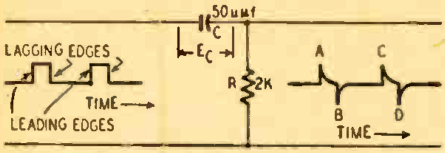


Fig. 1—Effect of high-pass filter on pulse.

A high-pass filter for the horizontal synchronizing pulses is shown in Fig. 1. The square-topped input pulse is applied to the input terminals and a sharply peaked pip A appears at the output terminals. To understand the transition in form, we must consider the action within the network upon the application of the synchronizing pulse.

The initial voltage in the circuit is zero. Upon the application of the leading edge, a short flow of current takes place through the resistor, charging the condenser to the applied voltage. The length of time required to charge the condenser depends upon the time constant (R × C) of the combination. In the horizontal system, the time constant is kept short, permitting the condenser to charge (and discharge) quickly.

The form of the pulse across the resistor is determined by the short time constant and the fact that voltage across a condenser cannot change instantaneously. When the voltage is initially applied across the input terminals, Ec is zero and the resistor receives the full input voltage. The current flowing through the circuit exponentially charges the condenser and lowers the resistor voltage. When the condenser potential equals the applied voltage, current flow ceases. There is no voltage across the output terminals until the lagging edge is reached. At the instant the input voltage decreases to zero, we have the electrical equivalent of a short circuit across the input terminals. The voltage across the condenser is thus placed across the resistor, but in opposite polarity to previous resistor potential (pip B). The reversal occurs because the condenser, in charging, received a voltage that opposed the applied voltage. The duration of the discharge will again depend upon the time constant of the filter. Pips C and D are produced by the second input pulse.

Pips A and C are one horizontal line apart, as are B and D. However, A and B or C and D are less than one line distant and only one of each group is useful in controlling the synchronizing oscillator. In practice the leading edge of each pulse acts as the control, the second pip having no effect.

Thus far, only the horizontal pulses have been considered. Since both forms of pulses are applied across this network, let us determine what occurs when the equalizing pulses (to be explained shortly) become active. At the leading and lagging edges of each equalizing pulse, a pip of voltage will appear across the output terminals. This is shown in Fig. 2-b. Note that two sets of equalizing pips will appear during one horizontal line (Fig. 3) because the spacings of the equalizing pulses are

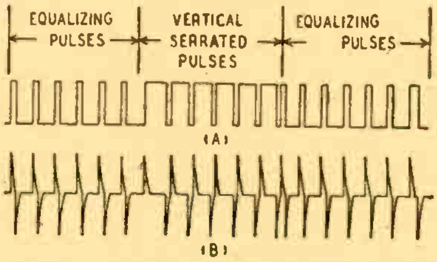


Fig. 2, a—Incoming equalizing and vertical pulses; b—pips at the high-pass filter output.

one-half the horizontal pulses. However, the synchronizing oscillator is so designed as to be unresponsive to any pips except those which occur at approximately 1/15,750 sec apart.

During the following interval when the long serrated vertical pips are active, current flows for a short time in the filter of Fig. 1 only when there is a rise or a decrease in voltage. Throughout the long interval between rise and fall of voltage in the vertical pulse, no output is obtained from the horizontal filter. Therefore the vertical pulse is serrated. Every other serration produces a pip which can be (and is) utilized to control the horizontal oscillator. Thus, there is no loss of control when the vertical pulse is active. In Fig. 3-a, all pips marked A are active in controlling the horizontal synchronizing oscillator. Note that all are evenly spaced, and differ by 1/15,750 sec. These conditions are found only when the field ends after a full line. Fig. 3-b shows the situation when the field ends on a half line. Note that now the same equalizing and serrated pulse pips are not active in controlling the horizontal oscillator. Because of the difference in field ending, the control has shifted to those intermediate pips which were inactive in Fig. 3-a. However, the shift has in no way interfered with the timing in the control pips. This shift, from field to field, illustrates why all the equalizing and vertical pulses are designed to produce pips twice in one horizontal line interval.

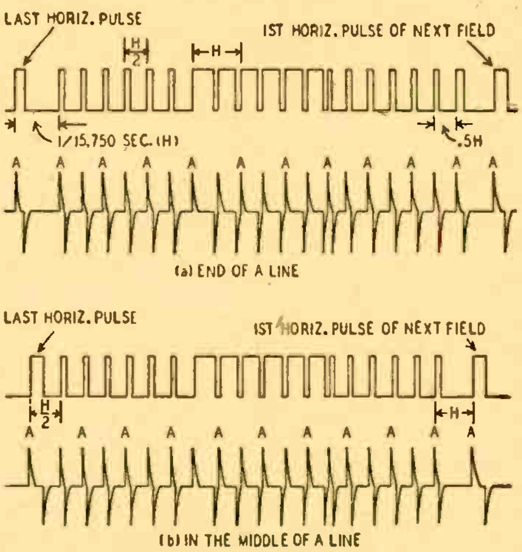


Fig. 3—Conditions during vertical pulses. The pips labelled "A" control the horizontal sweep oscillator.

For the vertical pulse separation, the low-pass filter shown in Fig. 4-a is used. From the value of the components we see that the combination has a long time constant. Hence, rapid changes in voltage, such as are obtained from the horizontal and the equalizing pulses, are without effect. The voltage across the condenser begins to build up only during the interval that the serrated vertical pulses are active. At the proper instant, the condenser voltage reaches a value high enough to trigger the vertical synchronizing oscillator.

The purpose of the equalizing pulses can be seen from a comparison of the conditions existing at the start of the vertical serrated pulses after each field. See Fig. 5. In each instance the equalizing pulses are omitted. When the serrated pulses start in the middle of a line, there is some *small* voltage still remaining on the condenser from the last horizontal pulse. This is not true when the vertical pulses start at the end of a line, for now sufficient time has elapsed since the last horizontal pulse so that the voltage across con-

(Continued on following page)

denser C of Fig. 4-a is zero. Because of this slight but significant difference, the vertical oscillator will trigger sooner in the instance illustrated in Fig. 5-b. The result, visually, is the pairing of lines due to upward displacement of one field

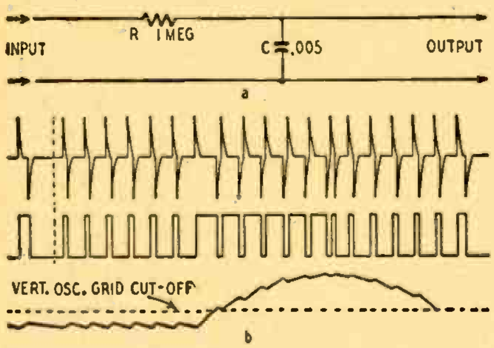


Fig. 4, a—Low-pass filter for separation of vertical from horizontal pulses; b—Waveform of the rise in voltage across the condenser due to vertical pulses.

with respect to the other. With equalizing pulses, the charge on the output condenser before the insertion of the vertical pulses is the same in all instances and the pairing of lines does not occur.

In summary, then, the vertical pulses are inserted into the signal, once in the middle of a line and, in the following field, at the end of a line. The electrical charge on the condenser feeding the vertical oscillator must be the same in each field if identical triggering of this oscillator is to occur. Without the equalizing pulses acting as a buffer, there would be more charge on the condenser when the vertical pulse begins to act in the middle of a line than when it comes at the end of a line. Addition of the charge arising from the vertical pulse to the previous small remainder would cause a premature triggering of the vertical oscillator. To obtain the same triggering, we add the same number of equalizing pulses before *every* series of vertical pulses. Condenser charge, in all instances before each vertical pulse, will be identical.

Synchronizing Oscillators

Once the pulses are separated, they are fed to their respective oscillators

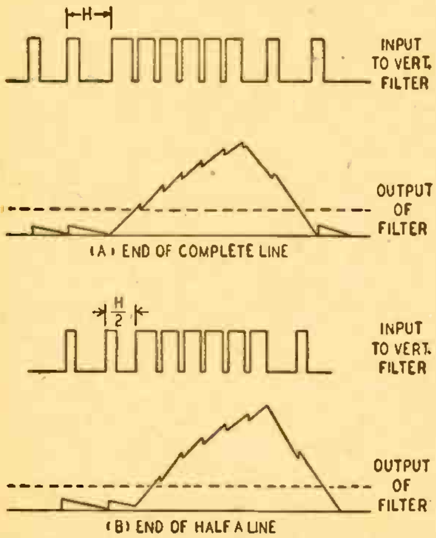


Fig. 5—Difference in voltage before vertical pulse when no equalizing pulses are used.

for control. Each oscillator, in turn, controls the charge and discharge of a condenser which generates the saw-tooth voltage or current. A saw-tooth voltage across a pair of deflecting plates or a saw-tooth current through a deflecting coil will properly guide the electron beam across the face of the cathode-ray tube.

The Blocking Oscillator

Two types of oscillators have been almost universally employed for synchronization; the blocking oscillator and the multivibrator. Not only are these oscillators readily controlled by applied pulses, but they are also characterized by sharp changes in plate current which makes condenser discharging fairly rapid. Oscillators which have currents flowing throughout their entire cycle would not be suitable for saw-tooth wave generation.

A blocking oscillator is shown in Fig. 6. Feedback between plate and grid occurs through the transformer. To analyze its operation, consider what occurs when a slight disturbance causes the grid voltage to become more positive. The plate current increases and, if the connections to the transformer are properly oriented, the feedback will drive the grid even more positive. The cumulative rise of plate current and positive grid voltage will continue until grid current flows, charging C1 and quickly biasing the tube to cut-off. Thereafter no current flows in the plate circuit until the accumulated negative charge at the grid condenser leaks off through R1 and R2 back to the cathode. How long this takes depends upon the time constant of the resistors and the condenser. When current is once more permitted to flow, the same rapid rise in current will ensue, once again eventually driving the grid to cut-off. Thus, the frequency of the plate pulses is entirely dependent upon the R-C network in the grid. By making one of these components variable, we can control the frequency of the oscillator. The control, because of its effect on the image, is known as the *hold* control.

Grid and plate wave forms are also shown in Fig. 6. Note that the plate current rise and fall occurs within a relatively short time interval. Throughout the remainder of the cycle the tube is held beyond cut-off.

To control the frequency of this oscillator effectively, the synchronizing pulses should be applied to the grid just prior to the instant when the voltage on the grid permits the flow of plate current. The point of insertion of the synchronizing pulse is indicated in Fig. 6-b. A sharp positive pulse at this moment will raise the grid voltage above cut-off and start the flow of plate current. If the oscillator free-running frequency is too far off, the synchronizing pulses will be unable to assume and maintain control. Should this occur, the "hold" potentiometer can be adjusted, until the oscillator can be locked in.

The grid voltage characteristic indicates why voltages reaching the grid of the oscillator during the most negative portions of its path are not effective in synchronizing the oscillator. A pulse must have enough amplitude to bring the grid out of cutoff. Unless this is done, there is no reaction from the oscillator. However, the oscillator becomes increasingly vulnerable to interfering pulses which arrive slightly before the instant proper synchronizing pulse is applied. Such interference will cause a premature triggering of the oscillator, and the following line will be misplaced on the screen.

To generate a saw-tooth wave, using the oscillator, we place the proper condenser in the plate circuit of the blocking oscillator. See Fig. 7. When the tube is cut off, the B-plus voltage of the power supply is applied directly to the condenser through the series resistors. Hence, during the entire interval that the tube is nonconducting, the condenser is slowly charging. If the power-supply voltage is relatively high and the time constant of R3 + R4 and C long compared to oscillator frequency, the voltage rise across the condenser will be essentially linear. When the plate current flows again, the rapid rise of positive voltage on the grid reduces the tube's resistance to a small value and the condenser quickly discharges. This will be recognized as the retrace interval that occurs when the synchronizing pulse triggers the oscillator. Thereafter the tube is cut off and the charging of the condenser starts anew. A variable resistor R4 in the charging path of the condenser permits control of the amplitude of the voltage build-up across the condenser. This, in turn, will regulate the swing of the electron

(Continued on page 60)

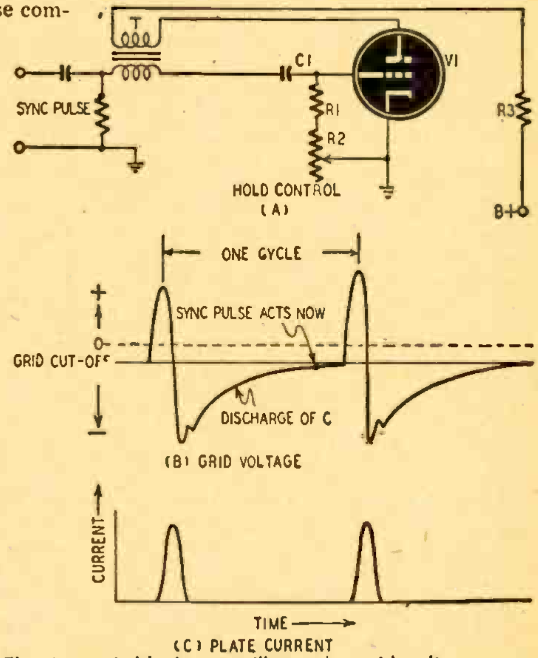
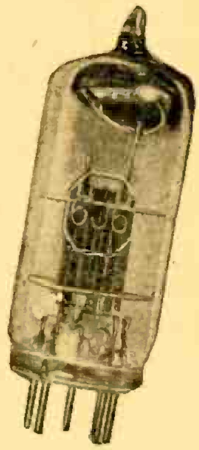


Fig. 6, a—A blocking oscillator; b—grid voltages; c—plate current pulses during one cycle.

By EDWARD D. PADGETT

WORKING ON 50 AND 420 MC



Two Experimental Transmitters for V.H.F. and U.H.F.

THE WRITER built two special very-high-frequency circuits in 1944 as part of a research project on remote control instruments. Having no idea that these circuits would be of future interest to anyone, photographs of the equipment were not made and the apparatus has since been dismantled. Despite this handicap the material may still be interesting.

The first circuit is for the 50-60-mc band. The second, using one of the latest tube developments, has a range of 400-500 mc. This includes the 420-450 mc amateur band and the new citizens' band. Both circuits stood up very well under exacting conditions, including vibration and shake-table tests, to which they were subjected to determine the amount of abuse the apparatus could withstand. The approximate cost for both circuits is $15.00, a small investment for the return in knowledge of u.h.f. techniques.

Conventional parts and circuits are used in v.h.f. circuits from approximately 30 mc to 100 mc. However, due to distributed capacity effects, the lengths of leads and the location of components are very important. Above 100 mc slightly different provisions must be made. In most v.h.f. and u.h.f. applications lumped L-C circuits are replaced by quarter-wave lines along whose length the L and C are distributed, and whose Q is high enough for the desired frequency. For most v.h.f. applications special low-loss insulating materials are used. Power-supply lines become "hot" to r.f. and necessitate much shielding and filtering. The conventional Hartley oscillator becomes troublesome above 50 mc. Filament and plate power-supply cables are "hot" to r.f. (they oscillate), and body capacitance causes the oscillator to change frequency. The Colpitts oscillator is free of this difficulty and provides an economical circuit of very good stability. This points up the theory: "the more capacity in a circuit the greater the stability" (a low L/C ratio means a high Q).

A 50-Megacycle Circuit

Fig. 1 shows this Colpitts circuit. This oscillator uses two 6C4 tubes connected in parallel. Some readers may criticize this arrangement as having more parasitics than a single tube. These are not troublesome. Two 6C4s in parallel form a very stable and practical circuit. The output is between 8 and 10 watts which is adequate for ordinary purposes.

Mobile c.w. operation can be undertaken immediately with a vibrator, dynamotor, or battery pack as power supply. The Electronic Labs No. 605 vibrator, the No. 4201B Radiart vibrator, or the Pioneer E1W272 dynamotor, all operate from a 6-volt storage-battery source and are suitable for this circuit. The filaments of the 6C4 operate on 6.3 volts (a.c. or d.c.).

In time a modulator may be developed from such tubes as the pentodes 6K6-GT or 6AQ5 and added to the oscillator. The 6AK5 is also suitable but manufacturers say that, when present military surpluses of this tube are depleted, it will be hard to get. Miniature-button, 7-pin, bakelite sockets are best (heat from this circuit melts polystyrene sockets). Mount these sockets on the chassis so that their pins clear each other by about ⅜ inch. Miniature shield cans may be used if desired, and one of the small chassis will suffice for operation on c.w. only; a larger chassis can be used if modulation is to be added. To permit the use of the shortest possible leads, orient the sockets so that the grid pins are closest together. The other leads will then be reasonably short, too. The tank inductance is made up of four turns of No. 18 tinned wire, spaced 3/16 inch on a 3-inch piece of 1-inch lucite (or polystyrene) rod (see Fig. 2-a). If this coil is located in the center of the lucite rod and grooves cut in the rod, by means of a lathe, to a depth of ¼-inch, the tank inductance can be countersunk into the coil form and the antenna coupling coil, of two turns of No. 16 tinned wire, may be mounted on the outside of the form (Fig. 2-b). Then the coil form can be mounted over the tube sockets on 2¼ x ⅜ x 0.045-inch brass brackets as shown in Fig. 2-c. Both these coils are made from bare wire.

If the tank condensers C1 and C2 are mounted in the same plane to clear the coil form by ½-inch, all leads will be sufficiently short. Do the necessary tube wiring before mounting the coil form and tank condensers. The fixed condenser should be of the silver ceramic type. The variables were LC1644 Tiny Mites.

Use a lowered plate voltage when ad-

(Continued on page 36)

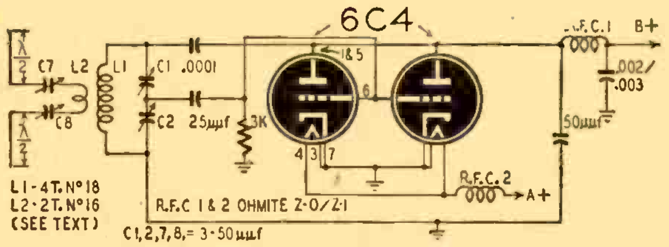


Fig. 1—Circuit diagram of 50-megacycle experimental transmitter.

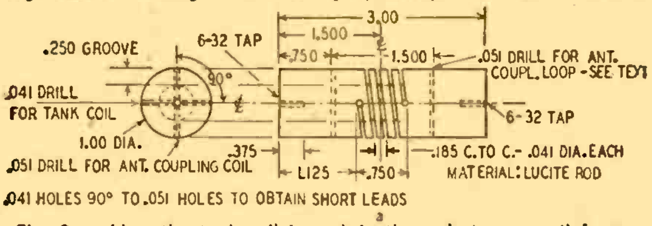


Fig. 2-a—How the tank coil is sunk in the polystyrene coil form.

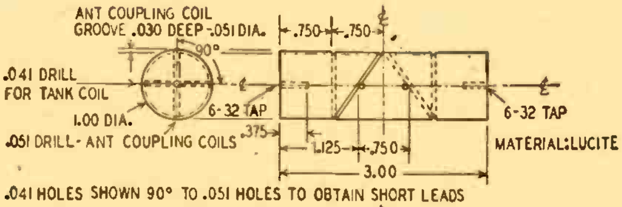


Fig. 2-b—The antenna coil is wound on the surface, over the tank.

justing the circuit. Then gradually increase this to about 260-280 volts with a d.c. plate current of approximately 40 ma. Operating the tubes at 300 volts at 50 ma will reduce their life span.

A number of antenna combinations are available. The one illustrated is conventional for a full-wave antenna. An interesting experiment is to make one section of the antenna ¼ and the other ¾ and substitute a 25-μμf and a 75-μμf Tiny Mite for the two 50-μμf units.

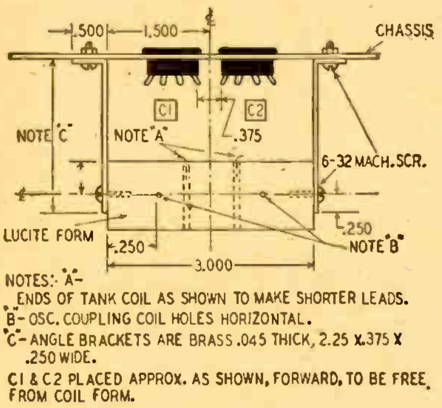


Fig. 2-c—Mechanical layout of the 50-mc set.

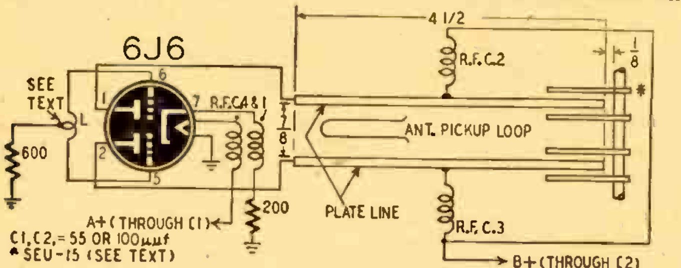


Fig. 3—Special long-lines oscillator circuit for 420 megacycles.

A 450-Megacycle Oscillator

As operation gradually shifted to higher and higher frequencies the 6C4 underwent a change in the laboratories of the tube manufacturers. The result was the development of the 6J6 Twin Triode (see photograph), a miniature 7-pin tube, which is the heart of some of the wartime radar instruments. This tube is now available to the amateur and provides the basis for the second circuit, the foundation of another good ham rig.

The frequency range of this 6J6 oscillator is from approximately 400 to 500 mc. Like the 6C4 this circuit can be used immediately for c.w. operation and the amateur can add a modulator at his leisure. The modulator tubes mentioned for the 6C4 can be used with the 6J6. Plate modulation is conventional in u.h.f circuits.

The r.f. circuit employing this 6J6 twin triode is shown in Fig. 3. It is a symmetrical push-pull affair. In effect this is a tuned-plate tuned-grid oscillator. A small loop of No. 18 tinned (bare) wire, marked L in the diagram, about ¼-inch in diameter, is used to connect grid pins 5 and 6 of a polystyrene, miniature-button, 7-pin socket. This loop provides the inductance in the grid circuit while the interelectrode capacitance provides the proper L-C ratio. The same analogy holds for the plate circuit; the tube oscillates through the plate interelectrode capacitance and the distributed L-C of the plate lines. The frequency is controlled by means of a capacitive load on the plate lines. The unusual plate lines consist of pieces of 4½ x ⅞ x 1/16-inch; *brass strap;* their length for the desired frequency range was determined by trial and error. This is a deviation from conventional plate lines of brass or copper *tubing.* For ideal operation these plate lines should be silver-plated, but if this is impractical the experimenter must be sure that the strap is thoroughly cleaned before mounting. The plate lines are separated by ⅞-inch and terminate in a modified National SEU-15 frequency condenser; other condensers of the SEU series may be used if modified. A standard 180-degree dial attached to the condenser shaft with an insulated coupling permits calibration and tuning by means of a single control.

(Continued on page 57)

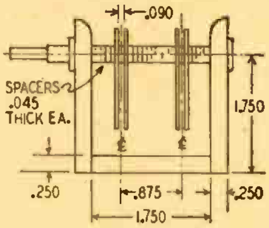


Fig. 4-a—How SEU-15 is modified for use in the circuit.

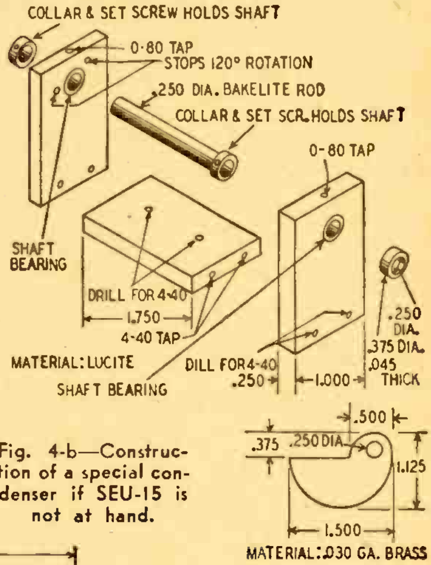


Fig. 4-b—Construction of a special condenser if SEU-15 is not at hand.

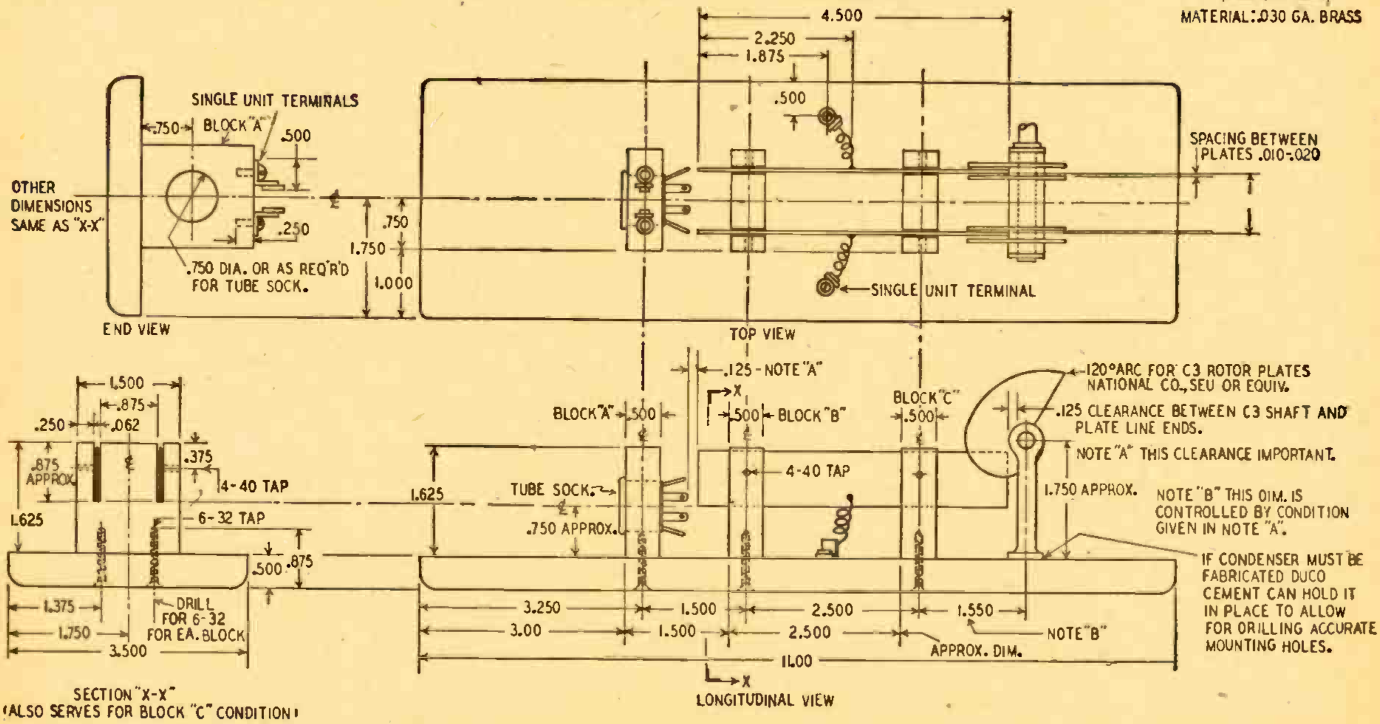
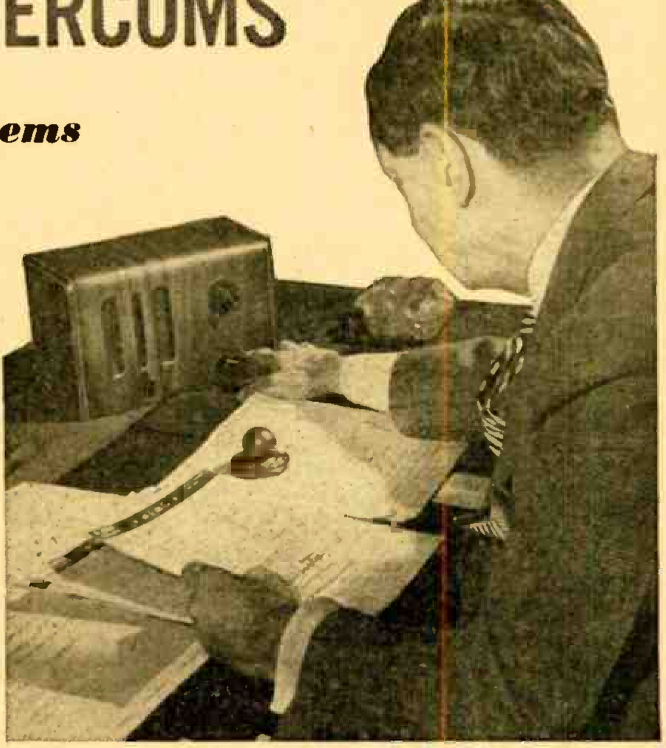


Fig. 5-a (top) and 5-b (bottom)—Top, side, end and sectional views of the 420-megacycle transmitter, showing detail of the long lines.

By RICHARD H. DORF

MULTI-STATION INTERCOMS

Part I — Master-to-Master Systems



INTERCOMMUNICATION systems are useful in many homes and almost indispensable in large offices. Any establishment which needs communication facilities between its various parts is a potential user of an intercom system.

As a spare time venture, making, installing, and servicing intercoms can prove to be both interesting and profitable. They practically sell themselves. This article describes the construction of three different types of systems. Next month's article will discuss installation and trouble shooting.

There are two basic types of intercom systems: the "master-to-master" and the "master-to-remote." In the first type, each station may communicate with any other station. In the second type, there is only one master. It can communicate with any of the other stations or "remotes," but a remote can talk only with the master, not with other remotes. There are many variations of these systems, including both masters and remotes, but only the basic types will be considered.

The most important consideration is always the master station or stations. Its requirements are easily met: 1—utmost possible simplicity, electrically and mechanically, 2—operation from 117-volt a.c. or d.c. mains, 3—use of standard parts only, 4—reliability, 5—reasonably small size, and 6—professional appearance.

The fifth and sixth requirements are conveniently met by the small finished wood cabinets which are available. The photograph shows a master station mounted in a typical cabinet, 7x10½ x4¾ inches, available through jobbers and mail-order houses. While it is not heavily built, it looks good and will stand up well in use. The chassis is made up out of aluminum by a machinist. The cost is higher than for a standard chassis, but its convenience and appearance make up for it. It is entirely practical to cut a piece of metal to size and bend it to form the chassis in the shop, the difficulty depending on the thickness of the metal. Alternatively, a flat piece may be used for the chassis deck and plywood used for the front and rear aprons.

A Master-to-Master System

Fig. 1 shows a complete master station which meets requirements 1, 2, 3, and 4 admirably. It is a 2-tube amplifier powered by a simple half-wave rectifier operated directly from the line. The loudspeaker, as is usual in these systems, acts both as speaker and microphone, and there is a minimum amount of switching for the user.

The 6SJ7 is a voltage amplifier and the 25L6 the power amplifier. The tubes are resistance-coupled. The input transformer primary is 4 ohms, as is the secondary of the output transformer. In fact, the same type of transformer may be used for both purposes, although the special intercom input transformer made by some manufacturers is preferable. If an output transformer is used for the purpose, the highest-impedance plate winding available is best.

No volume control has been included. The volume is about right for most locations and the omission increases simplicity.

No filter choke is used in the power supply. The hum level is surprisingly low with only the filter resistor. Again, space is saved, as well as cost. The series filament resistor is in the line cord. Universal line-cord resistors can be purchased for very small cost and will provide any needed value.

Fig. 2 shows a switching diagram for a master-to-master system, with the amplifiers themselves shown in block form only. This particular system accommodates five stations.

One side of each speaker, input transformer primary, and output transformer secondary is common. These commons are connected together throughout the system and only the "high" side of each need be switched.

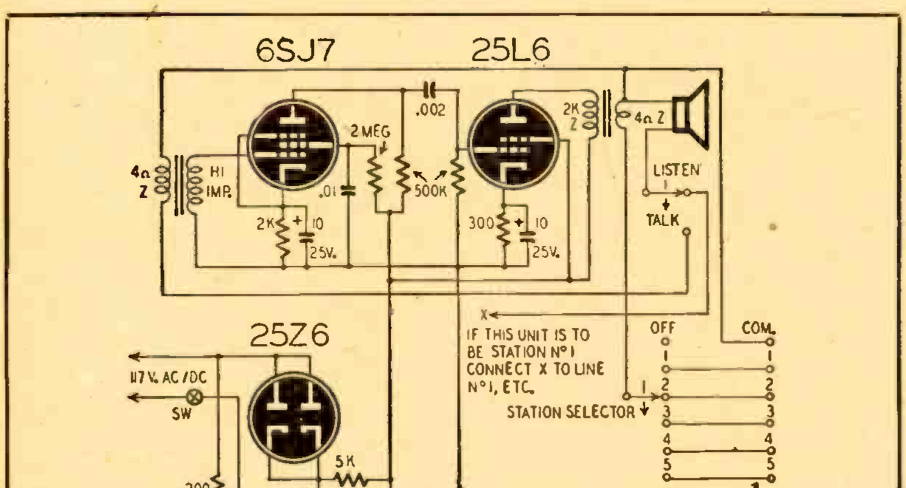


Fig. 1—One of the identical units in a master-to-master intercommunication system.

(Continued on page 77)

WORLD-WIDE STATION LIST

Edited by ELMER R. FULLER

RECEIVING conditions have not been exceptional for the past several weeks, but a few catches are worth mentioning. The Palestine stations have been heard very fine business from 0000 to 0115 and 0500 to 1315 EST, on both 6.135 and 6.170 megacycles. No call is used. The station is located at Jaffa. Another frequency, 11.720 megacycles, is not heard in this country. ZAA in Tirana, Albania, comes in like a house on fire on 7.850 megacycles from about 1445 to 1630 daily. Algiers is heard best now on 11.840 megacycles at 1100 to 1300, and often at 1600 to 1800.

The Antarctic Expedition is being heard on several frequencies. Call used is NAVE when their transmission is from the flagship Mount Olympus. Frequencies they intend to use are 17.820, 16.170, 15.940, 12.260, 9.670 and 9.280 megacycles. The first three are used until noon, and the others after noon. Reports on their reception will be greatly appreciated.

Amateurs from all over the globe are beihg heard on the ten- and twenty-meter bands, and a few on the eighty-meter band. Any country you wish to mention can be found on either ten or twenty sooner or later.

How do you like the new time system? Do you think it is an improvement over the old method of using am and pm, and often making mistakes when putting it in print? Let us have your views on this. Also, would you be interested in obtaining a short reception dope card each week or two weeks? This was done a few years ago, and we have been thinking of taking it up again. If there is sufficient interest it will be re-established.

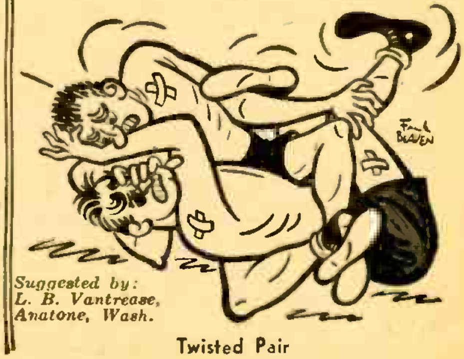
This service would be free of charge to active shortwave reporters to this department, would include latest dope on receiving conditions, and would be mailed either every week or every two weeks. If you are interested, drop us a letter. All correspondence should be sent to: Elmer R. Fuller, Shortwave Editor, c/o RADIO-CRAFT, 25 West Broadway, New York 7, N. Y.

All schedules are Eastern Standard Time. (24-hour clock system)

Freq.	Station	Location and Schedule
7.260	JVW	TOKYO, JAPAN; 1500 to 0830.
7.270	VUD8	DELHI, INDIA; 0600 to 0700; 1115 to 1315; 1830 tc 1915; 2100 to 2200.
7.280	VLC8	SHEPPARTON, AUSTRALIA; 1015 to 1045.
7.280	JLW	TOKYO JAPAN; 0200 tc 0800.
7.290	VUD3	DELHI, INDIA; 2040 to 2245.
7.290	ZOY	ACCRA, GOLD COAST; 1045 to 1300.
7.290		ATHENS, GREECE; 1430 tc 1530.
7.300		MOSCOW, U.S.S.R.; 1300 to 1800; 1815 tc 2100.
7.310	YSN	SAN SALVADOR, SALVADOR; 1300 to 1500; 1900 to 2300.
7.320	GRJ	LONDON, ENGLAND; 0000 to 0015; 0645 tc 0700; 1045 to 1815.
7.380	HEK3	BERNE, SWITZERLAND: 1000 to 1045, 1510 tc 1530.
7.570	EAJ43	SANTA CRUZ, CANARY ISLANDS; 0630 tc 0800 1100 tc 1200; 1230 to 1800.
7.640	KU5Q	GUAM; 0400 to 1200.
7.850	ZAA	TIRANA, ALBANIA; 1400 to 1800.
7.860	SUX	CAIRO, EGYPT; 1200 to 1600.
7.950		ALICANTE, SPAIN: 0730 to 0930; 1530 to 1800.
8.030	FXE	BEIRUT, LEBANON; 0015 tc 0115; 0525 to 0630; 1000 tc 1600.
8.560	AFN	MUNICH, GERMANY; 0400 to 1200.
8.700	COCO	HAVANA, CUBA; 0700 to 2330.
8.720	COJK	CAMAGUEY, CUBA; 2000 to 0030.
8.830	COCQ	HAVANA, CUBA; 0530 to 0030.
8.950	COKG	SANTIAGO, CUBA; 1830 tc 2325.
9.030	COBZ	HAVANA, CUBA; 0700 to 0100.
9.080	CNR3	RABAT, MOROCCO; 0100 tc 0330; 1300 to 1700.
9.120		BALIKPAPAN, BORNED; 0700 to 0935.
9.160	CR6RB	BENGUELA, ANGOLA; 1330 to 1430.
9.180	HEF4	BERNE, SWITZERLAND.
9.210	HI2G	CIUDAD TRUJILLD, DOMINICAN REPUBLIC; 0530 to 0830; 1300 to 1530; 1700 to 1845; 1930 to 2230.
9.230	COBQ	HAVANA, CUBA; 0800 to 1200; 2000 to 2200.
9.270	COCX	HAVANA, CUBA; 0700 to 0030.
9.360		CETINJE, YUGDSLAVIA.
9.370	EAQ	MADRID, SPAIN; 1500 to 1700; 1830 to 2100.
9.380	CDBC	HAVANA, CUBA; 0700 to 2400.
9.380	OTC	LEOPDLDVILLE, BELGIUM CONGO; 0000 to 0200; 1045 to 1600.
9.420		BELGRADE, YUGOSLAVIA; 0000 to 1230; 1630 to 0845; 1000 tc 1045; 1110 to 1125.
9.340	HBL	GENEVA, SWITZERLAND: 1300 to 1500.
9.440	FZI	BRAZZAVILLE, FRENCH EQUATORIAL AFRICA; 0000 to 0130; 1100 to 2020.
9.460	TAP	ANKARA, TURKEY; 1000 to 1615.
9.470	CR6RA	LDUANDA, ANGOLA; 0115 to 0230; 0630 to 0745; 1400 to 1530.
9.480		MDSCDW, U.S.S.R.; 1500 to 1700; 1830 tc 2100; 0000 to 0100; 0530 to 0815; 1100 to 1130.
9.500	XEWW	MEXICD CITY, MEXICO; 0800 to 0200.
9.500	OIX2	LAHTI, FINLAND; 1100 to 1600.
9.510	JLG2	TOKYO, JAPAN; 0300 to 0830.

Freq.	Station	Location and Schedule
9.520	VLW7	PERTH, AUSTRALIA; 0530 to 1030; 1700 to 2045.
9.520	ZRG	JDHANNESBURG, SOUTH AFRICA; 0300 to 0700.
9.520	OZF	COPENHAGEN, OENMARK; 1300 to 1800.
9.520	JLU2	TOKYO, JAPAN; 0600 to 1200.
9.530	SBU	STOCKHOLM, SWEDEN; 0130 to 0145; 1330 to 1700; 2000 tc 2100.
9.540	VLR	MELBOURNE, AUSTRALIA; 1620 to 1900; 2045 to 0220.
9.540	LKJ	OSLO, NORWAY; 0200 to 0230; 0445 to 1700.
9.540	CJCA	EDMONTON, CANADA; 0815 to 0200.
9.540		ALGIERS, ALGERIA; 1230 to 1700.
9.550	XETT	MEXICO CITY, MEXICO; 0700 to 0100.
9.550		PARIS, FRANCE; 0130 to 0145; 0530 to 0615; 0630 to 0800; 0915 to 0930; 1145 to 1615; 1630 to 1730; 1745 to 1830.
9.560		SINGAPORE, MALAYA; 0315 tc 0515; 0530 to 1100.
9.560		KOMSOMOLSK, U.S.S.R.; 0100 to 0930; 1100 to 1400; 1545 to 1650; 1700 to 1830.
9.580	GSC	LONDON, ENGLAND; 1100 to 1315; 1330 to 1415; 1430 to 1530; 1615 to 2300; 2345 to 0030.
9.580	VLG	MELBOURNE, AUSTRALIA; 1100 to 1200.
9.590	VUD4	DELHI, INDIA; 0030 to 0100; 0200 to 0400; 0430 to 0515; 0900 to 1230.
9.590	PCJ	HUIZEN, NETHERLANDS; 1400 to 1500; 1745 to 1815; 2000 to 2200.
9.600	XEYU	MEXICO CITY, MEXICO.
9.600	GRY	LONDON, ENGLAND; 1800 to 2230; 2300 to 0030; 1230 to 1600.

RADIO TERM ILLUSTRATED



Suggested by: L. B. Vantrease, Anatone, Wash.

Twisted Pair

9.610	ZRL	CAPETOWN, SOUTH AFRICA: 0300 to 0700; 0900 to 1030.
9.610	ZYC8	RIO DE JANEIRO, BRAZIL: 1500 to 2200.
9.610	VLC6	SHEPPARTON, AUSTRALIA; 0830 to 1200.
9.620	XGNC	KALGAN, CHINA; 0400 to 0815.
9.610	TIPG	SAN JOSE, COSTA RICA; 0700 to 2330.
9.620	CXA6	MONTEVIDEO, URUGUAY; 1530 to 2100
9.620	GWO	LONDON, ENGLAND; 0045 to 0130; 0200 to 0300; 0600 to 0630; 0700 to 0900; 1045 to 1400; 1700 to 2030.
9.630	CKLO	MONTREAL, CANADA; 1600 to 1800.
9.640	GVZ	LONDON, ENGLAND; 1500 to 1730; 1800 to 2230; 0100 to 0500.
9.650	XGOY	CHUNGKING, CHINA; 0630 to 1030.
9.650	KRHO	HONOLULU, HAWAII; 0400 to 1100.
9.650		MOSCOW, U.S.S.R.; 1100 to 1220; 2200 to 2235.
9.670	VUD4	DELHI, INDIA; 0000 to 0130; 0200 to 0400; 0430 to 0515; 0730 to 0745; 0800 to 0830; 0845 to 1230.
9.680	HVJ	VATICAN CITY; 1200 to 1330.
9.680	XEQQ	MEXICO CITY; MEXICO; 0700 to 0045
9.680	VLB2	SHEPPARTON, AUSTRALIA; 0900 to 1100.
9.680	EQC	TEHERAN, IRAN; 1200 to 1430.
9.680	LRAI	BUENOS AIRES, ARGENTINA; 1600 to 1630.
9.700		FORT DE FRANCE, MARTINQUE; 0900 to 1245; 1600 to 1610; 1730 to 2030.
9.710		MOSCOW, U.S.S.R.; 2300 to 0730.
9.720	PRL7	RIO DE JANEIRO, BRAZIL; 0430 to 0600; 1415 to 1445; 1500 to 2100.
9.730	XGOA	CHUNGKING, CHINA; 0900 to 1030.
9.730	CSW7	LISBON, PORTUGAL; 1900 to 2000.
9.740	OTC	LEOPOLDVILLE, BELGIAN CONGO; 1300 to 2015.
9.820		VIENNA, AUSTRIA; 2345 to 2030.
9.820	GRH	LONDON, ENGLAND; 1215 to 1600; 1700 to 2300.
9.830	COBL	HAVANA, CUBA; 0715 to 0045.
9.860		MOSCOW, U.S.S.R.; 2200 to 0200; 0830 to 0930; 1000 to 1200.
9.900	ZTJ	JOHANNESBURG, SOUTH AFRICA; 0315 to 0715.
9.930	SVM	ATHENS, GREECE; 1300 to 1800.
9.960	HCJB	QUITO, ECUADOR; 0545 to 0845; 1200 to 2230.
10.000	WWV	WASHINGTON, D. C.; U. S. Bureau of Standards; frequency, time, and musical pitch; broadcasts continuously day and night.
10.000	XGOL	FOOCHOW, CHINA; 0400 to 1000.
10.220	PSH	RIO DE JANEIRO, BRAZIL; 1700 to 1800.
10.730	VQ7LO	NAIROBI, KENYA; 0500 to 0600; 0830 to 0915; 0945 to 1100.
10.780	SDB2	STOCKHOLM, SWEDEN; 1100 to 1720.
11.040	CSW6	LISBON, PORTUGAL; 0900 to 1130; 1230 to 1500; 1600 to 1800.
11.090		PONTA DEL GADA, AZORES; 1500 to 1600
11.630		MOSCOW, U.S.S.R.; 1930 to 0300; 0600 to 0800; 0830 to 1300.
11.650	XTPA	CANTON, CHINA; 0400 to 0915.
11.680	GRG	LONDON, ENGLAND; 0600 to 0645; 0700 to 0900; 1000 to 1130; 1145 to 1200; 1230 to 1430.
11.690	XORA	SHANGHAI, CHINA; 1830 to 2400; 0300 to 0930.

FCC SETS UP RULES FOR CITIZENS RADIO BAND

Citizens radio has been put on an established basis with the issuance of a set of regulations and specifications by the Federal Communications Commission. Two types of transmitters are contemplated: Class A, with a frequency deviation of not more than .02 percent; and Class B, with a frequency deviation not greater than 0.2 percent. Class A transmitters will probably be permitted in any part of the 460- to 470-mc band, unless 460-462 megacycles is reserved to fixed stations. Class B transmitters are to be adjusted to operate on a frequency within 0.2 percent of 465 mc.

Controls for frequency adjustment shall be accessible from outside the case unless specifically approved by the FCC.

Power is limited to 50 watts, and the bandwidth of a transmitter to 200 kc.

No manufacturer has yet reported success in constructing equipment suitable for use in the band, but it is felt that the setting up of specifications by the FCC will hasten research in this direction.

NEW RADAR FOR AIR SAFETY

(Continued from 22)

the aircraft regardless of barometric pressure is also important. Lack of such information has caused many a crack-up. At airports which cannot afford blind landing facilities, it can be used in conjunction with beacons for emergency blind approaches.

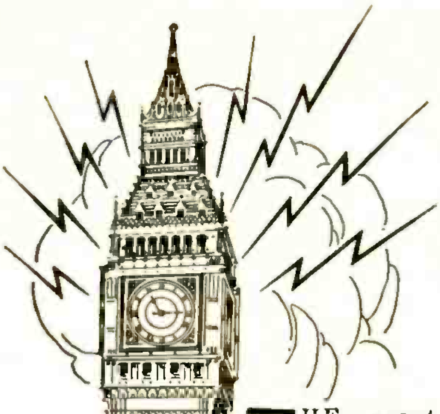
In coastal or lake regions this radar will provide a map of the terrain below which can be interpreted by a relatively unskilled observer. In less distinctive terrain it can provide an accurate "fix" anywhere and under all conditions of visibility when used in conjunction with ground beacons.

An outstanding feature of the new and improved model now in process of development will be its gyroscopically stabilized antenna: the picture presented to the pilot will not be affected as the plane banks, climbs, or dives. This refinement is expected to remove one of the main limitations to general use of the equipment during maneuvering flight.

Commercial operators would like to perfect airborne radar to the extent that it would see mountains even in the midst of intense storms, would pick up other airplanes, and even individually identify the large Manhattan skyscrapers. This is regarded by electronics engineers as the ultimate. This ultimate is some years away and may never be completely attained.

TRANSATLANTIC NEWS

From our European Correspondent, Major Ralph Hallows



THE recent de Forest number made no mention of one of the least known of de Forest's innumerable achievements. It will come as a surprise to many to know that the first talkies were made not in Hollywood or by anyone whose name is normally connected with the films, but in England by Lee de Forest! It was back in 1925 that de Forest brought his electric recording apparatus and camera synchronizing gear to England, where he started a small organization called Phonofilms at Clapham in London. A good many short talkies were made, but neither de Forest's genius nor his three-electrode tube were sufficient to surmount the formidable difficulties of those early days. External noises, faulty synchronization, and poor reproduction—not surprising in those days of reed-driven loudspeakers and a.f. circuits coupled by "peaky" transformers!—slaughtered these early attempts. Nevertheless, de Forest has a double claim to being called one of the fathers of the talkies. Not only did he take an active part in its development in pioneer days, but also he invented the grid-controlled tube, without which talkies could never have existed.

Across the Pond on 50 mc

On Sunday November 24, 1946, at 1616 GMT, T. O'Heffernan, G6GBY, picked up a 50-mc transmission by E. P. Tilton, who operates station W1HDQ, West Hartford, Conn. The two had been working on the 30-mc band, and as conditions promised to be good, a switch-over to 50 mc was made. Reception continued until 1720 GMT, with signals reaching R9. Tilton was heard also by another English amateur, D. W. Heightman, G6DH. O'Heffernan's station is in the West country, in Devonshire; but Heightman's is in the East, in Essex.

This is claimed to be the first amateur contact established on 50 mc across the Atlantic. Probably it is; but I certainly heard speech from America in 1940 on a frequency not far away. At the time I was using a u.h.f. set tuned to something well above 40 mc when, to my astonishment, I heard speech for a few seconds between two American stations. At the time I was rather busily engaged in playing my small part in the Battle of Britain and no diary record was made. Nor did I subsequently succeed in tuning in those transmissions. But the memory is vivid, for it was one of the big thrills of a lifetime.

Wireless Exhibition, 1947

Prior to the war a radio exhibition was held every year in London in the early part of September. The last held was in 1938, for the outbreak of war on September 3, 1939, caused that year's exhibition to be abandoned. It is always an interesting show and I have had the privilege of walking around and viewing its displays in the company of several Americans distinguished in the electronic field. One of these was the late Dr. C. F. Burgess, of the Burgess Battery Company, and I well remember his enthusiasm over the pentode tube, which was seen at Olympia for the first time. Another was Walter B. Schulte, till recently president of the Micro-switch Corporation of Freeport, Ill. This year the exhibition is to be from October 1 to October 11. If any reader of RADIO-CRAFT is then visiting England, I shall be happy to do all I can toward making his visit interesting and satisfying.

Pulse Modulation

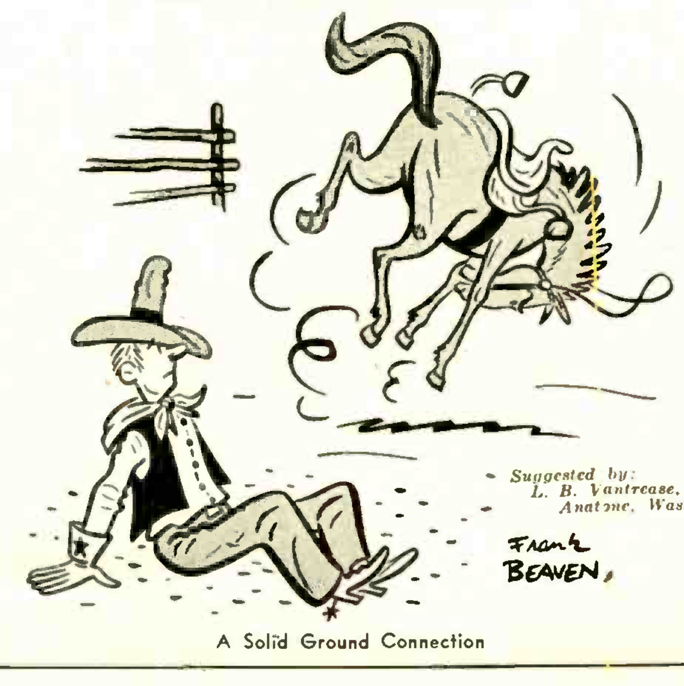
So much has been written and said on the European side of the Atlantic about pulse modulation that anyone who did not know the ropes and was not endowed with a critical mind might easily imagine that the whole future of u.h.f. radio was inseparably bound up with one of its four possible modes: amplitude, duration, frequency, or phase. A good, sound debunking was needed. It has come from H. L. Kirke, head of the British Broadcasting Company research department, who has been investigating the various systems of pulse modulation as possible means of u.h.f. broadcasting.

I have mentioned before that in this country we shall almost certainly have to adopt in the near future some method of u.h.f. broadcasting. Under the European radio agreements the broadcast-band channels assigned to us are far too few to allow the whole country a sufficient number of alternative programs. Moreover, man-made static is a great and growing menace. The only solution in sight is the use of extensive chains of u.h.f. relay stations, each serving a comparatively small area.

The big problem is which modulation system to adopt before the work of construction is launched—AM, FM, or PM. Field trials on 45 and 90 mc have proved that FM is vastly superior to AM in freedom from interference and in the small field strength needed to give adequate reception. Now careful investigations show that PM appears to be in no way better than FM. Kirke finds that there is no superiority of PM over FM in freedom from noise; that if a a single PM transmitter is used to radiate a number of programs simultaneously, it needs a far greater band width and is considerably less effective in noise suppression than several FM transmitters used similarly; and lastly that, if one PM transmitter radiates several programs, cross talk between them is inevitable owing to

(Continued on page 55)

RADIO TERM ILLUSTRATED



A Solid Ground Connection

Build a TELEVISION

To stimulate its radio and television training programs, this famous resident radio and television school is offering men interested in television this unusual opportunity.

You can build a direct viewing television chassis similar to the one pictured above, complete with all tubes, including speaker and 7-inch picture tube, right in your own home by following carefully the exact instructions sent to you by this famous television school, located square in the HEART of America's television manufacturing and broadcasting industry. Mail the coupon on the next page to get full details.

Here is a typical scene showing an instructor checking the construction completed by the two students in the background.

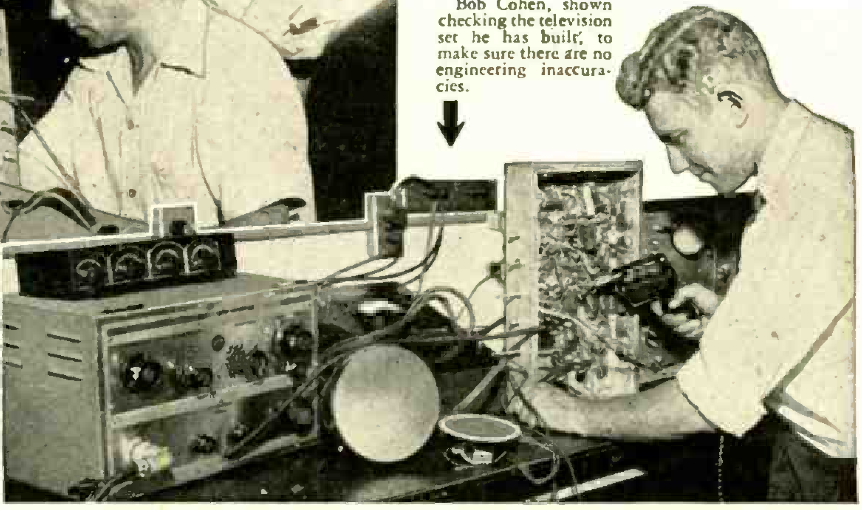
IF you are unable to leave home to go to a resident school, N.Y.T.I. of N.J. can supply you with all the parts to build a television chassis in your own home. You will be supplied with exactly the same instructions and directions with which the school's resident students are equipped, when they reach the stage in their training that calls for television set construction. If you already have a sound radio background, with experience in building radio receivers, you will be surprised to find how much you can learn about television by studying the directions, and building this set.

N.Y.T.I. of N.J. is one of America's leading resident schools in television for men seeking dependable, thorough, up-to-the-minute training in the various fields of radio and television.

The schooling offered by N.Y.T.I. of N.J. is particularly useful to those who recognize the high-earning possibilities of technical training in radio and television and are willing to tackle the class and laboratory work offered.

A grammar school education definitely is required. Moreover, N.Y.T.I. of N.J. requires that a student be earnest, sincere and radio-minded. Students without proper mathematical backgrounds are taught the radio and television mathematics and theory they need.

A considerable number of out-of-



Bob Cohen, shown checking the television set he has built, to make sure there are no engineering inaccuracies.

MAIL THE COUPON TO GET FULL

SET *Right in Your Own Home!*

state students attend the school because of its excellent, practical type of radio and television courses, so difficult to get anywhere else. Living quarters are obtainable by single students. Married students are requested not to bring their families until they can find suitable accommodations for them.

You Put Into Practice Everything You Learn

Students at N.Y.T.I. of N.J. particularly like the way the school puts into practice what it teaches. You may actually build a 17-tube television chassis. You also help build as many as 7 radio receivers of different types, a total of 75 electronic educational devices. Class study and laboratory study, in the proper combination, increase interest—and your hands get as smart as your head.

A 17-tube, experimental, television chassis may be built by all resident students of television, and may be kept as their own property, if they so choose.

Located in the Heart of the Radio, Electronic and Television Industry

The New York Technical Institute of New Jersey is in Newark, N. J., just across the river from New York City (only 20 minutes from Broadway by subway or train). The school is located in the heart of America's great radio and television industry. Such leading television, radio and electronics manufacturers as R.C.A., Western Electric, DuMont, Federal, Westinghouse and Edison are nearby. This means that the school offers numerous advantages, as it is in touch with the most recent developments.

Highly qualified television and radio instructors are here in abundance. Equipment is easier to get. Television students are offered exceptional advantages in this great electronic center.

Coupon Brings Full Information — FREE

The school issues a special Bulletin which illustrates and describes its truly exceptional laboratory facilities and equipment. This Bulletin also describes classes that may be attended, housing conditions, costs, hours, etc. If you are interested in Television—you will want to read this Bulletin. You can have it *free*, merely by mailing the coupon at right.

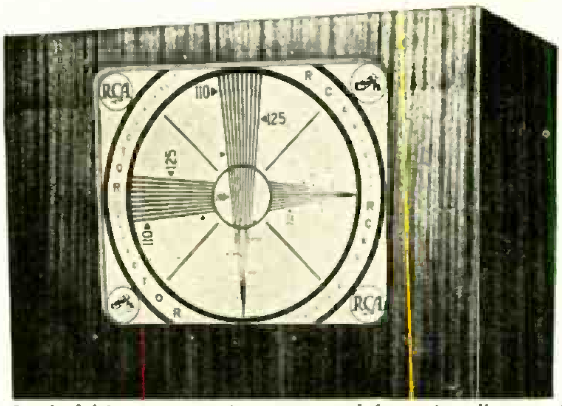
The school will also be happy to send you complete information about the television kits and directions which are now available to you if you desire to build your own television chassis at home.

Just fill out the coupon at right and mail it NOW to: *New York Technical Institute of New Jersey, Dept. 43, 158 Market Street, Newark, N. J.*

INFORMATION *Free*

Instructor demonstrating theory of light in connection with study of optical systems used in projection type television receivers.

Big picture television, 16"x21¼", "in the flesh" at N.Y.T.I. of N.J. All types of television receivers are available for student use and instruction in the resident school.



Standard laboratory type test pattern used for testing all types of television transmitters and receivers. (You can see it at N.Y.T.I. of N.J.)

New York Technical Institute of New Jersey, Dept. 43
158 Market Street, Newark, New Jersey

☐ Check here if you wish to receive the Special FREE Bulletin describing the resident school of the New York Technical Institute of New Jersey located in Newark, N. J.—including its facilities, equipment, courses offered, costs, hours, etc.

☐ Check here if you wish complete information about building a television chassis in your own home.

☐ Check here if you are a War Veteran.

Name..*Age*..........

Address..

City.................................... *Zone (if any)* .... *State*..........

(N.Y.T.I. of N.J. employs no salesmen to call.)

NEW RADIO-ELECTRONIC DEVICES

MULTI-TESTER KIT

Radio Kits Co.
New York, N. Y.

The Model 120 Multi-Tester Kit is designed to demonstrate ohm-volt-milliammeter construction to students. It has five voltage ranges, three current ranges and three ohm ranges. Sensitive needle and clear dial make for easy reading.

Voltage ranges are 0 to 5, 0 to 50, 0 to 150, 0 to 500 and 0 to 1,500 volts. Current ranges are 0 to 50, 0 to 150, 0 to 500 milliamperes.

Resistance ranges are 0 to 2.000, 0 to 20,000 and 0 to 200.000 ohms.—RADIO-CRAFT

A.C.-D.C. AMPLIFIERS

Altec Lansing Corporation
New York, N. Y.

The new A-319A and A-319B amplifiers are designed to supply 4 watts output when supplied from 105-125 a.c. or d.c. lines.

The A-319A amplifier which comes in a metal wall cabinet, has a balanced bridging input transformer with a 5,000 ohm input designed for bridging across 250-500-600-ohm lines without requiring isolating transformers. Its gain is 50 db from a 600-ohm line.

The A-319B amplifier, normally supplied without the wall cabinet, has a high impedance input for crystal pickup use. The gain is 57 db from 250,000-ohm line. A wall cabinet must be purchased separately if required.

Both amplifiers have adjustable low frequency boost. The A-319A has an adjustable high frequency boost to compensate for line losses. The A-319B has an adjustable high frequency droop to

eliminate needle scratch. Inverse feedback from push-pull output stage to input stage keeps distortion to a minimum. The feedback is taken from a tertiary winding on the output transformer thus leaving the output ungrounded. The normal output impedance of both units is 8 to 15 ohms.—RADIO-CRAFT

SQUARE WAVE GENERATOR

Maguire Industries, Inc.
Bridgeport, Conn.

The new Square Waver converts the output of audio sine-wave generators into square waves for testing a.f., FM, television and other circuits.

Technical specifications are:

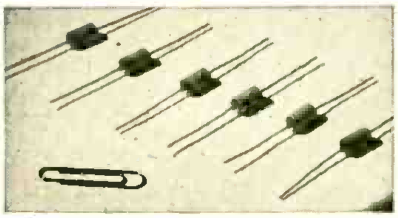
Input: Frequency range—2 to 200,000 cps. Impedance—75,000 ohms. Voltage—6 to 150 volts.

Output: Frequency Range—20 to 20,000 cps waveform square to 1 percent (2 to 200,000 cps total response). Rise Time—1 microsecond to 99 percent of maximum amplitude. Voltage—15 volts maximum peak-to-peak open circuit with continuously variable attenuation 0-60 db.—RADIO-CRAFT

GERMANIUM CRYSTAL

General Electric Company
Syracuse, N. Y.

This new germanium crystal diode has a safe forward current of .05 ampere and a safe back voltage of 60, which makes it useful as a rectifier, modulator, detector or voltage regulator in radio, television and other electronic applications.



Weighing several grams with a body length of 23/64 inch and diameter of 7/32 inch, the diode has an interelectrode capacitance of approximately .2 μμf. Its life performance is at least 3,000 hours.—RADIO-CRAFT

SIGNAL GENERATOR

Bliley Electric Co.
Erie, Penna.

This crystal-controlled oscillator, known as the CCO, employs low-temperature-coefficient quartz crystals, stable to within plus or minus 0.1 percent, to provide direct crystal control, with instant selection, of the five most commonly used intermediate frequencies: 175, 262, 370, 455 and 465 kc.

crystal control is also provided at 200 kc for r.f. alignment and at 1,000 kc for shortwave alignment. An external socket is provided to accommodate special frequencies that may be required. A three-position modulation selector and a five-step attenuator with vernier output control from 0 to 15 volts provide finger-tip operation. Power consumption is 17 watts at 117 volts a.c. or d.c.—RADIO-CRAFT

LADDER ATTENUATOR

The Daven Company
Newark, N. J.

The Type LAC-720 is essentially a ladder network designed so that the

frequency characteristics follow the hearing response of the human ear, with the effect that bass notes have a smaller loss than the middle or upper registers.

By proper external connection to lugs on the terminal board, it is possible to obtain six different attenuation-vs.-frequency curves varying from the human ear type of response to flat. When the unit is wired for a flat frequency response it functions as a straight ladder of 2.5 db per step.—RADIO-CRAFT

FREQUENCY CALIBRATOR

Browning Laboratories, Inc.
Winchester, Mass.

The new Frequency Calibrator Model RH-10 allows full use to be made of the frequency standards transmitted from radio station WWV. It is pretuned for 5 and 10 megacycles. Either may be selected at will. Provisions are made for coupling secondary standards or other r.f. sources and comparing their fundamentals or harmonics with the standard frequencies transmitted by WWV. A cathode-ray indicator permits frequency comparisons to be made to at least 1/10 cycle. A dual filter allows the selection of either the 440 or 4,000 cycle modulation. This allows them to be used as a primary standard.

The senstivity is better than ½ microvolt and the image rejection ratio is more than 50 db and is supplied in a cabinet or rack mounting. Dimensions: 9x19x11 inches. Weight: 30 pounds.—RADIO-CRAFT

DE FOREST TO THE NAB

On more than one occasion Dr. de Forest has expressed something less than absolute satisfaction with the science of broadcasting which he made possible and originated. His most recent expression on the subject was in a letter to the *Chicago Tribune* during the recent convention of the National Association of Broadcasters:

A Father Mourns His Child

In the Palmer House is assembled the convention of the National Association of Broadcasters. There many words are spoken on behalf of a great industry which thrives chiefly on spoken words. Broadcasting depends largely on the tongue and jaw muscles, plus breath, of thousands of men standing before microphones, at so much per syllable.

One wonders if our simian ancestors had any conception that ages later such monkey chatter as they originated could some day be transformed into the essentials of livelihood. Of such are the mysteries of evolution. Today fabulous sums are paid for talk; speech, not silence, has been proven golden; and the dispersers of such merchandise to the millions are here foregathered, to plan for more speech, for more money.

I, who originated the idea, and the means for broadcasting, was not invited to their council. Had I been, I might have said: "What have you gentlemen done with my child? He was conceived as a potent instrumentality for culture, fine music, the uplifting of America's mass intelligence. You have debased this child, you have sent him out on the streets in rags of ragtime, tatters of jive and boogie woogie, to collect money from all and sundry for hubba hubba and audio jitterbug. You have made of him a laughing stock to intelligence, surely a stench in the nostrils of the gods of the ionosphere; you have cut time into tiny cublets, called spots *(more rightly stains)*, wherewith the occasional fine program is periodically smeared with impudent insistence to buy or try.

"The nation has no soap, but soap opera without end or sense floods each household daily. Said a man, 'I have to use their alkalizing tablets, their commercials upset my stomach.'

"Murder mysteries rule the waves by night and children are rendered psychopathic by your bed time stories. This child of mine, now 30 years in age, has been resolutely kept to the average intelligence of 13 years. Its national intelligence is maintained moronic, as though you and your sponsors believe the majority of listeners have only moron minds. Nay, the curse of his commercials has grown consistently more cursed, year by year.

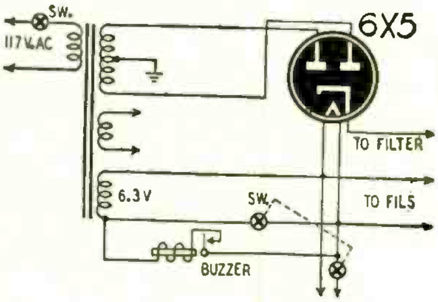
"Yet, withal, I am still proud of my child. Here and there from every station come each day some brief flashes worth the hearing, some symphony, some intelligent debate, some playlet worth the wattage. The average mind is broadening, and despite all the debasement of most of radio's offerings, our music tastes are slowly advancing. Some day the program directors will attain the intelligent skill of the engineer who erected his towers and built the marvel which he now so ineptly uses."

LEE de FOREST

RADIO·ELECTRONIC CIRCUITS

RECEIVER CONVERSION

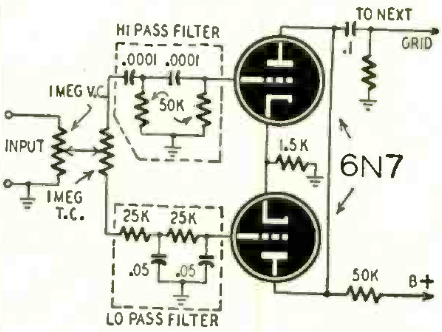
Here is the method I used to operate small a.c. receivers from a 6-volt storage battery. The filament-type rectifier is replaced with a 6X5 and the filter input lead connected to the cathode. The 5-volt winding is unused. (An 0Z4 may be used if the current drain is under 50 ma.) A small 6-volt vibrator is connected in series with the 6.3-volt filament winding with leads running to the battery. A switch shorts the vibrator when a.c. is used. When using a.c., the battery should be disconnected; and for d.c., the 117-volt line should be disconnected. By using a d.p.d.t. switch, the one circuit can be opened and the other closed at the same time.



ALBERT THOMAS, JR.,
Elm Grove, W. Va.

NOVEL TONE CONTROL

Here is a useful tone-control circuit that I have developed for use with my phono amplifier. It consists of high- and low-pass filter circuits fed from a common source and working into the grids of a 6N7. The plates of the tube are tied together to form a mixer circuit. The voltage input to the networks is controlled by the setting of a 1-megohm volume control. A 1-megohm variable tone control determines the amount of voltage applied to each grid through its filter network.



The values shown in both circuits are sufficient for most applications. However they may be altered, within limits, to suit the constructor.

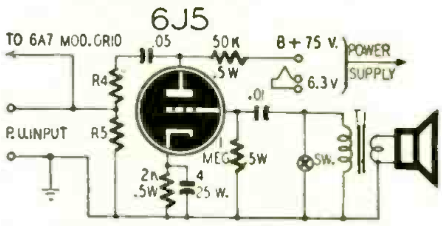
GEORGE A. FRANCE, W3LTA,
Phillipsburg, N. J.

RECORD PLAYER PRE-AMP

When called upon to install a microphone on a Philco Model RP1 record player, I accepted the job thinking that I could use a small PM speaker and output transformer in place of the pickup. I found that the speaker output was insufficient for full modulation.

The circuit shows a preamplifier that was added to the unit for greater efficiency. The 6J5 socket is mounted between the 6A7 and the power transformer. All leads are brought through the motor mounting hole. The speaker transformer, designed to match the voice coil to a 10,000-ohm, or higher, load, should be placed for minimum hum pickup. A single-pole, single-throw switch across the input circuit will reduce hum when the mike is not in use. Plate and filament voltages are taken from the power supply. This circuit may be used with any phono amplifier having a filament transformer.

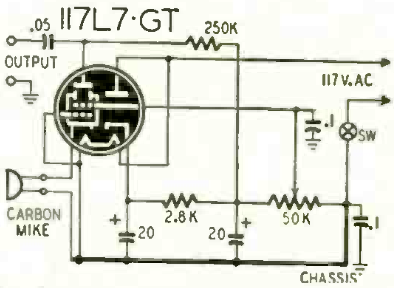
If high-mu triodes are used in place of the 6J5, it may be necessary to add a volume control to prevent overmodulation when talking close to mike.



ORRIN G. WATERS,
Hendersonville, N. C.

MIKE PREAMPLIFIER

Here is a circuit that I use as a substitute for mike battery and transformer. The voltage output from this circuit is much higher than it would be from a conventional carbon mike input circuit.



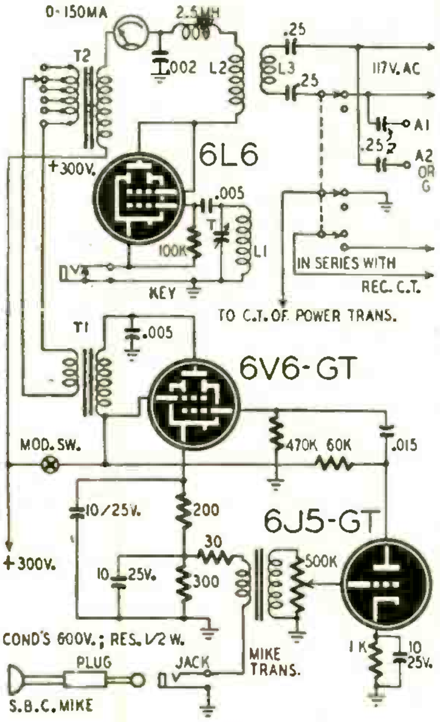
The pentode section of the 117L7-GT is used as a grounded grid amplifier. The variations in the resistance of the microphone create a varying voltage between the cathode and control grid. All ground connections are made to a common bus which is connected to the chassis through a 0.1-μf condenser. This eliminates a hot chassis. *(But not a hot mike!*—Editor)

ROBERT J. HALL,
Richmond, Calif.

CARRIER COMMUNICATOR

This simple carrier-current phone-c.w. transmitter may be constructed from parts normally found in a junk box. The circuit uses a 6L6 oscillator, modulated for phone transmission by a 6V6-GT. A 6J5-GT speech amplifier works from a single-button carbon mike. Excitation voltage for the mike is obtained from a tap on the modulator cathode resistor.

The oscillator tank coil is an old 175-kc i.f. transformer with one of the windings replaced with 75 to 100 turns of No. 30 d.c.c. wire scramble-wound. This winding is the tickler. The output loop consists of 8 to 12 turns of No. 24 d.c.c. wire wound around the tickler. The



frequency is set by tuning the trimmer condenser, T (15-250 μμf).

Two output transformers T1 and T2, connected back-to-back, are used in place of a modulation transformer. Impedance matching is changed by changing the taps on T1. Condensers between L3 and the line are 1,000-volt mica type.

For proper operation, the output coil is adjusted so that the oscillator draws 70 ma with 300 volts on the plate. Phone or c.w. QSO's are consistent over two miles. For c.w. operation, the modulator switch is opened and a key inserted in the closed-circuit jack in the oscillator cathode lead. A three-circuit two-position switch opens the receiver B-minus lead, closes the transmitter B-minus lead, and connects the pickup coil to the line, when transmitting. For receiving, the connections are reversed. Midwest long-wave receivers are used at this installation.

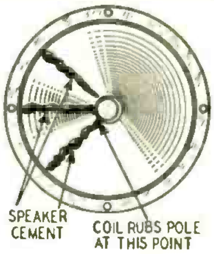
ROBERT K. COBB,
Tampa, Fla.

(Some of the Army surplus aircraft and Navy shipboard radios might also be useful for wired-wireless communication.—*Editor)*

TRY THIS ONE

SPEAKER KINK

Here is a method that I use for recentering speaker voice coils when they cannot be centered by any other means. I apply 3 radiating rows of speaker cement, about ¼ inch wide, on the side of the cone where it is rubbing the pole



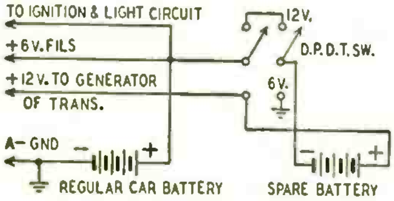
piece. The cement is warmed so that it will dry quickly. The drying cement shrinks the cone on one side and recenters the voice coil.

WALTER C. WILLIAMS,
Youngstown, Ohio

(If shims are put in place before the cement is applied, a better job of centering can be done.—Editor)

12-VOLT SUPPLY

Here is a circuit that I find useful for mobile operation of a surplus radio transmitter designed for operation from a 12-volt vehicular storage battery. A spare 6-volt battery is placed in the vehicle and connected to a d.p.d.t. switch used to connect the two batteries either in series or in parallel. When they are



connected in series, the transmitter generator may be operated at full power. In the parallel connection, the generator will operate at reduced power and the spare battery is useful as a reserve power supply for starting on cold mornings. This connection also permits the automobile generator to recharge the spare battery.

A heavy-duty knife switch, capable of carrying 50 amperes, should be mounted on the fire wall or near the battery. A choke lever may be installed to operate the switch from the dashboard. Heavy leads should be used in the battery wiring to prevent excessive voltage drop.

ZOLAN T. BOGAR, W3CJM,
Laurel, Maryland

CABLE BREAK DETECTOR

Practically all experimenters and servicemen have had trouble locating a break in a long piece of insulated wire or cable. While in the Navy, we found that this may be done simply with a radio receiver and a signal generator.

An antenna will suffice if a strong signal can be tuned in.

A single turn of wire is wound around a nonmetallic cylinder large enough to pass the questionable cable. One end of the loop is connected to the antenna post of the receiver, and the cylinder is anchored so that the wire may be passed through it quickly and easily. One end of the cable is connected to the signal generator or a good antenna. The receiver is tuned to a strong signal or to the frequency of the signal generator. As the free end of the cable is passed through the loop, the signal from the receiver will be equally strong on either side of the break with a definite attenuation or null when the break is within the loop. If multiwire cable is used, each end of the normal wires should be grounded.

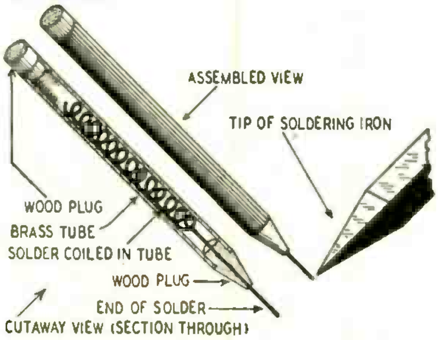
D. W. BAIRD,
Ashland, Wis.

RADIO-CRAFT wants original kinks from its readers, and will award a one year subscription for each one published. To be accepted, ideas must be new and useful. Send your pet short-cut or new idea to RADIO-CRAFT today!

SOLDER PENCIL

Soft wire solder can be handled more conveniently and easily in the pencil-type holder shown.

The barrel of the holder is a 6-inch length of ½- or ¾-inch copper tubing. A tapered wooden dowel is wedged into one end of the tube and drilled with a hole slightly larger than the diameter of the solder.



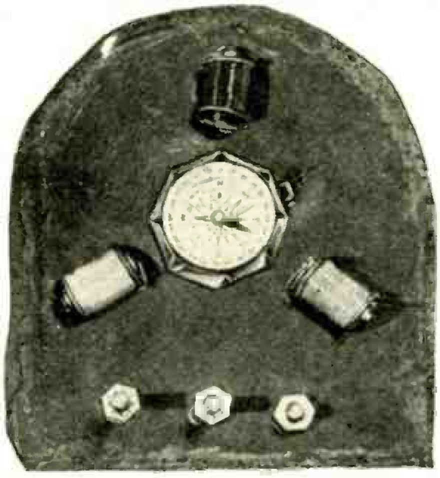
The solder is formed into a spring-like spiral by winding it around a pencil or small rod, leaving a short straight projection. The solder is loaded into the open end of the holder so that the projection will pass through the hole. When the pencil is used, the solder is pulled down as needed.

E. H. STUTZ,
Cleveland, Ohio

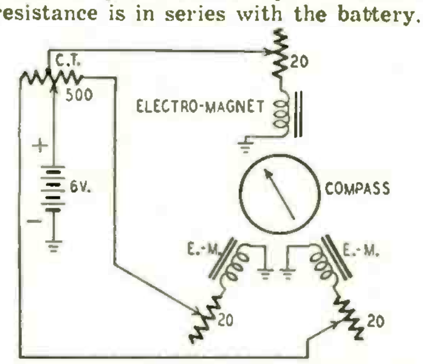
(Is there no way of using an old mechanical pencil for the barrel?—*Editor)*

BEAM ANTENNA INDICATOR

This circuit is a direction indicator for rotary beam antennas. It consists of small electromagnets spaced every 120 degrees around a pocket compass, and is driven by variable currents supplied from a 6-volt battery in series



with variable resistance. This resistance is a 500-ohm center-tapped potentiometer coupled to the rotating shaft of the antenna. The magnet coils are connected so that a portion of the potentiometer resistance is in series with the battery.



The resistance in the coil circuits depends on the setting of the resistor arm. The coil having the least circuit resistance will draw most current, thus creating the strongest magnetic field.

The coils for the electromagnets are salvaged from a doorbell or buzzer or may be wound by hand on a suitable core. Calibrating 20-ohm wire wound rheostats are inserted in each circuit to equalize the strength of the magnets.

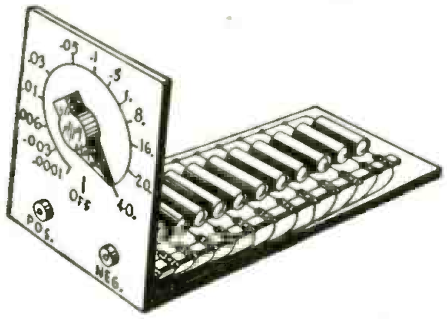
The 500-ohm potentiometer selected should have a wide rotation arc and a linear taper. The coils are spaced equidistant around the compass but should not be placed closer than one inch from the case.

HERBERT L. HARDY,
Buffalo, N. Y.

(An excellent and accurate direction indicator may be made by winding a special circular resistor and tapping it at points exactly 120 degrees apart, in place of the potentiometer.—*Editor)*

CONDENSER DECADE

In radio servicing, suspected condensers often are checked by substituting good condensers. This may necessitate searching through a drawer full of condensers to find one of the correct value. With a condenser decade, you turn



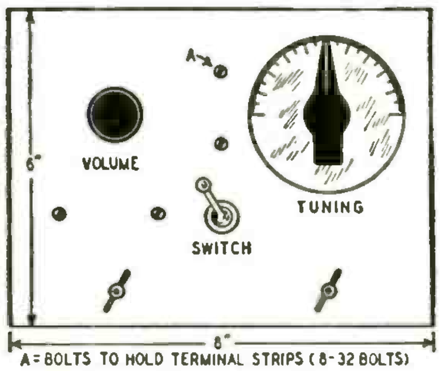
a pointer to the correct value and connect test leads into the circuit.

This decade uses a 14-position switch and 13 condensers of standard values. The switch is mounted on the front panel and the condensers on 2 terminal strips. The negative sides of all condensers are tied to the negative pin jack on the panel. The positive leads are connected to points on the switch. The switch selector arm is connected to the positive pin jack.

MARVIN R. SOLOMON,
Alexandria, Va.

RECEIVER PANEL

After constructing several small receivers, I realized that most of them used the same parts mounted on the front panel. I decided to build a "per-



A=BOLTS TO HOLD TERMINAL STRIPS (8-32 BOLTS)

petual panel" that could be used for all future circuits.

A 6 x 8 inch piece of Masonite was selected for the panel. A 350-μμf variable condenser, s.p.s.t. switch, and a 50-000-ohm potentiometer were mounted on the panel. Connections between the controls and the chassis are made by terminal boards mounted near each of the components. The panel is fastened to the chassis with two bolts and wing nuts.

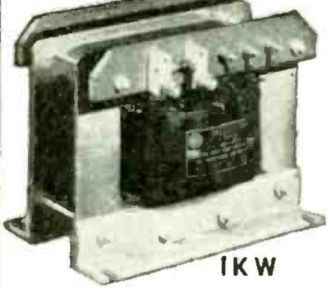
REAL BRONSARD,
Grand Mere, P. Q.

SOLDERING TIP

The tip of a soldering iron may be kept bright by fastening a small suede shoe brush to the work bench so that the tip of the iron may be rubbed over the wire bristles of the brush each time it is used.

JOHN ZACHAZEWSKI,
Northampton, Mass.

SAVE! ON THESE AND THOUSANDS OF OTHER BARGAINS IN STOCK FOR *IMMEDIATE DELIVERY*



1KW

Modulation Transformer

SPECIALLY PRICED AT $14.95

We have a real value in a modulation transformer. This item, made by RCA TO BROADCAST SPECIFICATIONS, is conservatively rated at 550 Watt audio to modulate that one KW rig. Really rugged construction with protective flashover gaps which are adjustable. Terminals and gaps are mounted on a "Mycalex" terminal board. The laminations that make up this transformer are of high audio quality and are extremely thin, making it impossible for the core to "chatter or talk." Audio Watts—550 Sec. #1—450 Mils Sec. #2—80 Mils Turns Ratio—Pri: Sec. #1-1:1 Pri: Sec. #2-5:1 Pri: Sec. #2 Tap-25:1 Impedance Ratio—Pri: #1-1:1 Sec. Pri: Sec #2-25:1 Pri: Sec #2 Tap-625:1 DC Resistance—Pri. 135 ohms Sec: #1 112 ohms; Sec. #2 99 ohms Transformers insulation tested: Pri. 8000V.; Sec. #1-11-000V; Sec. #2-2000V. In the rest of the coils and core. Primary center-tapped for Class "B" modulators. Secondary #2 will carry 80 Mils to modulate screens of beam power or screen grid tubes. Primary will match any Class "B" tubes up to 10,000 ohms plate to plate, such as 810's, 75T's, 8005's, ZB120's, 203's, HY51Z's, 211's, 813's, 828's, 805's 203Z's. Size 9½" wide, 7½" deep, 7¼" high. Heavy channel iron mounting brackets. Weight approx. 40 lbs.—Cat. No. MT-100

Something You Can't Be Without

PIN STRAIGHTENER

For miniature tubes—Gov't cost $4.80 our price—Cat. No. P10 **49c**

MICA CAPACITATOR

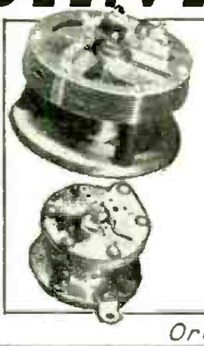
Mica capacitator .002 MFD 3000 WVDC Cat. No. RT-101 **49c**

IF TRANSFORMER

IF transformer, mounted in aluminum shield can. 1500 KC, with air trimmer. Impedance coupled type—Cat. No. T-19 **95c**

30MC IF TRANSFORMER

30 MC IF transformer in square aluminum can, silver slugged tuned—Cat. No. T-20. **29c**



Butterfly Condensers

Ideal for high frequency work.

Type A—frequency range 76 to 300 megacycles to be used with 955 tubes. Cat. No. BC-1

Type B—frequency range 300 to 1000 megacycles to be used with 368AS doorknob tube. Cat. No. BC-2

Sockets part of assembly on both.

95c each

Order by Catalog Numbers!

CONDENSERS

CATALOG NO.	CAP. MFD.	WORKING VOLTS	YOUR COST
C110	1	5000 OIL	$3.95
C111	3	4000 OIL	$4.95
C112	1	1000 OIL	44c
C113	4	500 OIL	49c
C114	8	600 OIL	95c
C115	2	600 OIL	49c

VARIABLE CONDENSERS

100 MMFD variable APC type—Cat. No. T-21. **59c**

30 MMFD variable APC type—Cat. No. T-22. **25c**

12 MMFD variable ¼" shaft—Cat. No. T-23. **30c**

CHOKES

Thordarson 8 HY 150 M choke—Cat. No. FC-201. **95c**

Thordarson 8 HY 175 M choke—Cat. No. FC-202. **$1.49**

Thordarson 12 HY 25 M choke—Cat. No. FC-203. **39c**

Thordarson 8 HY 350 M choke—Cat. No. FC-204. **$4.95**

Thordarson T48003

Thordarson 2H-7H 550 MA swing choke size 4⅛ x 5⅛ x 5⅛ square black crackle case. Cat. No. FC-205

$5.95

Filament Transformers

Thordarson 6.3 V—4 amps., 6.3 V—4.5 amp., 9.7 V—.5 amp., pri. 110 V AC 25 or 60 cy—Cat. No. FT-11 **$1.95**

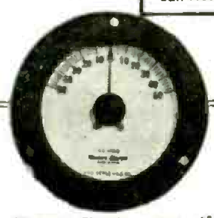
Thordarson pri. 110 V 60 cy.—sec. 6.3 V 6 A, CT—Cat. No. FT-12 **$1.49**

Thordarson 110 V 60 cy. pri., sec. #1—2.5V 10 A CT, 3000 V ins., sec. #2 10 V 3.25 A, Two 5 V 3 A; 6.3 V 1 A—Cat. No. FT-13 **$4.95**

All Orders F.O.B. Detroit

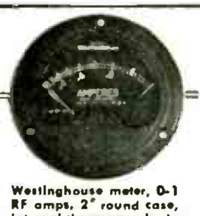
Westinghouse meter, 0-1 MA movement, 2" round case, scale calibrated 0-140 and 0-500. Includes mounting hardware. Cat. No. M-101.

$2.95



Western Electric meter, 4" round, zero center, 0-½ MA each side. Cat. No. M-102.

$3.95



Westinghouse meter, 0-1 RF amps, 2" round case, internal thermocouple, in original box. Includes mounting hardware. Cat. No. M-103.

$2.95

SHALLCROSS ACRA-OHM WIRE WOUND RESISTORS

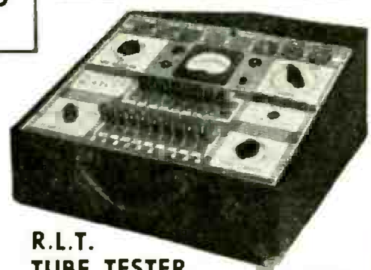
2,000 ohm	60,000 ohm
3,300 ohm	65,000 ohm
9,000 ohm	70,000 ohm
15,000 ohm	75,000 ohm
18,000 ohm	100,000 ohm
25,000 ohm	160,000 ohm
30,000 ohm	600,000 ohm
50,000 ohm	

±1W

39c each

3 for $1.00

1 MEG. .89c



R.L.T. TUBE TESTER

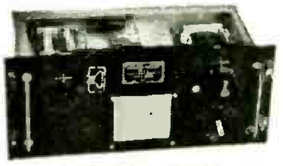
Tests all tubes up to 117 V. • Tests shorts and leakages. • Tests individual sections. • Works on 90-125 V 60 cycle AC. • Comes in portable cabinet complete with all operating instructions with lid. Cat. No. TT-100

PRICED AT ONLY **$49.95**

SELSYN MOTORS

The ideal way of indicating the position of rotary beams, wind indicator, etc. (400 cycle). Line cord and instructions for 110 VAC operation furnished.—Cat. No. SM-100.

2 for $3.95



TUNING UNIT

Tuning unit BC 375. Approx. 65 MMFD cond., coils, RF chokes, dials, asstd. mica condensers 2500 WVDC, over $50.00 in parts. Cat. No. TU-101.

$3.75

PHOTO FLASH TUBE

Photo Flash Tube. High speed photo flash tube, 12,000,000 lumens light output. Stops all action. Ignition coil included on back of bulb. 10,000 flashes. Diagrams furnished on request. Your cost Cat. No. PF-101.

$8.95

DYNAMOTOR

Power supply—inputs 6 or 12 V, output 500 VDC at 160 MA, mounted on box with circuit breakers, relays, interference filter and two 10 ft. cables. U. S. Govt. surplus. Cat. No. DM-101.

$9.95

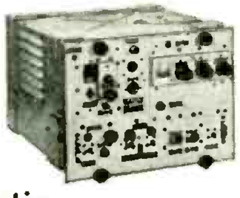
Hot Spot Specials

- Asst. resistors ½ watt fully insulated in popular ohmages per 100—Cat. No. R-5. **$1.49**
- Asst. mica condensers per 100—Cat. No. C-12. **$1.95**
- Wafer sockets 4-5-6-7 & 8 prong per 100 Cat. No. WF-4. **$2.95**
- 12" Utah P. M. Speaker Alnico #5 with 6F6 output transformer—Cat. No. ST-100. **$6.95**
- Asst. knobs push on wood & plastic per 100—Cat. No. KP-100. **$1.95**
- 6J4—$1.50, 6J6—95c.
- Johnson sockets #210—25W—Cat. No. JS-210. **49¢**
- 75,000 ohm 200 W bleeder—Cat. No. B-75. **49¢**
- 955-9004 tubes—Cat. No. T-99. **65¢**
- Sockets for acorn tubes—Cat. No. AT-10. **19¢**
- 8-8 MFD 350 WVDC, 20 MFD 150 WVDC, round can—Cat. No. RC-88. **69¢**

Receiver and Transmitter

SCR-522 USED In good cond.

100-156 MC receiver and transmitter complete with 18 tubes. Cat. No. RT-10 **$29.95**



Transmitter and Receiver

Has been widely used on the 144 MC band. Shipping wt. 100 lbs. U. S. Govt. surplus. Your price, less tubes and power transformer. Cat. No. RT-102. **$14.95**

Write for **FREE** *Bulletin*

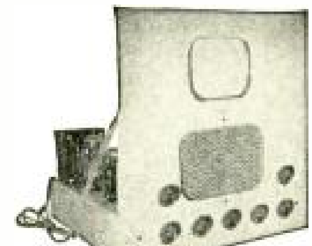
HERSHEL RADIO CO.

5249 GRAND RIVER DETROIT 8, MICHIGAN

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

Metropolitan fills Mail Orders **Same day received!**

NEW TELEVISION RECEIVER KIT



Easy to assemble. No knowledge of television required. Complete easy-to-follow instruction sheet gives you all the knowledge you need. Finished Television Receiver has a picture that is clear and sharp . . . comparable to a moving picture.

All necessary components are included: nothing is required except a screw driver, cutting pliers and a soldering iron. Only the highest quality standard parts are used—the list price value of these parts alone is more than $300. 110 volts, 60 cycles HC.

FACTORY GUARANTEE—set guaranteed to operate satisfactorily if directions are followed exactly. Servicing of component parts and assembled parts will be performed by the factory at factory costs.

$159.50

The New Model B-45

BATTERY OPERATED SIGNAL GENERATOR

for servicing AM, FM and Television Receivers

Self-modulated Signal Generator, providing a highly stable signal. Generates R.F. frequencies from 150 Kilocycles to 50 Megacycles (150 Kc. to 12.5 Mc. on Fundamentals and from 11 Mc. to 50 Mc. on Harmonics). R.F. is obtainable separately or modulated by the Audio Frequency.

Direct reading—all calibrations are etched on the front panel. Complete with shielded test lead, self-contained batteries and instructions.

NET **$27.75**

We carry nearly 5,000 instruments in stock. All models listed below are available for *immediate* delivery.

PRECISION APPARATUS INSTRUMENTS

832S—31 Range AC-DC Multi-Range Tester	23.04
844P—34 Range AC-DC 6000 volts AC and DC VOLT-OHM MILLIAMMETER	32.20
856P—44 Range 20,000 ohms per volt AC-DC TESTER	49.94
864-AC-DC VOLT-OHM-DECIBEL-MILLIAMMETER with large 9" meter	59.60
912P-Dynamic Mutual Conductance Tube Tester	61.20
E-200—A.M.—F.M. and Television Signal Generator	64.15
EV-10P—6000 volts AC and DC Vacuum Tube Multi-Range-Meter	71.81
920P—Combination Dynamic Mutual Conductance Tube Tester, Battery Tester and 33 Range AC-DC Multi-Range Set Tester	84.22
954P—Combination Dynamic Mutual Conductance Tube Tester, Battery Tester and 37 Range Super-Sensitive AC-DC Multi-Range Set Tester, 20.000 ohms per volt DC	99.20

SUPREME INSTRUMENTS

543-Multi-Tester	18.95
589-Tube and Battery Tester with Rollchart	48.95
599-Tube and Set Tester with Rollchart	62.50
565-Vacuum Tube Voltmeter	63.50
576-Signal Generator	68.95
805-Combination Tube and Set Tester with Rollchart	89.50
546-Oscilloscope	89.75

McMURDO SILVER CO.

905-"Sparx" Dynamic Signal Tracer	39.90
904-Capacitance Resistance Bridge	49.90
900-"Vomax" Vacuum Tube Voltmeter	59.85
906-A.M.-F.M. Signal Generator	89.90

RADIO CITY PRODUCTS

447-Multi-Tester	17.95
448-Multitester	24.50
322-Dynoptimum Tube Tester	41.50
461-P-Sensitive Multi-Tester 2000 ohm per volt DC	42.63
664-Electronic Multi-Tester	45.00
705-Signal Generator	49.50
315-Rollchart Tube Tester	59.50
802N-Combination Tube & Set Tester	59.50
668-V.T.V.O. Capacity Meter	73.01
805-Combination Tube & Set Tester	89.50
665A-V.T. "Billionaire" Insulation Tester plus V.T.V.M.	92.61

SUPERIOR INSTRUMENTS

CA-11—Signal Tracer	18.75
670—Super Meter	28.40
CA-12—Audible-Visual Signal Tracer	34.85
450—Tube Tester	39.50
650—Signal Generator	48.75
400—Electronic Multi-Tester	52.50
600—Combination Tube & Set Tester	62.50

SHALLCROSS MFG. COMPANY

Decade Resistance Boxes	13.50
Portable Galvanometers	27.50
630—Wheatstone Bridge	75.00
637—Kelvin Wheatstone Bridge	100.00
638-2-Kelvin Wheatstone Bridge	150.00

ALLEN B. DUMONT LABORATORIES

185A—Electronic Switch and Square Wave Generator	105.00
274—5" Oscilloscope	115.50

WATERMAN "Pocket" Oscilloscope	55.00
MONITOR Crystallincr Signal Generator	57.50
BLILEY, Crystal Controlled Signal Generator	69.50
WESTON-689-1F Ohmmeter, including leather carrying case, list price $25.50	only 14.85

The New Model 200

MUTUAL CONDUCTANCE TUBE TESTER

Here, FOR THE FIRST TIME, is a true. mutual conductance type tube tester with complete flexibility, and at a price no higher than that charged by other manufacturers for the ordinary emission type.

Note the unfailing accuracy with which it classifies the tubes under test, on the REJECT-GOOD scale. There is absolutely NO DANGER of BAD tubes reading "good" and GOOD tube reading "bad" on this E.M.C. Series 200 Tube Tester, as there is on all of the old-fashioned emission type testers.

3" Meter in sloping counter case	$49.85
3" Meter in hand-rubbed carrying case	53.85
4½" Meter in sloping counter case	52.85
4½" Meter in hand-rubbed carrying case	56.85

Check These Features

1. Checks mutual conductance on a calibrated micromho scale, as well as on a REJECT-GOOD scale.
2. Checks five element tubes as pentodes.
3. Checks tubes for gas content.
4. Sufficient plate current to check both emission and mutual conductance.
5. Detects both shorted and open elements.
6. Complete switching flexibility allows all present and future tubes to be tested, regardless of location of elements on tube base.
7. Tests tubes for radio frequency and other noise.
8. Tests all tubes from .75 volts to 117 filament volts.
9. Tests all loctal, octal, and miniature tubes.
10. Tests cold cathode, magic eye, and voltage regulator tubes, ballast resistors.
11. Instrument is protected with fuse, which is easily replaceable from front of panel.
12. Individual sockets for each tube-base type eliminates possible errors
13. Checks individual sections of multiple-purpose tubes.
14. Attractive four-color panel with plenty of eye-appeal. Wrinkle background for durability.

TERMS: 25% Deposit, Balance C.O.D. Or Full Payment with Order.

SEND FOR FREE CATALOG!

Metropolitan ELECTRONIC & INSTRUMENT CO.

Dept. C, 6 MURRAY STREET
NEW YORK 7, N. Y., U. S. A.

Cable Address: METRONICS
Phone: BArclay 7-5556

TECHNOTES

. . . . STROMBERG MODEL 1120

Intermittent distortion and loss of volume in Stromberg-Carlson Model 1120 series sets is often caused by voice-coil leads shorting to the speaker at the point where they pass through the hole in the frame. The hole should be lined with a rubber grommet. Spaghetti tubing is not satisfactory, as it will stiffen the leads and cause them to break at the ends.

Don Tsuboi,
Tremonton, Utah

. . . . G.E. PORTABLE BL530

If this set operates only on the high-frequency end of the dial or erratically on the low end, replace the 1A7 regardless of the tube-tester indications.

Otto Woolley,
Colorado Springs, Colo.

. . . . FADA MODEL 652

A general complaint about this set is that the dial sticks. Close observation will show that the dial pointer rubs the top of the cabinet. Remove the spacer from under the speaker. This lowers the assembly about 1/8 inch and clears up the trouble.

Floyd D. Goff,
Black Mountain, N. C.

. . . . MOTOROLA 8-30

If a terrific hum develops in this model, check the filter condensers. If they are not at fault, the vibrator should be replaced. A universal vibrator cannot be used in this set, as it will often cause even more hum. A Mallory No. 859 (902M) is an exact replacement and can be used.

John Findarle,
Modesto, Calif.

. . . . ZENITH 8S647

The push-buttons on this set do not always catch when pushed down for station setting. To remedy this condition, put a drop of light lubricating oil on each end of the small horizontal sliding bar which holds the vertical catches. After oiling, continue to push the buttons until smooth operation is obtained.

Manuel E. Silvia, Jr.,
Monterey, Calif.

RESCUE BY HAM RADIO

A radio amateur in Ohio was able to rescue 300 motorists trapped in a blizzard in New Mexico last November. The amateur, Paul L. Hughes of Canton, Ohio, picked up an urgent message from Dale L. Hauch, another amateur from Battle Creek, Michigan, who had a mobile transmitter in his car.

Relaying the message: "Trapped in terrific snowstorm 65 miles west of Albuquerque. Can you get help?" to an Albuquerque ham, Foy A. Roger, the Ohio amateur was informed that a rescue party was under way just twenty minutes after the call for help had been received.

JOBBERS AND DEALERS DIRECTORY

FOR READERS OF RADIO-CRAFT

This list of Radio Jobbers and Dealers has been compiled as a service to RADIO-CRAFT readers. The magazine is sold by the stores listed below where they are displayed on counters and shelves for your convenience. At these stores you will also be able to buy standard parts, sets, and every other product of the radio and electronic industry.

ALABAMA

Decatur
Radio & Tel. Sup. Co.
717 Bank St.

Dothan
Hand Wholesale Radio & Refrig.
707 S. Oates St.

Tuscaloosa
Allen & Jomison Co.

ARIZONA

Phoenix
Radio Specialties & Appl.
401 W. Jackson

ARKANSAS

Fort Smith
Packard Radio Co.
205 Garrison Ave.

Wise Radio Supply
1001 Towson

Lexarcana
Lavender Radio Sup. Co.
Ash at 4th Sts.

CALIFORNIA

Bakersfield
Bakersfield Radio Sup.
2808 Chester Ave.

Fresno
Jack C. Arbuckle
1427 Broadway

Hollywood
Hollywood Radio Sup. Inc.
5521 Hollywood Blvd.

Yale Radio Electric Co.
6616 Sunset Blvd.

Long Beach
Fred S. Dean Co.
969 American Ave.

Scott Radio Supply
226 Alamitos Ave.

Los Angeles
General News Agency
326 W. 5th St.

Papel Bros.
2639 E. 4th St.

Radio Tel. Sup. Co.
149 12th St.

Sacramento
E. M. Kemp Co.
1115 R. St.

Sacramento Elec. Sup. Co.
711 Capitol Ave.

San Bernardino
George D. Bagley Co.
1216 D St.

San Diego
Harold W. Burt Radio-Electronic
4162-64 Park Blvd.

Electronic Equip. Distr.
1228 2nd Ave.

Western Radio & Elec. Co.
1415 India St.

San Francisco
Associated Radio Dist.
1251 Folson St.

San Francisco Radio & Supply Co.
1284 Market St.

San Jose
Frank Quement Wholesale Radio
156 W. San Fernando St.

Santa Ana
Radio & Tel. Equip. Co.
207 Oak St.

COLORADO

Denver
McGee Radio & Elect. Co.
4330 Broadway

Radio Products Sales Co.
1237 16th St.

Western Electronic Lab. Co.
913 18th St.

Grand Junction
Radio & Electronics Supply Co.
418 South 7th St.

CONNECTICUT

Bridgeport
Coastal Radio Service Co.
1559 Stratford Ave.

R. C. Seeli & Co. Inc.
84 Elm St.

L. N. Waldhaus
1132 Norman St.

Hartford
R. G. Sceli & Co.
317 Asylum St.

New Britain
United Radio Supply
53 E. Main St.

New Haven
Congress Radio & Battery Co.
207 Congress Ave.

Rockville
Alfred C. Denson
38 Park Place

DELAWARE

Wilmington
Radio Electric Service Co
4th and Tatnall Sts.

DISTRICT OF COLUMBIA

Washington
Capitol Radio Wholesalers
2120 14 St. N.W.

Intercommunications Co.
2027 Nichols Ave. S.E.

Kenyon Radio Supply Co.
2214 14th St. N.W.

Sun Radio
938 N.W. F St.

FLORIDA

Jacksonville
Radio Parts Co.
712 Main St.

Thurow Distr. Inc.
806 Main St.

Miami
Thurow Distr. Inc.
420 S.W. 8th Ave.

Orlando
Thurow Distr. Inc.
131 South Court St.

St. Petersburg
Welch Radio Supply
408 9th St. So.

Tallahassee
Thurow Distr. Inc.
213 E. Tennessee St.

Tampa
Thurow Distr. Inc.
115-117 St. Franklin St

West Palm Beach
Thurow Distr. Inc.
209 No. Olive St.

GEORGIA

Augusta
Prestwood Electronics Co.
727-29 Reynolds St.

Columbia
Radio Sales & Svce. Co
1326 First Ave.

Macon
Guy White Radio
654 Mulberry St.

ILLINOIS

Benton
Lampley Radio Co.
802 N. McLeansboro St

Danville
Allen Electric Co. Radio Supply
109 N. Hazel St.

Decatur
York Radio Distr. Co.
801-805 N. Broadway St

Chicago
Allied Radio Corp.
833 W. Jackson Blvd.

American Parts Inc.
610 W. Randolph St.

Concord Radio Corp.
901 W Jackson Blvd.

Electronic Distributors
620 W Randolph

Mr. Martin C. Flyn American Telev. Inst.
433 E. Erie St.

Lake Radio Sales Co.
615 W. Randolph St.

Radio Shack
630 W. Randolph St.

Radolek Co.
601 W. Randolph St.

Schuh Radio Parts
1253 Loyola Ave.

East Moline
C. L. Swanson Radio Laboratory
933 15th Ave.

Goreville
Century Supply Co.
Main St.

Rockford
Mid-West Associates
306 Walnut St.

Springfield
Harold Bruce
303 E Monroe

Wilson Supply Co.
108 W. Jefferson St.

W. Frankford
Radio Hospital
1107 E. Main St.

INDIANA

Anderson
Seybert's Radio Supply
19 E. 12th St.

Evansville
Castrup's Radio Sup.
1014 W. Franklin St.

Montoux Auto & Machine Co.
517 Locust St.

Gary
Cosmopolitan Radio Co.
524 Washington St

Hammond
Stanten Radio Supply
521 State St.

Indianapolis
Rodefeld Co.
614 N. Capitol

South Bend
Commercial Sound & Radio Co.
534 E. Colfax Ave.

Terre Haute
Terre Haute Radio
501 Ohio St.

IOWA

Council Bluffs
World Radio Labs

Des Moines
G. W. Onthank Co.
11th & Cherry

Dubuque
Boe Distributing Co.
498 N. Grandview

Fort Dodge
Ken-Els Radio Sup. Co
111 So. 12th St

Sioux City
Dukes Radio Co.
114 W. 4th St.

Power City Radio Co.
513 7th St.

Sioux City Radio & Appliance Co.
313 Fifth Street

Waterloo
Ray-Mac Radio Supply
324 W. 4th St.

KANSAS

Pittsburgh
Pittsburgh Radio Sup. Co.
103 N. Broadway

Topeka
Acme Radio Supply
516 Quincy St.

Wichita
Interstate Distr. Inc.
1236 E. Douglas

Radio Supply Inc.
1125-27 E. Douglas

KENTUCKY

Lexington
Kentucky Radio Supply Co.
519 Georgetown St.

Louisville
Peerless Electronic Equip. Co.
912-914 So. Second St.

Newport
Apex Distributing Co.
506 York St.

Prestonsburg
General Supply Co.
North Broadway

LOUISIANA

Lafayette
Radio-Electronic Sup.
1419-21 Cameron St.

Monroe
Hale & McNeil
301 Pine St.

New Orleans
Wm. B. Allen Supply Co.
916-918 W. Claiborne Ave.

Radio Parts Inc.
807 Howard Ave.

Shreveport
Koelemay Sales Co.
327 Market

MAINE

Bangor
Radio Service Lab.
45 Haymarket Sq.

Portland
Maine Electronic Supply Corp.
13 Deer St.

Radio Service Lab.
45 A Free St.

MARYLAND

Baltimore
Henry O. Berman Co. Inc.
12 E. Lombard St.

D. & H. Dist. Co.
31 E. Lee St.

Royal Radio
941 Penna. Ave.

Wholesale Radio Parts Co. Inc.
311 W. Baltimore St.

Cumberland
Cumberland Radio Wholesalers
143 N. Centre St.

MASSACHUSETTS

Boston
Hub Cycle & Radio Co. Inc.
596 Commonwealth Ave.

Sager Electrical Sup. Co.
201 Congress St.

Lawrence
Hatry & Young of Mass. Inc.
539 Essex St.

Melrose
Melrose Sales Co.
407 Franklin St.

New Bedford
C. E. Beckman Co.
Commercial St.

Springfield
Springfield Radio Co. Inc.
405 Dwight St.

Springfield Sound Co.
147 Dwight St.

Worcester
Radio Electronic Sales Co.
46 Chandler St.

Radio Maintenance Supply
19-25 Central St.

MICHIGAN

Ann Arbor
Purchase Radio & Camera Shop
605 Church St.

Berkley
The J. M. Morel Co.
1949 Woodward Ave.

Detroit
M. N. Duffy & Co.
2040 Grand River Ave.

Electronics Inst. Inc.
21 Henry at Woodward

Radio Center
5834 W Warren

Hershel Radio
5429 Grand River Ave.

Radio Electronic Supply
1112 Warren West

Radio Specialties
456 Charlotte St.

Radio Supply Co.
6724 Michigan Ave.

Radio Supply & Eng. Co.
129 Selden Ave.

Flint
Radio Tube Mdse Co.
508 Clifford

Sheldon Radio & Appliance
2914 N. Saginaw St.

Jackson
Fulton Radio Supply Co.
707 S. Blackstone St.

Lansing
Electric Products Sales Co.
427 E. Michigan Ave.

Muskegon
Industrial Electric Supply
1839 Peck St.

Saginaw
Orem Distributing Co.
801 E. Genesee Ave.

Radio Parts Co.
234 S. Second St.

MINNESOTA

Duluth
Lew Bonn Co.
228 E. Superior St.

Northwest Radio
109 E. First St.

Minneapolis
Lew Bonn Co.
1211 LaSalle Ave. So.

Northern Radio Lab.
3927 East Lake St.

Ron's Radio Supply
4001 Bryant Ave., So.

MISSISSIPPI

Jackson
Cabell Electric Co.

Meridian
Radio Supply Co.

MISSOURI

Cape Girardeau
Suedaccum Electronic Supply Co.
902 S. Sprigg St.

St. Joseph
Acme Radio Supply
110 N. 9th St.

St. Louis
Napper Radio Co.
3117 Washington

Springfield
Harry Reed Radio & Supply Co.
833-37 Boonville Ave.

MONTANA

Butte
Geo. Steele & Co.
126 W. Broadway

Great Falls
Geo. Lindgren Co.
109 Central Ave.

NEBRASKA

Lincoln
Hicks Radio Co.
1422 "O" St.

Omaha
Alco Radio Inc.
411 Cuming St.

All-State Distr. Co.
2857 Farnum St.

H. C. Noll Co.
226 Harney St.

Omaha Appliance Co.
18th & St. Mary's

Radio Equipment Co.
2820-22 Farnum St.

NEW HAMPSHIRE

Concord
Evans Radio
18 N. Main

NEW JERSEY

Bridgeton
Joe's Radio Shop
67-69 S. Pearl

Camden
Radio Electric Service Co.
513 Cooper St.

Hackensack
Trade Radio Service Co.
101/2 Morris St.

Newark
Radio Wire Telev. Inc.
24 Central Ave.

Variety Electric Co.
601 Broad St.

Phillipsburg
Carl B. Williams Co.
154 South Main St.

Red Bank
Bradleys Radio Service
Newman Springs Rd.

See Other Side For Additional Listings

JOBBERS AND DEALERS DIRECTORY

FOR READERS OF RADIO-CRAFT

This list of Radio Jobbers and Dealers has been compiled as a service to RADIO-CRAFT readers. The magazine is sold by the stores listed below where they are displayed on counters and shelves for your convenience. At these stores you will also be able to buy standard parts, sets, and every other product of the radio and electronic industry.

NEW JERSEY—Cont'd

Trenton
Allen & Hurley
25 South Warren St.
Carl B. Williams
25 S. Warren St.

NEW YORK

Albany
E. E. Taylor Co.
465 Central Ave.
Binghamton
Broome Dist. Co.
221 Washington St.
Brooklyn
Electronic Equipment Co. Inc.
1460 Bushwick Ave.
Green Radio Distr.
482 Sutter Ave.
Hornbeam Distributing Co.
1639 Bedford Ave.
Buffalo
Buffalo Radio Supply
219 E. Genesee St.
Scheller Radio Co.
269 Oak St.
Standard Electronics Dist. Co. Inc.
1497-1501 Main St.
Cortland
C. A. Winchell
37 Central Ave.
Groton-On-Hudson
WRO Radio Laboratory
6 Hamilton Ave.
Elmira
Fred C. Harrison Co.
108 W. Church St.
Jamaica
Harrison Radio Corp.
172-31 Hillside Ave.
Norman Radio Dist.
94-29 Merrick Rd.
Peerless Radio Dist. Co.
92-32 Merrick Rd.
Jamestown
Johnson Radio & Electronic Equip.
48-50 Harrison Ave.
Mount Vernon
Davis Radio Dist. Co.
66-70 E. 3rd St.
New York City
Adson Radio
221 Fulton St.
Arrow Radio
82 Cortlandt St.
Beam Radio
165 Nagle Ave.
Bian Radio
64 Dey St.
Eagle Radio
84 Cortlandt St.
Federated Purchaser Inc.
80 Park Place
Grand Central Radio
124 E. 44th St.
Harrison Radio Corp.
12 W. Broadway
Harvey Radio Co.
105 W. 43rd St.
Highbridge Radio Television & Appl.
340 Canal St.
B. Lar
210 Greenwich
Niagara Radio Supply Corp.
160 Greenwich St.
Newark Electric Co.
224 Fulton St.
Radio Wire Telev. Inc.
100 Sixth Ave.
Sun Radio
122 Duane
Wilco Radio Dist.
383 E. 138th St.
Olean
Wanamaker & Redstone
413 Third Ave.
Poughkeepsie
Chief Electronics
104 Main St.
Rochester
Hunter Electronics
233 East Ave.
Masline Radio & Electric Equip.
192-196 Clinton Ave. N.
Rochester Radio Sup. Co.
114-118 St. Paul St.
Syracuse
Broome Dist. Co.
912 Erie Blvd. E.
Stewart W. Smith Inc.
325 E. Water St.
Syracuse Radio Supply
238-40 W. Willow St.
White Plains
Westchester Electronic Sup. Co.
333 Mamaroneck Ave.

NORTH CAROLINA

Charlotte
Henry V. Dick & Co. Inc.
311 E. 5th St.
Goldsboro
Signal Radio Supply
124 S. James St.
Raleigh
Supreme Radio Suppliers
130 W. Hargett St.
Winston-Salem
Dalton-Hege Radio Sup. Co.
340 Brookstown Ave.

NORTH DAKOTA

Fargo
Radio Equipment Co.
624 2nd Ave. N.

OHIO

Ashtabula
Morrison's Radio Supply
331 Centre St.
Akron
Brighton Sporting Goods Corp.
110 E. Market St.
Cincinnati
Chambers Radio Supply
1104 Broadway
Herrlinger Dist. Co.
15th & Vine Sts.
Holub & Hogg
500 Reading Rd.
Cleveland
Northern Ohio Labs.
2073 W. 85th St.
Radio Surplus Co.
648 Prospect Ave.
Strong, Carlisle & Hammond Co.
2801 St. Clair Ave.
Winteradio Inc.
1468 W. 25th St.
Columbus
Electronic Supply Corp.
219 N. 4th St.
Whitehead Radio Co.
120 East Long St.
Warren
Radio Specialties
136 S. Pine St.
Dayton
Standard Radio & Elect. Prod.
135 E. 2nd St.
E. Liverpool
Hausfield Radio Supply
414 E. 5th St.
Kent
Kladag Radio Labs.
105 W. Erie St.
Marion
Bell Radio Supply
527 N. Main St.
Steubenville
D & R Radio Supply
156 S. 3rd St.
Hausfield Radio Supply
230 N. 4th St.
Toledo
Lifetime Sound Equip. Co.
911-913 Jefferson

OKLAHOMA

Lawton
Reynolds Radio Supply
909½ C Ave.
Oklahoma City
Radio Supply Inc.
724 N. Hudson, Box 597

OREGON

Portland
Appliance Wholesalers of Oregon
600 N.W. 14th Ave.
Harper-Meggee
1506 N.W. Irving

PENNSYLVANIA

Allentown
Radio Electric Service Co.
1042 Hamilton St.
Altoona
Hollenback's Radio Supply
2221 8th Ave.
Kennedy Radio Supply
1500 Fifth Ave.
Beaver Falls
Reliable Motor Parts Co.
1700 7th Ave.
Easton
Radio Electric Service Co.
916 Northampton St.
Erie
Jordan Electronic Co.
201 W. 4th St.
Warren Radio
12 & State Sts.
Harrisburg
D. & H. Distributing Co. Inc.
311 S. Cameron St.
Lancaster
Eshelman Supply Co.
110 N. Water St.
Philadelphia
A. G. Radio Parts Co.
3515 N. 17th St.
Almo Radio
509 Arch St.
Flanagan Radio Corp.
N.E. Cor. 7th & Chestnut
M. & H. Sporting Goods Co.
512 Market St.
Radio Electric Service Co.
7th & Arch Sts.
3145 North Broad St.
5133 Market St.
Warner Radio Co.
631 Market St.
Scranton
Broome Dist. Co.
26 Lackawanna Ave.
Fred P. Pursell
550 Wyoming Ave.
Sharon
Helges Bros. Inc.
73 Central Way
York
J.R.S. Distributors
646 W. Market St.

RHODE ISLAND

Providence
William Dandreta & Co.
Regent Ave.
Powell Radio Supply
49 Atwells Ave.

SOUTH CAROLINA

Charleston
Radio Laboratories
215 King St.
Greenville
Arthur Rexor
209 W. Washington

SOUTH DAKOTA

Sioux Falls
Power City Radio Co.
209 So. First Ave.

TENNESSEE

Chattanooga
Curle Radio Supply
825 Cherry St.
Kingsport
Radio Electric Sup. Co.
210 Cherokee St.
Knoxville
Bomar Appliance Co. Inc.
520 Western Ave.
Memphis
Bluff City Dist. Co.
905 Union Ave.
Radio & Electronic Supply Co.
1002 Jackson Ave.
Shobe Inc.
1117 Union Ave.
Nashville
Frost Electric Inc.
1922 West End Ave.

TEXAS

Amarillo
R & R Electronic Co.
412 W. 10th St.
Tom Thomas Sound Sales & Service
410 S. Jackson
Beaumont
R. C. & L. F. Hall Co.
961 Pearl St.
Dallas
All-State Dist. Co.
2405-07 Ross Ave.
R. C. & L. F. Hall Inc.
2123 Cedar Springs
Southwest Radio Sup.
1820 N. Harwood
Fort Worth
Ft. Worth Radio Sup. Co.
1201 Commerce
The Electronic Equip. Co.
301 E. 5th St.
Galveston
R. C. & L. F. Hall Inc.
1803 Tremont
Houston
R. C. & L. F. Hall Inc.
1015 Caroline St.
R. C. & L. F. Hall Inc.
1306 Clay St.
Sterling Radio Prod. Co.
1602 McKinney
Laredo
Radio & Electronics Supply Co.
1219 Lincoln St.
Lubbock
R & R Supply Co. Inc.
706 Main St.
Port Arthur
Lapham Radio Co.
309½ Proctor St.
San Antonio
Mission Radio Inc.
814 So. Presa St.
Tom Hopkins Radio
324 Nacogdoches St.
R. L. Ross Co.
118 7th St.
South Texas Radio Supply Co.
445 E. Commerce
Tyler
Radio Service Supply Co.
111 University Place
Waco
The Hargis Co. Inc.
1305 Austin Ave.

UTAH

Ogden
Ballard & Carter Co.
203 24th St.
Salt Lake City
O Laughlin's Radio Supply Co.
113 E. Broadway
Radio Supply Co.
45 E. 4 South

VIRGINIA

Norfolk
Ashman Distributing Co.
807 Granby St.
Radio Parts Dist. Co.
128 W. Olney Rd.
Radio Supply Co.
711 Granby St.
Richmond
Johnston Gasser Co.
1402 E. Main St.
Roanoke
H. C. Baker Sales Co.
19 W. Franklin Rd.
Leonard Electronic Supply Co.
106 Second St. S.W.
Salem
Richie Radio Supply
306 E. Main St.
Staunton
Southern Electric Corp.
14 E. Johnson St.

WASHINGTON

Bellingham
Waitkus Supply Co.
110 Grand Ave.
Seattle
Harper-Meggee
960 Republican St.
Western Electronic Supply Co.
2609 First Ave.
Spokane
Columbia Electric & Mfg. Co.
P.O. Box 1441 S.
123 Wall St.
Tacoma
C. & G. Radio Sup. Co.
714 St. Helens Ave.
A. T. Stewart Co.
743 Broadway
Wible Radio Supply
909 Tacoma Ave.

WEST VIRGINIA

Clarksburg
Trenton Radio Co.
791-93 W. Pike St.
East Charleston
Hicks Radio Supply
10 Virginia St.
Parkersburg
John A. Cox Radio Supplies
554 7th St.
Wheeling
General Distributors
21 10th St.

WISCONSIN

Appleton
Valley Radio Dist.
518 N. Appleton St.
Chippewa Falls
Bushland Radio Spec.
Green Bay
Neslo Electronic Dist.
312 N. Chestnut
Northern Electrical Dist.
708 S. Broadway
Hudson
J. H. Larson Co.
109 Walnut St.
LaCrosse
Stark Radio Supply Co.
131 S. 6th St.
Madison
Satterfield Radio Supply Inc.
326 W. Gorham St.
Manitowoc
Harris' Radio Company
115 No. 10th St.
Milwaukee
Acme Radio Supply Corp.
510 N. State St.
Acme Radio Supply
310 W. State St.
Central Radio Parts Co.
1723 West Fond du Lac Ave.
Electro-Pliance Dist. Inc.
2458 W. Lisbon Ave.
Electronic Supply Corp.
436 W. State St.
Juneau Radio Supply Co.
1337 W. Juneau Ave.
Taylor Electric Co.
112 N. Broadway
Racine
Standard Radio Parts Co.
1244 State St.

WYOMING

Casper
Golden Power Oil & Supply Co.
260 S. Center
Cheyenne
Houge Radio & Supply Co.
2008 Carey Ave.

CANADA

Radio Supply Co. Ltd.
Grd. Floor McLeod Bldg.
Edmonton, Alberta.
Western Radio Supply Co.
328-330 King St. E.
Hamilton, Ontario
Delroy Sales Ltd.
203 Rideau St.
Ottawa, Ont.
Electronic Supply Co. (Ottawa Ltd.)
244 Slater St.
Ottawa, Ont.
Electro-Voice Sound Systems
141 Dundas St. West
Toronto, Ont.
Hygrade Radio Ltd.
673 Homer St.
Vancouver, B.C.

DEALERS: If you are not receiving RADIO-CRAFT, please ask for our Special Consignment Proposition.

TRANSATLANTIC NEWS

(Continued from page 41)

multipath transmissions due to reflections by buildings, mountains, and so on. Despite all that has been said of other systems, practical trials and careful analysis of data have shown that FM stands unrivaled in the field.

Radio and Air Safety

We, like everyone else, have been so worried over the appalling number of airplane disasters all over the world in recent months that the decision of P.I.C.A.O. to adopt standardized systems of navigation and landing aids at all international airports has come as a relief. As the SCS-51 and Loran have been judged the best means of ensuring this, we welcome their coming. At the same time we should like to see the adoption of more specialized aids to the planes engaged in comparatively short hops of 200 to 500 miles, such as we have in England and in many parts of Europe. We're conceited enough to believe that our O.R.B. (Omni-directional Radio Beacon) and P.O.P.I. (Post Office Position Indicator) are the best available aids for jobs of that kind. The latter does *not* show you the way to the post office! It was developed by the engineers of the British General Post Office. Both are responder radar beacons which identify themselves and give his bearing to any pilot whose apparatus "interrogates" them. There is no doubt that chains of such beacons are needed on all flying routes. Warning radio "lighthouses" are also needed to give the pilot notice that he is approaching steep rises in the ground surface.

Rador-Radio Ship

One of the most remarkable ships now afloat is the British Navy's *H.M.S. Boxer*. To all intents and purposes she is nothing more nor less than a floating radar and radio center. Designed to control the fighter planes over troops making a landing, she incorporates six high-power major radar equipments, besides several smaller ones, IFF for both ships and aircraft, radio beacons of various kinds, and radio telegraph and telephone equipment for all bands.

Four masts and a large part of her deck space are required to carry the multiplicity of antennas—"cheeses," "mattresses," "Yagis," simple dipoles, folded dipoles, stacks of dipoles, and just plain honest-to-goodness antennas —that bewilder the eye when you first catch sight of her. The *Boxer* has no room for anything much in the way of armament: all that she carries is a few antiaircraft guns. But she can control and guide home a mass of fighters, besides keeping a lookout for hostile aircraft, surface ships, and submarines; and at the same time conducting two-way communications simultaneously with army and navy headquarters and maybe a dozen other friendly ships. She carries, besides navigating crew, 30 officers and 250 men, all radio and radar specialists.

THE 'SCOPE—A REPAIR TOOL

(*Continued from page 28*)

as was indicated in the first part of this article.

I.F. Section

The next step in the order of testing is to answer the lady who innocently tells us, "My husband noticed that those little screws on top of the cans were loose and he tightened them up good, but the set still plays terrible!" So, on to the i.f. section. The quick check point for this portion, (test No. 14), consists of an observation as it appears on the 'scope of the audio output of the *demodulated i.f. signal* (455 kc), connected across the detector output at the diode load resistor (high end of the 500,000-ohm volume control).

The r.f. signal from the signal generator is tuned to 455 kc, modulated at 400 cycles, and fed into the grid of the 12SA7 converter tube at the stator connection of the antenna tuning condenser. With the radio's volume control in its normal operating position, the signal from the generator is attenuated to the lowest value that will give a useful reading. A check on alignment can be made readily at this point by adjusting the i.f. trimmers with an insulated alignment screwdriver and observing the peaks of the audio signal for maximum output. If there is any reason to suspect an individual i.f. stage (for misalignment, faulty a.v.c. operation, or the like), we follow the injected signal backward step by step through each portion, (Tests No. 10, 11, 12 and 13), successively investigating the second i.f. transformer, the i.f. amplifier tube, the first i.f. transformer, the converter tube 12SA7, and then the a.v.c. action. [For a measure of the a.v.c. action in d.c. volts, a high-resistance (20,000-ohms-per-volt or vacuum-tube) voltmeter may be connected between the high end of the diode load resistor and the chassis. The 'scope is indicating the demodulated audio output.]

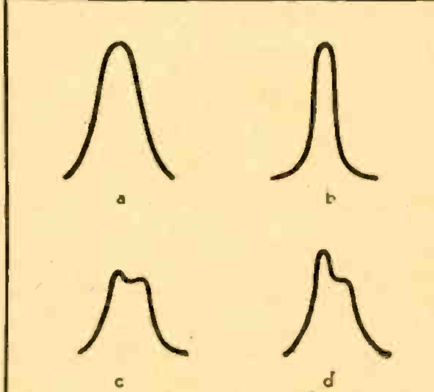


Fig. 1—I.f. patterns discussed in the text.

An even faster and better check of the i.f. system may be obtained by a visual pattern of i.f. response through the use of a frequency-swept ("wobbulated") signal. This method is discussed in a later paragraph and illustrated in Fig. 1.

The receiver oscillator test is the quick check point, test No. 15. The 'scope is still connected to show the demodulated set output (at the voice coil, for convenience in trimming), while the signal generator frequency is increased to 1425 kc, modulated at 400 cycles, to simulate a broadcast station in the upper frequencies. Operation of the oscillator circuit can now be checked while adjusting the oscillator trimmer with an insulated alignment screwdriver for maximum output. If the oscillator circuit is suspected, a rapid check on its operation may be obtained by measuring the negative d.c. voltage at the oscillator grid (pin No. 5 of the 12SA7) with a high-resistance or vacuum-tube voltmeter. This voltage should remain fairly constant (within at least ten per cent) while the receiver tuning dial is rotated through the entire frequency range of the set. (If no oscillator voltage at all is obtained, the signal generator may be substituted for the oscillator by injecting an r.f. signal at the oscillator grid and tuning the generator to a frequency 455 kc above that of the desired station.)

Antenna Section

The final test (test No. 16) is the quick check point for the antenna circuit that should provide a tuned input to the converter tube. To obtain this check on over-all receiver performance with the least possible interaction with other circuits, it is best to couple the signal from the generator by means of a pickup loop of one or two turns of wire with the ends connected to the signal generator terminals. This loop when held near and roughly parallel to the receiver loop, should provide ample inductive coupling for satisfactory receiver operation. The antenna tuning trimmer can now be adjusted for maximum output, first at 1425 kc and then at about 600 kc. A final retrimming of both oscillator and antenna trimmers completes the alignment.

Optional Tests

If available, a signal generator with a frequency-swept (wobbulated) output will provide a very rapid and effective check on the resonance (or band-width) characteristics of the i.f. circuit. This check is especially valuable for high-fidelity receivers. Such a signal has a center frequency equal to the intermediate frequency of the set (455 kc) and is swept above and below this frequency by the "wobbulator" at a periodic rate (such as 30 cycles), which can be synchronized with the EXTERNAL SYNC binding post of the 'scope. (Such signals are available from special Supreme and Hickok signal generators). The expected result, as shown in test No. 17, will appear as a tuning curve showing i.f. response starting with practically zero response below

(*Continued on page 68*)

WORKING ON 50 AND 420 Mc

(Continued from page 36)

The Special Capacitor

The stators of the SEU-15 and two of the rotors are removed and discarded and the pigtail cut off. The remaining 4 rotors and spacers are rearranged as shown in Fig. 4-a. Should an SEU-15 be hard to get, a substitute can be made up as indicated in Fig. 4-b. For this reason dimensions in Figs. 4 and 5 are approximated to allow for minor adjustments. The oscillator plate lines now act as stators and the rotor shaft and spacers should clear the plate lines by about ⅛-inch. At maximum capacitance the flat portions of the rotors are flush with the plate lines. Spacing between them should be approximately 0.020-inch. Stops should be provided so that the rotor shaft will pass through an angle of approximately 120 degrees. The legs of the homemade condenser may be either lucite or bakelite and the stops may be ⅜-inch brass machine screws tapped into the insulating material. If the SEU-15 is used, it *must be* insulated from the plate lines and ground, for the condenser is not at any potential. The frequency range of the oscillator may be extended somewhat by increasing the lengths of the homemade rotors and changing the spacing between the plate lines; changing the lengths of the plate lines will also alter the frequency range.

Working with u.h.f. circuits usually involves a certain amount of machine work. This should not discourage any interested and mechanically inclined technicians. It is well said: "The u.h.f. engineer is a glorified plumber!"

Figs. 5-a and 5-b show the oscillator mounted on a lucite base 11 x 3½ x ½ inches. The edges should be rounded off with a file so that the base can be mounted in a rectangular brass box 11 x 3½ x 3½ inches (conventional chassis do not provide sufficient shielding). Two holes should be cut in this box, in which two Centralab feed-through condensers of from 55 to 100 μμf may be soldered. These are for the A+ and B+ leads, although suitable 2- and 3-conductor connectors and cable are available. Feed-through condensers act as by-pass condensers at these higher frequencies and help prevent the formation of standing waves inside the chas-

(Continued on page 58)

WORKING ON 50 AND 420 MC

(Continued from page 57)

sis and on supply lines. The construction of this shield box may be postponed until the oscillator has been placed in satisfactory operation.

As indicated in Figs. 5-a and 5-b lucite block A is mounted 3 inches from one end of the lucite base so that the tube may be removed easily from its socket. Lucite blocks B and C support the plate lines. Block C should be situated so that it will not interfere with the closing of the C3 rotor. Slits 1/16-inch wide are cut in blocks B and C to a depth that permits the plate lines to be flush with the condenser rotor when the latter is in a horizontal position (maximum capacitance). Approximate dimensions are given here to permit adjustment. However, the plate lines should be raised about one-half inch off the base. Blocks B and C are tapped for 4-40 machine screws which are used to keep the plate lines firmly anchored. Blocks A, B, and C are mounted on the lucite base with ⅞-inch 6-32 flat-head machine screws. If round-head screws are used, provision should be made for countersinking them. All hardware should naturally be brass.

The plate lines should clear the pins of the tube socket by about ⅛-inch. The leads from the plate pins to the plate lines should be about ¼-inch long and should be cut from about 0.030-inch silver-plated brass or phosphor-bronze foil, if available. Otherwise, No. 16 tinned bare wire can be used.

Construction should start with mounting the tube socket and block A. Actual wiring will take only a few minutes. R.f.c. 1 consists of two turns of No. 18 tinned, bare wire, spaced about 1/16-inch, and ¼-inch in diameter (a homemade air-core solenoid). A single-unit terminal strip mounted on top of block A provides a firm anchor for this cathode coil and for the 200-ohm ½-watt cathode resistor. The other end of R2 which rests on top of block A terminates in a second single-unit terminal strip mounted near the other end of block A. It is necessary to experiment a little here to get the leads of R1 and R2, and r.f.c. 1 short enough for the desired frequency range. The second terminal strip is the common ground and should be connected to the box after the oscillator has been mounted in the brass box.

Two 0.045-inch holes are drilled in the middle of the plate lines and r.f.c.'s 2 and 3, consisting of 6 turns of No. 18 tinned (bare) wire, spaced 1/16-inch and ¼-inch in diameter (air-core solenoids as indicated above), soldered in these holes and to single-unit terminal strips appropriately mounted on the lucite base. R.f.c. 4, the same size

(Continued on page 65)

Japanese radio production is increasing more rapidly than that of even the United States. Early last autumn receivers were being produced at a rate exceeding 75,000 per month. Tubes were a bottleneck but were being produced at the rate of 230,000 per month, including a few repeater, transmitter and other non-receiving tube types.

Steps are being taken to improve the quality of radio sets turned out and all plants are establishing quality control systems to insure higher-quality production.

TELEVISION FOR TODAY

(Continued from page 34)

beam horizontally across the screen. In the horizontal circuit this is the width control. In the vertical system, it controls image height.

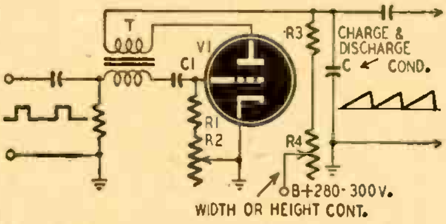


Fig. 7—A saw-tooth-wave blocking oscillator. Two sets of values appear at end of article.

The Multivibrator

Another popular oscillator circuit is the multivibrator. See Fig. 8. Essentially the multivibrator is a two-stage cascaded amplifier, with the output of the second tube fed back to the input of the first stage. Oscillations are possible because any voltage at the grid of V1 produces an output at V2 which is in phase with the original voltage.

Briefly, the operation of the multivibrator is as follows: Due to some disturbance in the circuit, the voltage across one of the grids, say V1, will rise. The increased current, as a result, will lower the plate potential of V1. Since the grid circuit of V2 is coupled to this point (via C1), the decrease will appear as a negative voltage across Rg2 and Rg3. This will decrease the plate current of V2, causing the plate voltage to rise. The positive voltage is coupled back to Rg1 (through C2) and aids the disturbance. The continuation of this action, causing the current through V1 to increase and that through V2 to decrease, is cumulative and rapidly brings V2 to cut-off.

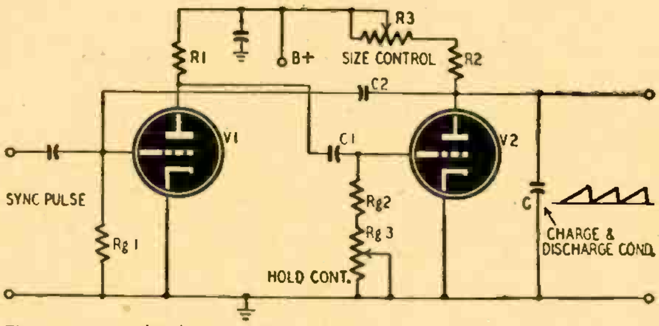


Fig. 8—A multivibrator saw-tooth-wave generator. Values in text.

The length of time that V2 will remain in this condition depends upon the time constant of C1, Rg2 and Rg3. Before V2 can conduct again, the accumulated negative charge on C1 must leak off through Rg2 and Rg3 and the low resistance of V1. As soon as the charge has been lowered sufficiently to permit current flow through V2, the previous set of conditions are reversed. The plate current of V2 increases, coupling back (through C2) a negative charge to the grid V1. Following the foregoing reasoning, V1 is quickly brought to cut-off and V2 conducts.

To generate a saw-tooth wave, the condenser C can be placed as shown in Fig. 8. When V2 is nonconducting, the full B-plus voltage is applied to the condenser and it charges. To discharge it, negative pulse is applied at the grid of V1, driving it into cut off and sharply pulling V2 out of cut off. The rapid transition or flip-over is caused by the coupling of a positive charge from the plate of V1 (due to its being brought from full conduction to cut-off) to the grid of V2, via C1. The positive pulse thus transferred is capable of overcoming whatever residual negative charge still remains in C1.

In designing the network, the time constant of C2 and Rg1 is made considerably longer than that of C1 and Rg2 plus Rg3. The ratio is generally on the order of 9 to 1. One cycle in the horizontal oscillator lasts for 1/15,750 sec., and it is simple to compute the time constant of each. If the multivibrator is used in the vertical system, the time of one cycle is 1/60 sec.

Before leaving synchronizing oscillators, mention should be made of a modified multivibrator which has been widely used. Its circuit, shown in Fig. 9, uses a coupling condenser C1 and the non-bypassed cathode resistor Rk which is common to both tubes.

C charges during the interval that V2 is nonconducting. If, at the proper moment, a sharp negative synchronizing pulse is applied to V1, the plate current will decrease and a positive pulse will be transmitted to V2 through C1. The plate current of V2 rises sharply, the tube resistance decreases, and C discharges through this low-resistance path.

Tube V1 is held to cut-off by the applied negative voltage and the large cathode bias developed as a result of the momentary large plate current of V2. V1 will remain in this nonconducting condition until the grid of V2 becomes blocked due to the flow of grid current resulting from the positive pulse transmitted through C1. When

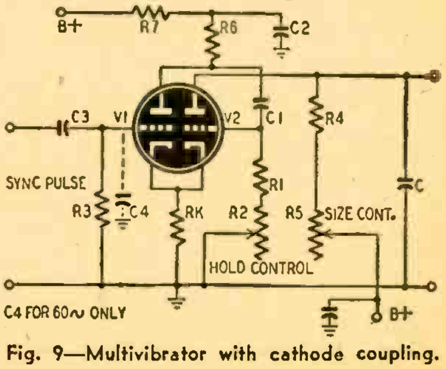


Fig. 9—Multivibrator with cathode coupling.

this occurs, the large negative bias is removed from the cathode resistor and V1 is again permitted to conduct. The length of time that V2 is held nonconducting will depend upon the time constant of C1 and both grid-leak resistors. As soon as the negative voltage here has diminished sufficiently to permit conduction, the switch over from V1 to V2 occurs. For synchronization, the negative pulses applied to V1 should arrive slightly before the switch-over would naturally occur.

Typical Values of Components

Figure 7.

60 Cycles	15,750 Cycles
V1—6J5	V1—6J5
C1—3,300 µµf	C1—820 µµf
R1—1.2 megohms	R1—33,000 ohms
R2—1.2 megohms	R2—50,000 ohms
R3—1.0 megohms	R3—47,000 ohms
R4—2.0 megohms	R4—500,000 ohms
C —0.1 µf	C —500 µµf
T—Best if one is bought which is specially designed for this purpose. These are currently available.	T—A small audio interstage transformer (3:1 ratio).

Figure 8.

V1—½6SN7	V1—½ 6SN7
V2—½6SN7	V2—½ 6SN7
Rg1—2.2 megohms	Rg1—220,000 ohms
Rg2—270,000 ohms	Rg2—68,000 ohms
Rg3—1.0 megohm	Rg3—50,000 ohms
R1—100,000 ohms	R1—47,000 ohms
R2—1.0 megohm	R2—47,000 ohms
R3—2.0 megohms	R3—500,000 ohms
C —0.1 µf	C —500 µµf
C1—0.01 µf	C1—0.001 µf
C2—0.05 µf	C2—0.005 µf

Figure 9.

V1, V2 } 6SN7 6N7 6F8	V1, V2 } 6SN7 6N7 6F8
R1—1.2 megohms	R1—33,000 ohms
R2—1.2 megohms	R2—50,000 ohms
R3—2.2 megohms	R3—2,000 ohms
R4—1.0 megohm	R4—470,000 ohms
R5—2.0 megohms	R5—500,000 ohms
R6—100,000 ohms	R6—47,000 ohms
R7—100,000 ohms	R7—100,000 ohms
C —0.1 µf	C —500 µµf
C1—0.01 µf	C1—0.001 µf
C2—0.1 µf	C2—0.006 µf
C3—0.01 µf	C3—50 µµf
C4—0.001 µf	C4—not necessary
Rk—470 ohms	Rk—470 ohms

—

EASY WAY TO STUDY CODE

Thousands of persons are now studying the International Code. Small groups of neighbors can study code if one of the group owns a broadcast receiver with a microphone jack for home "broadcasting," a microphone of the single-button carbon variety, a key and a buzzer or a small code oscillator.

Arrange the microphone, after plugging it in, so it will sit close to a high-pitched buzzer of suitable character. Place the buzzer as close to the mike as possible so its faint sound will be sufficiently amplified by the receiver. With a code oscillator, use either a small PM speaker or a headphone and place that as close to the mike as necessary. The exact arrangement must be determined by experiment.

Turn on the receiver and tune to a quiet spot on the dial between stations, first disconnecting the antenna and ground. Plug in the mike and hold down the key to obtain a sustained note. Then the volume control of the receiver can be turned up until the sound can be heard easily by all the students.

L. B. ROBBINS,
Harwich, Mass.

(Sometimes all that is necessary is to place the mike before the speaker and key it.—*Editor*)

DUTCH UNDERGROUND RADIOS

(Continued from page 26)

think it was because of the high sensitivity of the set. A ground was provided by the old telephone ground line.

To operate the set you had to turn the dial to seven and pick up the earphone. After that you could wait for Big Ben.

To avoid discovery by anybody who might want to use the telephone and by chance turn the dial to seven, I put a piece of paper above it. "*Pas op! Niet gebruiken, Defect.*" This means in English: "Take care. Don't use. Defective!"

In September, 1944, the Airborne Troops came down over our town and Arnhem had to be evacuated. When I returned everything in the house had been stolen, except my receiver! The Hun had not discovered it!

In Aalten, to which I was evacuated, a town of about 10,000 inhabitants, it wasn't so very difficult to listen to the Voice of Freedom, because there were not so many Nazis in the village.

The man whose house was my home for some time never had a receiver before the war, but now he had one.

It was made by the serviceman in the village and gave very satisfactory results. The circuit diagram is given in Fig. 6 and you can see it is a very common type of regenerative detector.

The tube used is an EF-g, a tube somewhat similar to the 6K7 but with better power output.

Tuning is by an iron-core coil and a variable condenser (L1, C1). The circuit regenerates by means of the tickler coil L2, and is controlled by C2.

Two plug-in coils, made from old

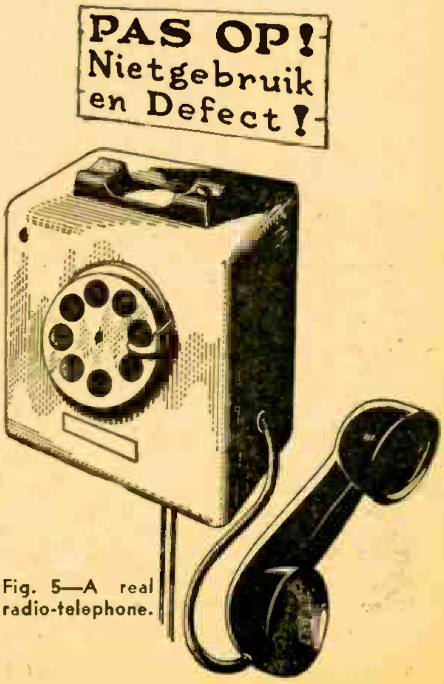


Fig. 5—A real radio-telephone.

tube sockets, were available, one for 200 kc. and one for 1000 kc. The former tuned in BBC; the latter, the broadcasting station in already liberated Holland.

The set was fed by external batteries, but the receiver itself was placed in a small wooden box and looked very good.

Later on the detector was coupled to a power amplifier which drove a 5-inch pm speaker. It gave the best results I have heard from a two-tube receiver.

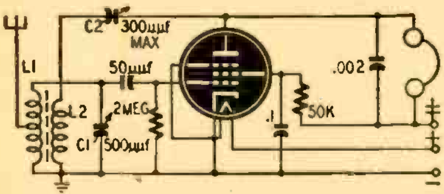


Fig. 6—Another standard underground receiver.

Close-up of one of the clandestine radios.

Total television hours in America's biggest television city (New York) amounted to 1,717 in 1946, *Radio Daily* reported last month.

The time was divided between New York's three television stations, with WNBT's 802 hours maintaining a lead

over WABD'S 625 and the 290 hours of WCBS-TV. Almost 35 percent of this time—606 hours—was commercial.

SUCCESSFUL SERVICE SHOP

(Continued from page 21)

condition of our operating capital. The books are completely balanced each evening, showing the total cash on hand and the bank account. We use an eighteen-column ledger and the disbursements are broken down into classifications corresponding to federal income tax returns. This in itself saves lots of time.

The income portion of the ledger is classified as Merchandise, Labor, and Miscellaneous. The miscellaneous column covers all nonprofit returns to capital account (such as withholding tax and social security) and special discounts on items purchased. We find our books as important and useful in making the shop pay as any instrument on the bench.

We watch our inventory very closely—not only from a dollar standpoint, but *each individual item.* Through the use of our inventory card, a sample of which is reproduced here, we are able to determine how each item is turning over. We attempt to turn our dollar inventory four times a year, and our inventory system is an investment that pays for itself in culling out slow-moving lines of stock.

A local jobber supplies us with the greater part of our needs, but hardly a week goes by that we do not have a jobbers' representative from one of the larger trade centers asking us to consider their line. We certainly have had no trouble obtaining merchandise. I firmly believe, as Mr. Gernsback points out in his editorial, that if the distributor can better himself by giving you critical supplies, he is more than willing to do so.

Ammonium dihydrogen phosphate crystals are now being used in piezo-electric devices.

WORKING ON 50 AND 420 MC

(Continued from page 58)

as r.f.c. 2, can be inserted in the filament lead. The 6J6 has a filament voltage of 6.3 (a.c. or d.c.) volts at 0.45 amp.

The antenna coupling loop, of No. 12 or 14 tinned (bare) wire, is about 2 inches long and ½-inch wide. It is mounted about ½-inch above the plate

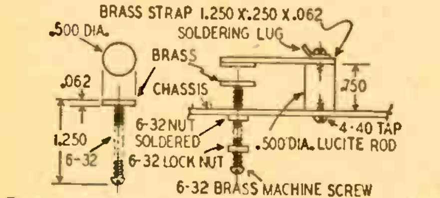


Fig. 6-a—Construction of antenna condenser.

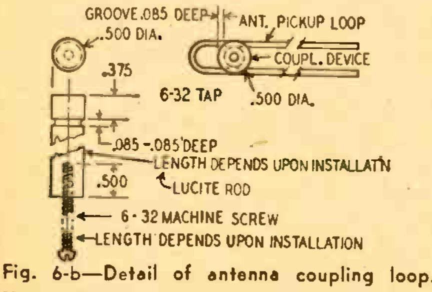


Fig. 6-b—Detail of antenna coupling loop.

lines. One side may terminate in a homemade padding condenser (Fig. 6-a). The other side is fed through a single-conductor AN connector and 52- or 72-ohm coaxial cable to a suitable dipole antenna. If desired, the coupling between the antenna coupling coil and the plate lines may be varied by using the coupling device shown in Fig. 6-b. The exact length of the coupling device depends on whether the antenna loop is mounted on the lid of the brass box or whether it is on the side of the box itself.

When adjusting the oscillator, the plate voltage should be reduced and the d.c. plate current should not exceed 8.5 to 17 ma for each plate. The manufacturers do not recommend operation of the 6J6 with fixed bias.

This 6J6 circuit is interesting for the beginner for it is easy to build and its operation is easy to understand. The circuit is unique in that flat brass strap is used for the plate lines, the conventional shorting bar is eliminated, and a capacity load on the plate lines controls the frequency.

If you like to experiment, try changing the size of the grid loop, then the values of R1 and R2, and then the spacing between the plate lines, noting the changes in frequency range and power output. This is the best way to learn about u.h.f. Another item of interest is that when u.h.f. transmitters are operated in the home they tend to pick up and be modulated by 60-cycle commercial interference from the various electrical fixtures. Considerable filtering and shielding is required in v.h.f and u.h.f. circuits to eliminate this noise.

The North Atlantic Region of the Institute of Radio Engineers will hold a one-day Engineering Meeting May 3 in Cambridge, Mass. All persons interested in radio and electronics are invited to attend. Six technical sessions will be held.

EQUIPPING THE SHOP

(Continued from page 27)

manuals available at a reasonable cost; they may be purchased from firms specializing in selling service manuals, the advertisements of these firms appearing in radio servicing magazines. Some radio schools offer a diagram service to students.

Many people think radio is very difficult. They ask, "I've no mechanical ability beyond handling a screwdriver and pliers; can I learn radio?" In practically all cases the answer is yes. Enroll with a good radio school. That is the most efficient way of getting started. Some individuals can learn by self-study, but a great amount of time is required. Some such individuals—of unusual ability—may become better radiomen than the average product of radio schools, others less brilliant, will not be thoroughly trained. For the average person, radio school training is essential. Even radio amateurs can benefit by taking a radio course, and thereby secure greater enjoyment from a fascinating hobby.

On the lips of many people today is the question, "Will there be job opportunities in radio?" In a word: "YES!" Opportunities in this field were never greater; for engineers, for servicemen, all interested in maintaining, designing, repairing all sorts of radio receiving, radio transmitting and electronic equipment. War-born radar has opened up new fields for employment in manufacturing, distribution and maintenance. This is definitely a radio-electronic age. Aviation and marine (ship) radar and standard radio applications will mean many jobs. To many, servicing work in any of these fields will be very attractive.

ANTENNA PRINCIPLES

(Continued from page 31)

mission line since the ends have opposite r.f. polarity at any instant. The difference of potential between the opposite edges of the slot is greater than it is between top and bottom of the cylinder, therefore the tendency is for electrons to travel *around* the loops rather than up and down. Because of the opening in the cylinder the field pattern is not truly circular. Slightly greater radiation takes place in the direction of the slot.

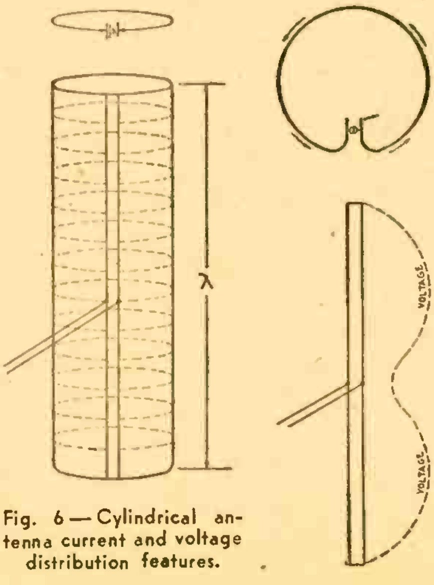


Fig. 6—Cylindrical antenna current and voltage distribution features.

Television service for 32.8 percent of the population of the United States is already assured by construction permits or licenses granted to 57 prospective stations in 30 metropolitan districts.

The Rocket is especially designed by Finch for FM and FAX transmission. It is a long hollow metal cylinder with a metal bottom and open top. Two rockets may be joined at their open ends to form a double rocket. Still higher directivity is obtained through the use of two double rockets, (known as a double-double array).

The Pylon Antenna

One of the most recent additions to the large family of FM antenna systems is the RCA pylon. As many as eight sections may be stacked to provide a gain of 12. The cylinder is rolled from a single sheet of metal forming a unit 13 feet high and 19 inches in diameter with a narrow vertical slot. A close-up of the pylon is shown in Photo C.

Height for height, the cylindrical antenna is claimed by its manufacturers to give greater gain than any other type of radiator. In addition, it is easy to erect and offers minimum wind resistance. Gain factors and field pattern of the pylon appears in Fig. 7.

The RCA Super-Turnstile

Technicians are acquainted with the fact that a circular pattern is obtained when two voltages of the same frequency, but displaced by 90 degrees, are fed to an oscilloscope. Each voltage is fed to one pair of deflecting plates. The same principle is utilized in the turnstile to produce a circular field pattern. Actually the antenna consists of two separate radiating units at right angles to each other. Each unit is fed with a voltage 90 degrees out of phase with the other.

Turnstile arrays were used before the war for FM transmission. The new Super-Turnstile has additional features which make it suitable for FM or for the very-wide-band modulation required by television (about 6 mc.). The ordinary dipole elements have been replaced by "current sheets" which have practically the same effect as solid metal sheets but which reduce wind resistance. These sheets have been shaped to produce an effect similar to that of a half-wave dipole, but they flatten out the frequency response so that a band width of about 40 percent (of the carrier frequency) can be handled. The open framework is constructed of steel tubing, each vertical member being grounded at both ends. A three-bay Super-Turnstile is shown in Photo D.

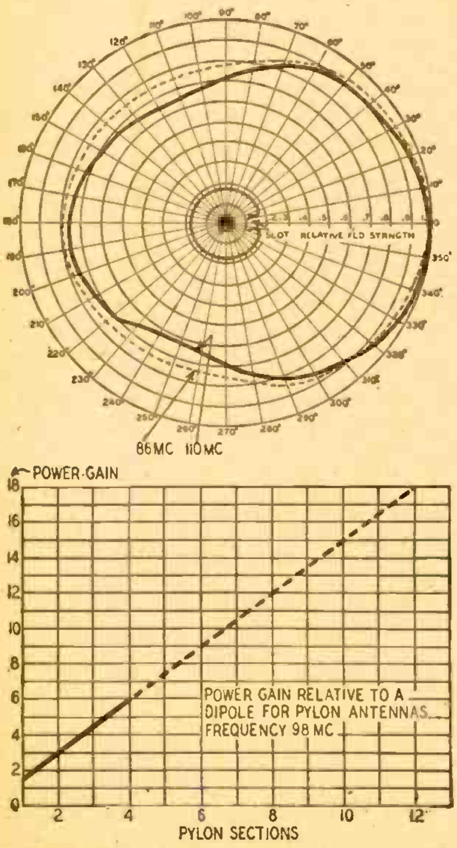


Fig. 7—Pylon field pattern and power gain.

THE 'SCOPE—A REPAIR TOOL
(Continued from page 56)

resonance, climbing up to a peak at resonance, and then falling off to practically zero above resonance, in one half cycle of the recurrence rate of 30 cycles. The next half cycle retraces the pattern with the frequency changing in reverse order. This double pattern remains stationary on the screen with the proper synchronization. These off-resonance response characteristics are shown in Fig. 1, which is simplified by showing only the trace produced in one direction. The part marked "a" in this figure shows a representative *single-peaked* response; "b," an excessively sharply-peaked response; "c," a typical broad (or high-fidelity) response; and "d," an example of misalignment in the i.f. transformer.

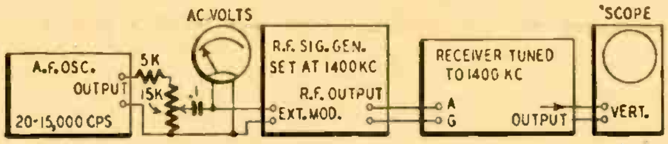


Fig. 2—The receiver can be checked for frequency characteristics with the set-up above.

Fidelity Response

A check on the fidelity of the entire receiver also can be made without a frequency-swept signal by the use of a variable-frequency audio oscillator to amplitude-modulate the generator signal (test No. 18). This can be done with most standard signal generators by connecting the measured output of the audio oscillator to the EXT. MOD. terminals of the signal generator, as shown in Fig. 2. By establishing a reference, around 400 or preferably 1,000 cycles, and noting the audio voltage produced by the signal generator, the frequency of the audio oscillator can now be run higher while maintaining the same voltage output by its attenuator. Experience with various sets will show the amount of falling-off at high frequencies to be expected from various types of sets.

Apart from the audio section, a common cause of poor high-frequency response is found in i.f. transformers that are peaked too sharply, cutting off part of the side bands of the high audio-frequency modulation. Such a fault, when not inherent in the design, can be easily located and remedied by the use of this method.

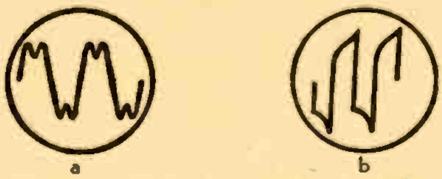


Fig. 3—Amplitude and harmonic distortion.

Summary:

This *quick check* method for localizing trouble calls for observing the following indications:

First: The filtered d.c. pattern (test No. 3); Second: The amplified a.f. signal pattern (test No. 9); Third: The amplified and detected i.f. signal pattern (test No. 14); Fourth: The converted heterodyne signal pattern (test No. 15); and Fifth: The tuned and converted r.f. signal pattern (test No. 16); and also additional optional tests on frequency-swept signal patterns (test No. 17), and variable-frequency, amplitude-modulated ones (test No. 18).

Of the many possible trouble indications encountered, aside from obvious nonoperation or too weak operation, the most common type of distortion is amplitude distortion (known also as harmonic distortion), which is illustrated in two forms in Fig. 3. Since its cause is some condition which results in the tube operating on a nonlinear portion of its characteristic curve, the trouble generally will be found to be an incorrect bias resistor (that may have changed in value with time), or to a tube being overdriven by an excessive signal (even though correctly biased), or some similar condition. Fig. 3-a illustrates a mild distortion, consisting mostly of a third harmonic component, that might have been introduced by slightly incorrect bias; Fig. 3-b shows an extreme condition in which the input signal overdrives the tube or a leaking coupling condenser upsets normal operation.

QUAINT SERVICE CUSTOMS

Servicemen in some foreign lands run up against problems and conditions not dreamed of by the American repairman.

In China, if the radio owner is interested in both local and foreign programs, the serviceman may be in a quandary to assure proper tone quality, because Western programs sound best with the basses accentuated, while Chinese music must have the trebles brought out. Thus, the tone control is backed up as far as possible for Chinese programs, while for foreign music it is advanced toward the forward stop. Thus the serviceman is in wrong if the radio does not amplify well at both ends of the audio range.

In Ecuador the radioman enjoys a siesta every afternoon for a three-hour period. During that period of time he cannot be disturbed no matter how urgently a radio set owner desires his services. And every radio repairman automatically takes one week off every six months, during which, so far as he is concerned, his shop ceases to exist.

BUILDING A TELEVISER

(Continued from page 32)

cation of the installation will determine, to a large extent, the selection of a suitable antenna. In suburban areas, antennas such as those shown in Photo A

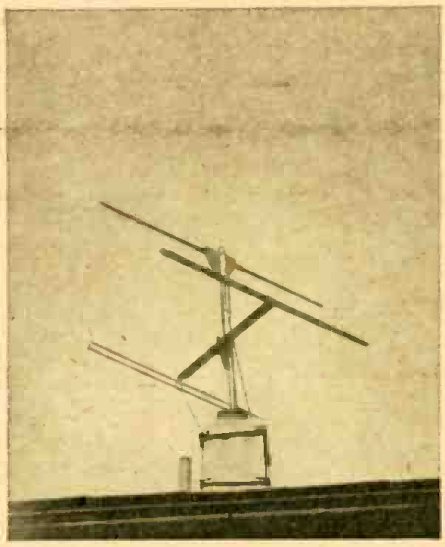


Photo A—The author's own television antenna.

may be used with satisfactory results. The top antenna is a dipole made of 1½-inch aluminum tubing and is connected to the receiver with 72-ohm coaxial transmission line. This antenna is cut for 60 mc and was used for receiving old Channels 1 and 2. It is satisfactory for the present Channels 2 and 3. The bottom antenna, used for receiving Channels 4 and 5, is a folded dipole made of ½-inch aluminum tubing and connected to the receiver through 300-ohm twin-lead transmission line. This antenna is cut for approximately 76 mc. Where the receiver is located in city areas it may be necessary to place reflectors behind the antennas to reduce ghosts due to signal reflections from buildings. Television signals are received along a line-of-sight path from the transmitter; therefore, any tall objects in this path should be avoided as they will absorb and reflect the signal. The receiver described here is used approximately 25 air-line miles from New York City and gives more than sufficient signal strength, although the antennas are only 25 feet above the ground. Each installation will be an individual case and the antenna should be adjusted in height and direction to give the best picture. Wide-band-type antennas should be used to give the best results. More details about the selection and installation of antennas can be found in any standard radio handbook and in the series of articles currently appearing in RADIO-CRAFT.

After the set is completed, it can be built into any type of cabinet that suits the decorative scheme of the home. The cabinet used by the writer houses the televiser as well as a phonograph and amplifier and an all-wave receiver. This televiser has been in service for two years and has given very little trouble.

SWITCHING AND TRIGGERING

(Continued from page 23)

thermometers constantly and regulate the heat supply and prevent temperature variations become unnecessary. One man can oversee many automatic controls.

For example, a heat chamber requires that a constant temperature be maintained at all times within it. To achieve this stability, a mercury thermometer may be installed in the chamber. A small source of light is focused through the thermometer on a phototube. A heater controls the temperature of the chamber, and is turned on and off by means of a relay actuated by an electronic switch.

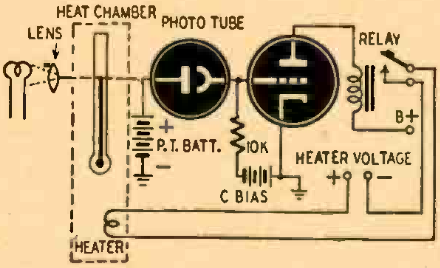


Fig. 3—Temperature control with phototube.

Operation of this circuit (Fig. 3) is similar to that of preceding switch circuit.

When the mercury in the thermometer falls below a certain required level, light strikes the phototube, causing it to conduct. Resultant current passing through the grid resistor provides sufficient grid voltage for the triode to conduct. Plate current flows, and the relay is energized, turning on the heater to provide additional heat in the chamber. As heat increases, the column of mercury rises until it intercepts the light beam. This stops photoemission, and permits the grid voltage of the triode to return to its fixed negative value—preventing conduction. Interruption of current through the relay coil turns off the heater in the chamber, until such time as the mercury in the thermometer drops below the critical value.

In similar ways, phototubes can be used to control illumination and determine smoke density. They can also be used to stop machinery when the product is imperfect. Phototube switch circuits are also frequently employed as safety devices—protecting workers engaged in dangerous phases of manufacture or production.

One such protective device is an electronic switch developed and used by RCA, which provides an invisible guardrail of infra-red light between die presses and workers' fingers (Photo A). Two small mirrors reflect a beam of infra-red light across the front of the die press and back to a phototube—the input of the electronic switch. Any interruption of the beam trips controlling relays and locks the powerful press with dies open.

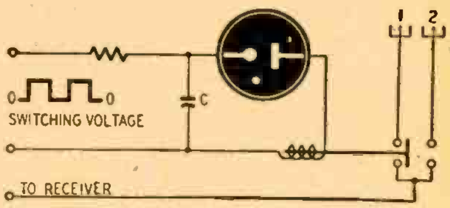


Fig. 4—A switching circuit using gas diode.

Courtesy RCA

Photo A—Phototube-operated electronic safety switch. Interrupting beam locks die open.

Gas-Filled Tubes

Gas-filled tubes—both diodes and triodes—are extremely useful for high-speed switching, because of their low internal resistance and their unusual conducting properties.

When such a tube is not conducting, the resistance across the device is very high. However, as the plate voltage is increased, the gas ionizes at the *instant* the plate voltage passes a given critical value. Current then flows through the tube and related circuit, until such time as the plate voltage is decreased and reaches a *second* critical value—at which time the gas becomes de-ionized and the tube ceases to conduct.

Introduction of a grid provides greater control of the tube's operation, but doesn't disturb above general function.

A simple relay switching circuit (Fig. 4) illustrates the action of a gas-filled diode. In this arrangement, either of two antennas can be connected to a single radio receiver—and it's desired to switch between them alternately at a very high speed. When the switching circuit is not in operation, a tension spring on the relay connects the arm to antenna 1. Application of a control impulse charges condenser C (Fig. 4), applying a positive potential to the plate of the gas-filled diode. When this potential reaches the critical voltage of the tube, the diode suddenly conducts. Resultant heavy current operates the relay arm, moving it instantly from antenna 1 to antenna 2. When the trailing edge of the control impulse suddenly reduces the voltage on the tube to zero (or a minimum value), the condenser C is discharged. Plate voltage is removed, the diode ceases to conduct, and the de-energized relay arm springs back to its original position.

Switching action is wholly dependent upon the control impulse. Thus, a series of pulses recurring at a high frequency would cause the two antennas to feed alternately into the receiver at that rate. Details of damping, etc., to prevent switch clicks have been omitted. But the variety of uses of such an arrangement are immediately apparent.

Precision Switching

Requirements of some types of precision switching circuits demand that the output impulses have very steep sides and sharp corners, be of extremely brief duration, and have sufficient voltage (or current) amplitude to activate the actual switch device.

Formation of pulses having such form and dimensions can be easily accomplished by pulse-forming stages contained in the complete electronic switch. Although the number and arrangement of such stages is almost limitless, individual functions of the stages in a control circuit are basically simple. Fig. 5 illustrates this simplicity.

As an industrial example, assume that the feed line for a high-speed automatic stapling machine must be regulated so that the machine functions at maximum efficiency. Staples fed to the machine 600 times per minute—or 10 per second—will do the trick. The feed line is controlled by an on-off low-capacity relay, which is actuated at the desired rate of 10 times per second. Direct actuation of the relay is accomplished by means of a series of recurrent, properly shaped pulses—produced

(Continued on page 72)

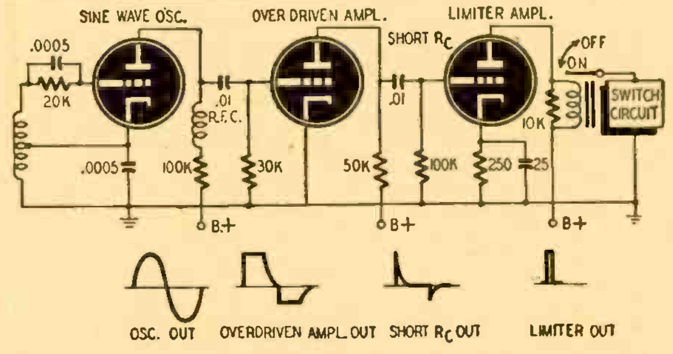


Fig. 5—Electronic switch. Relay is held down during output pulse.

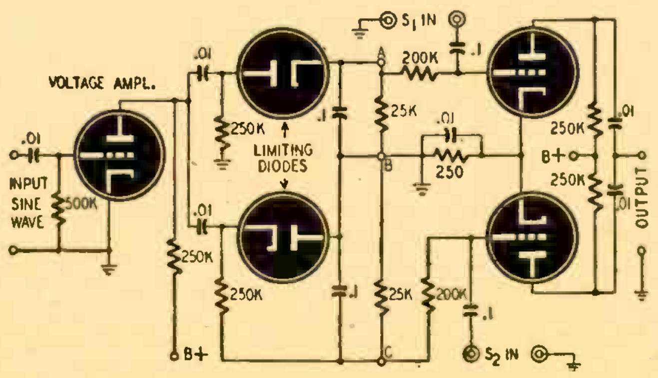


Fig. 6—A double-throw electronic switch.

SWITCHING and TRIGGERING

(Continued from page 71)

by an electronic switch *without* exterior control.

The rate of pulse repetition is the *pulse recurrence frequency*. This is the same as the *resonant frequency* of the audio oscillator located in the first stage of the switching circuit (Fig. 5).

Output of the oscillator is applied to pulse-forming stages which reshape the oscillations—and produce a series of recurrent pulses having the desired amplitude and duration. Exact shape of the voltage (or current) pulses will depend upon the input requirements of the relay or other electro-mechanical device being actuated.

Other Switches

One popular type of electronic switch uses a pair of triode or multigrid vacuum tubes to switch alternately between two input signals providing a consolidated output. The rate of switching between the two input signals is determined by a square-wave control voltage derived from a sine wave of known frequency. The complete circuit of the switch (Fig. 6) consists of a straight triode amplifier, two diodes providing positive and negative limiting of the controlling sine wave, and the two control tubes. These two tubes constitute the electronic switching action. Each tube is biased just beyond cutoff, and each tube receives one of the input signals.

After amplification by the triode, the input (control) sine wave is clipped and squared by the two limiting diodes. A positive half-cycle square wave appears between circuit points *A* and *B* (Fig.

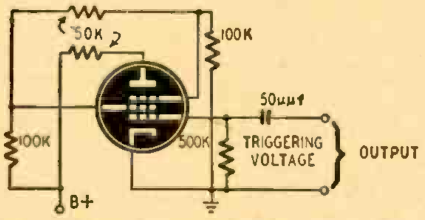


Fig. 7—Triggering circuit with pentode tube.

6), and a negative half-cycle square wave between *B* and *C*. Both of the switching tubes are biased just beyond cutoff. But the positive voltage — between points *A* and *B*—makes switching tube 1 conductive, and input signal S1 passes through tube 1 into the output of the control circuit. Switching tube 2 does not function, and input signal S2 is not passed into the output.

When the input (control) sine wave changes polarity and the half-cycle square waves—the limiter outputs—*also* change polarity, the condition is reversed. Positive voltage between points *B* and *C* make switching tube 2 conductive, and signal S2 passes through the tube into the output. Since tube 1 is not conducting during this half cycle, it effectively blocks signal S1.

Thus the two input signals—S1 and S2—appear alternately in the output of the switching circuit at a rate of recurrence determined entirely by the frequency of the input (control) sine wave of voltage.

Typical commercial model of an electronic switch (Photo B) is the General Electric type YE-9 for comparative studies of wave-form phases, frequency relationships, and amplitudes of any two input signals. Use of two such electronic switches in cascade permits simultaneous study of three independent input signals.

Many electronic switches are designed primarily for use in conjunction with cathode-ray oscilloscopes, to make possible the observation of two wave forms on a single cathode-ray screen. Such an arrangement is ideal for close examination and accurate comparison of two signals. Although the two wave forms are not actually on the screen simultaneously, they appear so to the human eye.

Trigger Circuits

An *electronic trigger* is a control circuit producing a source of electronic impulses which are used to cause an action in related circuits or devices connected directly to the output of the trigger circuit.

That is to say, the output impulses may start the operation of a secondary circuit or device. Or they may stop such operation. Or they may cause some other single electronic action to transpire sooner or later than it would normally.

The important characteristic of trigger-circuit impulses is that the *leading edge* of each pulse is the governing or controlling part of the wave form (See Fig. 1-B). Trigger impulses thus require no degree of definition or sharpness to their trailing edges, which considerably simplifies their generation and formation.

Pulse-forming circuits — similar to those previously described — may be used to produce trigger pulses. Simpler circuits can be employed, and the variety is extremely wide and flexible.

Every self-operated saw-tooth time base incorporates a trigger device of one kind or another. Thus many kinds of saw-tooth generators are immediately embraced into the family of trigger circuits. To these must be added most

(*Continued on page* 74)

Courtesy General Electric Co.
Photo B—A switch for study of two signals.

SWITCHING and TRIGGERING

(Continued from page 73)

of the relaxation and negative-resistance oscillators, since trigger circuits actually form the fundamental basis of their operation.

Probably the most popular of the present-day electronic trigger circuits are the Eccles-Jordan and flip-flop oscillators, with their many variations.

One such variation, using a single pentode tube, is shown in the trigger circuit of Fig. 7. Resistance coupling is used between the suppressor and screen grid. The circuit may be placed in operation by any one of three methods: (1) by inserting voltages in series with any of the supply voltages, (2) by changing any of the circuit resistances, and/or (3) by voltage impulses applied directly to the grid of the pentode. In actual practice, the most sensitive electrode for triggering purposes is the control grid.

Trigger circuits are widely used to control multivibrators and almost all types of electronic oscillators. There are also numerous methods for using electronic triggers as control devices.

For example, the voltage across a coil or resistance in the trigger circuit may be applied as a control voltage to a component or tube of a secondary circuit. Or, the current passing through some part of the trigger circuit may be used to operate a relay or other current-controlled device in another circuit. In some electronic applications the current drawn by a grid-limiting resistor is used to operate a relay in another circuit; and in other cases the entire voltage drop across a vacuum tube is used to trigger a secondary circuit.

RADIO-ELECTRONICS MONTHLY REVIEW

(Continued from page 19)

From time to time the statement has appeared that in my invention I contributed the grid to a rectifier, the Fleming Valve, and thereby created the Audion or the three-electrode tube, the present heart and soul of radio communication. What could be more simple in the way of an explanation? What at the same time further from the truth, and still further from a knowledge of the simple facts of electronic principles?

To recognize that the anode voltage is as essential a feature of the Audion as is the third electrode, that by virtue of this local energy alone is the Audion a relay device, and therefore an amplifier of transcendent value, instead of a mere rectifier of received alternating currents—seems so self-apparent, that I have always been at a loss to understand why anyone should fail to grasp it.

Add a third, or any number of electrodes, to the Fleming Valve and it remains a valve—a mere rectifier, possessing the utility of the rectifier and nothing more.

The evolution of the Audion patent claims marks, in a general but incontestable manner, the evolution of the Audion—first it was a gas effect in the open air, then in an enclosed vessel, then in an exhausted vessel, exhausted like an incandescent lamp—then to higher and higher degrees of vacuua (as early as 1912 I employed an X-ray vacuum). But it was always a relay. Always the B-battery was employed. The control-electrode idea even preceded the enclosed vessel. And *never* was the Audion "the Fleming Valve with merely a grid added."

Following the close of the first World War, I resumed my early broadcasting work, using the oscillator tube at the transmitter and the audion detector and amplifier at the receiver. With these three necessary components at that time so well developed, the possibilities of the radio broadcast began to be appreciated by various commercial agencies and with such zest that in the 1920's a new major industry had attained maturity, demonstrating its unlimited possibilities commercially and culturally, fittingly to be described as an expanding universe, an instrumentality which has been justly compared with the invention of printing.

The electron emerged from the university laboratory briefly before the beginning of the century. Its application to the service of man dates from the first knowledge of how to control its migrations through vacuo. Starting with that discovery the utility of this new physical tool has so amazingly accelerated that the first half of our century is fittingly termed "The Electronic Age."

From such humble tasks as control of a drinking fountain to transmitting a signal to our moon and return, even to those involved in the process of the cyclotron, where the foundation stones of our universe are shattered, scarcely a phase of activity in science, technology, or medicine has failed to demand essential aid from the vacuum electron.

Following world communication and broadcasting the tube with its manifold circuits has produced the talking picture, the living reproduction of recorded music, and Television—gigantic new industries, now or soon to be.

(Continued on page 76)

RADIO-ELECTRONICS MONTHLY REVIEW

(Continued from page 75)

Outstanding names among early leaders in electron investigation are Pierce, Chaffee and Zworykin, that genius who wedded the Iconoscope to the grid amplifier to give Television to the world.

Here in glass and metal lies the control of the world's greatest force, the electron. Here is man's eye to see through solids, beyond horizons, and to behold the infinitesimal, to make audible the inaudible, his voice heard around the world, his mastery of time, temperature and motion.

In the electron tube lies the safety of all who fly, making possible today's crowded aviation; the tube which now stands mutely asking leave to end collision, by water, air and rail; there lacking only sufficient of man's humanity to man to put it, generally and intensively, to that merciful job.

I count myself most fortunate among men to have been granted to live to see this gigantic unfolding of an implement, and an idea, which first came to me more than 40 years ago.

A.C. MAGNETIZER

An a.c. magnetizer will often prove useful around the shop for magnetizing screw drivers and other small tools and parts. It may also be used to remove troublesome magnetism.

The magnetizer consists of an old 6-volt speaker field coil, a porcelain light socket, and a quick-acting switch, all mounted on a firm wooden base. The field coil is firmly clamped onto the base and wired across the 117-volt a.c. line in series with the switch and socket. If the coil has a resistance greater than 10 ohms (roughly), then a 10-amp fuse can be used in series, but if the resistance is much lower, then a 660-watt heater element should be used. The switch can be any push-button type, or can be made from a strip of tin with an insulated knob on the end, a key-type switch being easier and faster to use.

To use the magnetizer, place the object to be magnetized in the field coil, push down the switch, and while holding down, draw the article out of the coil, thus completely demagnetizing it. Then replace the object in the coil, and give the switch a quick tap. To successfully magnetize anything, the connection must be made and broken while the a.c. is at the peak of a cycle, therefore, several attempts may have to be made until the object is sufficiently magnetized. When the switch is held down too long, the next cycle will reverse the field and demagnetize the metal. If the article is not held firmly when magnetizing, it may be shot out through the coil. To magnetize objects too large to enter the field coil, various jigs may be made which will fit into the coil and conduct the magnetism to where it is needed.

LEWIS SWANSON, JR.,
Toronto, Canada

OPPORTUNITY AD-LETS

MULTI-STATION INTERCOMS

(Continued from page 37)

The Talk-Listen switch in Figs. 1 and 2 is a rotary wafer-type switch with two positions and a spring action. In the upper or normal position, the station is in a listening condition; when the switch is held down (by a long offset bar knob) the user may transmit. In the "listen" position, the amplifier input is disconnected and the speaker connected to the incoming line corresponding to the station number. The upper station is No. 1 and connection "x" is made to line 1. The lower is station 2 and the "x" connection is to line 2. Now, if station 2 presses down his T-L switch, his speaker is transferred to his input transformer. His output transformer is connected, through the station selector, to line 1 and thence to the speaker of station 1, where his voice is heard. Then he releases his T-L switch and station 1 may connect its speaker to its input transformer, and its output transformer—through its station selector—to line 2 and the speaker of station 2. Each station, of course, selects the station to which he wants to talk by means of the station selector. The number of stations available is determined only by the number of points on the selector and, with standard switches, may be as high as 11, if the off position is omitted.

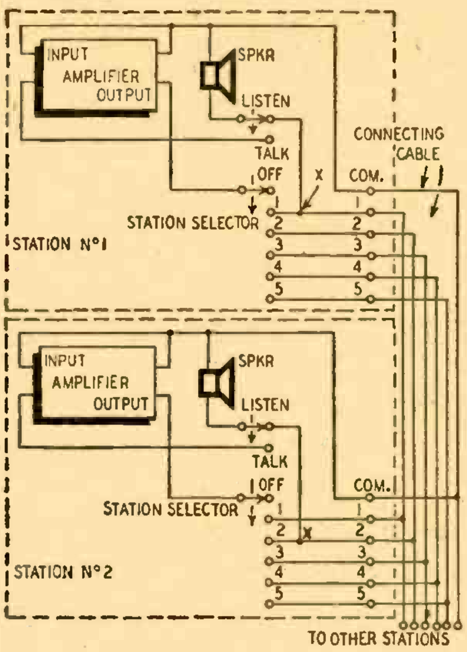


Fig. 2—Master-to-master switching system.

There is, of course, some slight hum in these amplifiers. If the selector of any station is left connected to a line, the station to which it is connected will hear the hum. While this is not excessive, provision of an off position silences the system. Another important point is the privacy. Note that no station can listen to a conversation uninvited, since the transmitting station selects the station to which it will talk. A station cannot select the station to which it would listen. Of course, as many separate conversations can be carried on over this system simultaneously as the number of lines permits.

WHY RADIO SPECIALIZATION?
(Continued from page 17)

of other subjects. They are all young too—from 18 to 22—and they know their subject, often amazingly well. These young men find little trouble in securing lucrative positions. Laboratories, manufacturers, and others are always on the lookout for such men—indeed they write and phone us right along to fill existing vacancies.

This brings us back to our letter. We agree at once with the college educators who maintain that what the student needs is "generalization." The embryo-engineer to a certainty should know all there is to be known in Electrical, Mechanical, or Civil engineering BEFORE he attempts to specialize in any given subject.

You must be an excellent skater *first* before you can become a trick figure skater.

Our correspondent realizes this perfectly himself when he says as much in his third paragraph—"the large companies . . . realize the impossibility of (colleges) teaching a student all he should know." Precisely. And that is the unfortunate rub. I have maintained for over 30 years that college training in this country leaves very much to be desired. The fault is decidedly not the student's, but the faculty's. The teaching system is wholly inadequate in all too many of our universities. With the exception of a few really good institutions, the bulk of the others do not equip the student with a dense enough core of learning to face a harsh and practical dollar-minded world after his graduation. I am far from being the first to make this indictment—it has been made countless times before and it serves no purpose here to suggest the obvious, needed remedies.

The fact remains that probably 80 percent of our college graduates remain still "students" for many years to come. They just do not have the necessary knowledge to succeed soon, because *their fundamental knowledge is woefully inadequate.*

Thomas A. Edison, in his lifetime, as is well known, never employed recently-graduated college men. Over a stretch of 38 years as a pioneer radio manufacturer and technological publisher I have not found it possible to engage more than a total of four young college men out of a total of several thousand employees! Hundreds upon hundreds applied as technicians and for editorial positions that were open, but only a negligibly small percentage could make the grade. When they looked over the questionnaire which I had prepared to test their knowledge (see end of this article) they fled! Or if they attempted to answer it, the result usually was pitiful in the extreme.

This should not by any means be construed as an indictment against college personnel as a whole. Quite the contrary. There is no question that we could have employed dozens of excellent engineers if we had wanted older, experienced and high-salaried men. Unfortunately, in a specialized business it would be necessary to break in such men too, teach them our routine, special requirements, etc. That is most expensive if you employ $5,000 to $8,000 men. For that reason it is better to select younger, less experienced men, as long as they must be broken in to the work anyway.

Unfortunately, when it comes to generalization, as taught in colleges, the term *superficialization* would be more appropriate. Generalization is excellent if the student is taught the subject *thoroughly.* It is useless if the knowledge which he gains is sketchy. And in all too many cases that is what happens today. Most of our colleges attempt to teach too much, drill in too many subjects not too closely related, with too few teachers, in far too short a period. The result is obvious—inadequacy.

Then when we present the young graduate with a questionnaire to get under his skin and test his knowledge, he often will come up with the standard cliché: "Oh, that kind of stuff should be looked up in a textbook." That is like trying to learn a foreign language by consulting a dictionary—one is apt to draw the most erroneous and ridiculous conclusions. *There is no substitute for knowledge.*

Fundamentally there is nothing wrong with textbooks. Unfortunately students have not sufficient time really to study the books thoroughly. Nor do they study enough GOOD books as a whole. Often the selection of certain textbooks is unfortunate—for many are incomplete and outdated. Frequently a little-known volume may be better than many textbooks on the same subject. *Nothing becomes obsolete quicker than a radio textbook.*

In due time the intelligent graduate student learns how to equip himself with books, magazines and other technical literature. He learns "book" research as applied to his own endeavor, and thus makes up for the partial vacuum acquired during his whole college life.

To sum up: We certainly believe in Generalization before Specialization—IF the generalization IS THOROUGH.

If you do not agree with the statements made here, may we suggest that you test a number of young college graduates with the questionnaire that follows. The questionnaire is similar to one used for many years as a test by a number of our organizations.

Most of the subject questions can be found in textbooks or engineering papers in any good technological library. Every one deals with electricity, radio, or a subject closely related to both. There are no out and out "trick" questions. All are on practical subjects such as come up continuously in engineering.

Yet that young college man who can answer even 80 percent of the questions without referring to books must be rated a first-class genius or a prodigy.

The answers to the questions that follow may be found on page 80.

STUDENTS' RADIO QUIZ

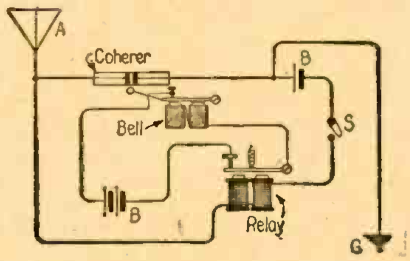
1. What is the composition and under what name is the most powerful type of permanent magnet known today?
2. If the fine wire hair-spring of a watch was magnetized accidentally, how would you restore the watch to perfect operating condition without taking it apart?
3. Without any electrical equipment how can you tell if a current supply is a.c. or d.c., merely by observing the light of an electric light bulb?
4. You are handed a positive and a negative lead storage battery plate. Which color is the positive, which is the negative?
5. You have a condenser such as used in radio. What tests do you make to find out if it is defective or still useful?
6. If no regular type of loudspeaker were available for a radio set, how would you make a condenser talk or get sound from it, to serve as a makeshift loudspeaker?
7. Give elements of a simple tone control.
8. Given the value of the parallel tuning condenser, how would you compute the inductance of a coil to resonate at 990 kc?
9. What is a coherer? Draw a diagram of a simple coherer and de-coherer.
10. How does an electron microscope work?
11. Sketch or give hook-up of a simple stroboscope.
12. Name the two main radio uses for selenium.
13. What is the Electret and how does it work?
14. How would you store electricity for a number of hours with well-known radio components? (Storage battery excluded.)
15. How can you generate from 75 to over 100 volts using only an ordinary electric house bell connected to a 3-volt battery? Sketch explanatory hook-up.
16. How would you devise a variable resistor to have no sliding contacts nor work on the compression or electrolytic principle?
17. What is the principle of the Bell Photophone and how does it work?
18. What form of natural lightning travels only a few feet per second and is often deadly?
19. What is an Ano-Kato? How does it work?
20. How does an electric Trevelyan Rocker operate?
21. What is the Hughes Induction Balance?
22. What is used as a depolarizer in an ordinary dry cell?
23. Describe a Geissler tube.
24. What is a Spinthariscope?
25. How can you generate cold with two metals and a battery?

FOR ANSWERS TURN TO PAGE 80

ANSWERS TO STUDENTS' RADIO QUIZ

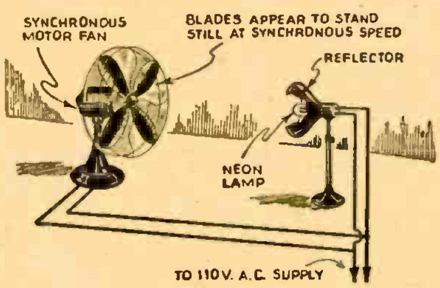
On Page 79

1. Alnico 5. The magnet contains aluminum, nickel, cobalt and iron.
2. Insert watch into field of an a.c.-excited coil and withdraw slowly. If no a.c. is available, suspend watch on twisted string in front of poles of a magnet; allow string to unwind while slowly withdrawing the spinning watch from magnet.
3. At arm's length, rapidly wave a pencil back and forth in front of lamp. It appears to flicker on a.c.
4. Positive plate is brownish red; negative plate is bluish gray.
5. (a) Test for short with continuity tester, (b) Momentarily connect across d.c. source. Then short condenser terminals. Spark indicates condenser is undamaged.
6. Assemble ten or more tinfoil and paper leaves loosely, placing rubber bands around the assembled condenser. Connect across primary of set's output transformer. Condenser will reproduce radio program.
7. Connect a condenser and variable resistor in series between plate and ground of an a.f. amplifier.
8. Inductance (henrys) $= \dfrac{1}{4\pi^2 f^2 C}$
(C is in farads, f in cycles.)
9. First device used to detect wireless waves. A glass tube has two silver plugs, between which are placed a small quantity of metal filings (90 percent iron, 10 percent silver). See diagram.



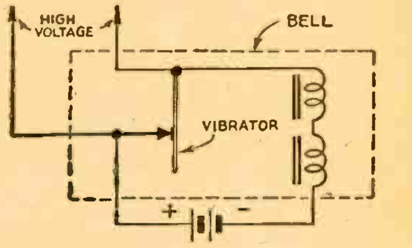
The coherer, first detector of radio waves.

10. Electrostatic or electromagnetic lenses refract a beam of electrons just as glass lenses refract a beam of light. Specimen to be examined is placed in the beam, and the visible image is formed by the electrons and shadow from specimen falling on a fluorescent screen.
11. See sketch.



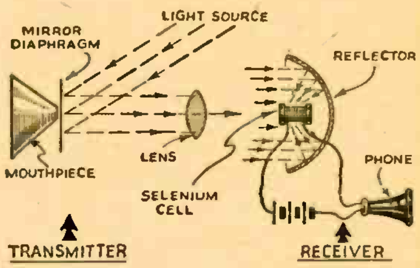
A simple stroboscope demonstration set-up.

12. Selenium is used for photocells and rectifiers.
13. The electret is a mass of wax which has been given a permanent electrical charge. It is then an electrical analog of a magnet. In bar form, one side of end carries a positive and the other a negative charge.
14. Charge a high-quality condenser. It will hold a charge for several hours.
15. By using the self-induction of magnets in the ordinary electric bell. See diagram.



High voltage is obtained from self-inductance of bell coils.

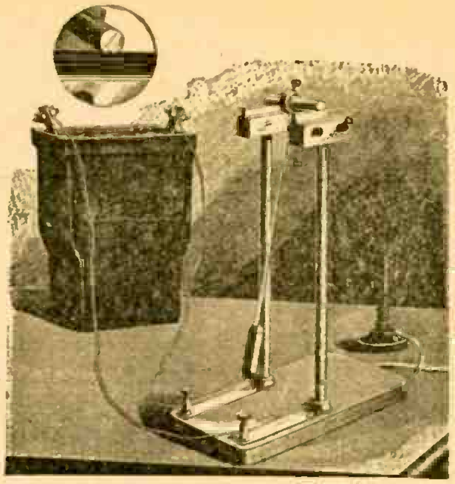
16. Bare resistance wire is wound from an insulating drum onto a metal one. This short-circuits the wire and its resistance is eliminated from the circuit. Another variable resistor is the plate-cathode resistance of a vacuum tube, which varies with changes in applied grid bias.
17. Light is directed through a lens and prism onto a mirror mounted on a diaphragm, fitted to a mouthpiece. Reflected light from the diaphragm mirror is thus modulated by the voice. At the receiver the light falls on a selenium cell (at focus of a parabolic mirror). Variation in cell's resistance modulates battery current, which is turned into sound by the telephone receiver.



Simplified diagram of the Bell Photophone.

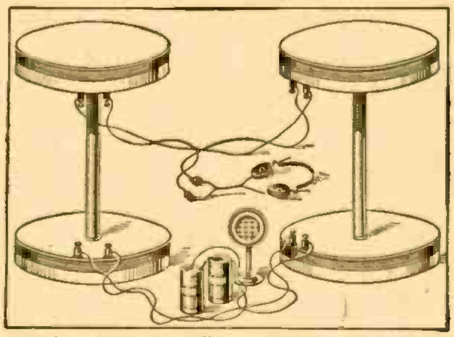
18. Ball lightning, a globular form of natural electrical discharge infrequently observed during electric storms.
19. A static-electricity toy. A shallow box is lined with tinfoil. Pith balls or small paper dolls are put into the box; cover is a piece of window glass. If glass is rubbed briskly with a piece of fur, static electricity generated animates pith or paper figures.
20. A scientific device operated by repeated heating and cooling of contact between a brass rod with a V-shaped slot along its lower edge and a lead support track. See illustration. Current from battery passes through rod and supporting rails. Lead expands instantaneously due to heat produced at one contact (in practice it is found that more current starts flowing at one contact than the other) and a sharp push is given to the rod, which rotates slightly, causing lead at other contact to ex-

pand and push it in opposite direction. The rod continues to rock continuously.



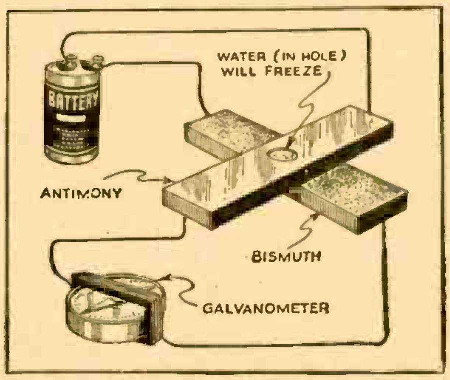
The little-known electric Trevelyan Rocker.

21. The magnetic fields of four coils, each having exactly the same number of turns, are balanced against one another. A small piece of metal placed in or near one of the coils upsets the electric balance, causing an indication, usually sound in a telephone receiver. The principle is used in mine detectors.
22. Manganese dioxide.
23. A glass tube evacuated and in some



Hughes Balance, college demonstration type.

cases filled with a rare gas. Tube is lighted by applying high voltage to electrodes at its ends. Various colors are obtained by using different gases or mixing various salts into glass of tube.



The Peltier couple is described on page 84.

24. A scientific instrument used to demonstrate radioactivity effects. It comprises a zinc-sulphide screen and a speck of radioactive mineral, such as pitchblende, placed in front of the screen. As the invisible particles emanating from the pitchblende strike the screen, flashes of light (scintillations)

(Continued on page 84)

INDEX TO ADVERTISERS

RADIO SCHOOL DIRECTORY
(See page 84)

BOOK REVIEWS

A CHRONOLOGICAL HISTORY OF ELECTRICAL DEVELOPMENT, compiled by E. S. Lincoln. Published by National Electrical Manufacturers Association. Stiff cloth covers, 6¼ x 9¼ inches, 106 pages, plus 24-page appendix and index. Price $2.00.

Beginning with the discovery of static electricity by Thales in 600 B.C., when he rubbed a piece of amber with a cloth, this book lists, progressively, all important discoveries and developments through 1944.

The years are listed chronologically along the left-hand edge of each page. One or more paragraphs are devoted to each notable development and happening of that year.

The appendix lists, according to the present name of the firm, member companies of the NEMA as of January 1946. Under these headings may be found the original name of the firm, date of founding, name of the founder and the first president.

COYNE RADIOMAN'S HANDBOOK. A Reference and Data Book. Compiled and prepared by the technical staff and published by the Coyne Electrical School. Flexible pebbled covers, 4½ x 7 inches, 355 pages. Price $3.25.

A useful handbook containing, according to the title page: formulas—methods — charts — rules — diagrams — circuits — laws — specifications — tests — emergency repair data — definitions — design.

The first part contains tables and formulas covering mathematics, symbols and various physical properties of materials. Drill sizes, machine screw and sheet metal data are given, together with other data.

The resistance and insulation section contains tables of copper wire properties, resistance wire data, and color codes for resistors. The chapter on electrical circuits covers Ohm's Law, with formulas and simple chart for computing volts, ohms and amperes quickly. Formulas for series and parallel circuits are given and, under "Power," new formulas and nomographs are presented.

Capacitors and capacitance receive goodly treatment, including color code charts for condensers. A large section is devoted to receiving tubes, with tables giving constants of tubes, socket connections, cathode data, replacement tube data, etc.

Coil winding tables and simple formulas for computing the inductance and resistance of different types of windings are given complete treatment.

A.c., d.c., and battery power supplies are covered in diagram and text. Receiving circuits of various types are discussed, and the alignment of receiver circuits, including FM sets, is included.

Among other subjects of practical importance are oscillators and antennas; sound systems (including tables and formulas on decibels and their meaning), meters and measurements, and others.

A complete index makes it easy to refer instantly to any one of the several hundred radio subjects covered. Many tables and formulas in this book have not appeared before. One of the most valuable features of the book is that the practical radioman, with only a fair education, can understand the subject matter and mathematics.—*H.W.S.*

INDUSTRIAL ELECTRICAL HEATING AND ELECTRICAL FURNACES, by E. S. Lincoln. Published by Essential Books. Stiff cloth covers, 5½ x 8½ inches, 192 pages. Price $3.00

Covering the fundamentals of electrical heating, this book will be of particular interest to industrial and thermodynamic engineers. The first half is devoted almost entirely to a discussion of resistance heating as applied to convection and immersion heating and electrically-operated steam generators. Separate chapters, in this section, are devoted to charts and tables of engineering material on various types of resistance wires and elements used in electrical heating.

The second half of the book covers industrial applications of electrical heating equipment with comparisons between arc, resistance, and induction heating. This section concludes with a discussion of high- and low-frequency induction heating apparatus and its selection, operation, and installation.

THE PEOPLE LOOK AT RADIO, by Paul F. Lazarsfeld and Harry Field. A report on a survey conducted by the National Opinion Research Center of the University of Denver, analyzed and interpreted by the Bureau of Applied Social Research, Columbia University. Published by the University of North Carolina Press. Stiff cloth covers, 5¾x8¾ inches, 158 pages. Price $2.50.

(Continued on page 84)

RADIO TERM ILLUSTRATED

Suggested by:
No name submitted
Kernersville, N. C.

A Good Connection.

RADIO SCHOOL DIRECTORY

AN ENGLISH RADIO POEM

"In the little town of Electron, away out beyond Anode Bend, is the grave of a radio mechanic, who lies earthed at his positive end. Let us give him his due in all fairness—he was good at his job; he had brains. But he *once* was a little too careless while fixing a plug to the mains."

There's a moral to this little story, a moral an infant could see. If you don't want short circuits to Glory, don't fool around with H. T.!

BOOK REVIEWS

(*Continued from page 83*)

A highly interesting short survey of the field, this book was the result of a survey undertaken for the National Association of Broadcasters by the University of Denver's National Opinion Research Center.

Unlike other recent books on the same subject, the problems of the broadcaster as well as those of the listener are considered in some detail. The main subjects of discussion are the people's overall appraisal of broadcasting, advertising, programming problems and criticism. There is an appendix of 28 tables.

RADIO ALPHABET. A Glossary of Radio Terms. Published by Hastings House. Stiff cloth covers, 5½ by 8¼ inches, 85 pages. Price $1.50.

This little dictionary of radio terms is edited by a string of Columbia Broadcasting System technicians and officials too long to print, and amply long enough to guarantee the authenticity of the terms and their definitions.

Only such technical terms as the layman is likely to encounter are defined. The others are the special vocabulary of the studio operators and the transmitting engineers, and vary from "agency, announcement, amplitude modulation" to "animator" (a device used in television). Slang terms are covered, but not to the exclusion of serious ones.

ELEMENTARY WAVE MECHANICS, by W. Heitler, professor of theoretical physics in the Dublin Institute for Advanced Studies. Published by the Oxford University Press. Stiff cloth covers, 5 by 8 inches, 136 pages. Price $2.25.

This little book, useful to the serious student of nucleonics, devotes itself to the electron in its relation to the atom to which it is bound.

Elementary only in the sense that a minimum of mathematics is used, a knowledge of calculus and classical physics is expected of the reader. The two last chapters, headed Theory of Homopolar Chemical Bond, and Valency, illustrate the usefulness of wave mechanics for chemical problems.

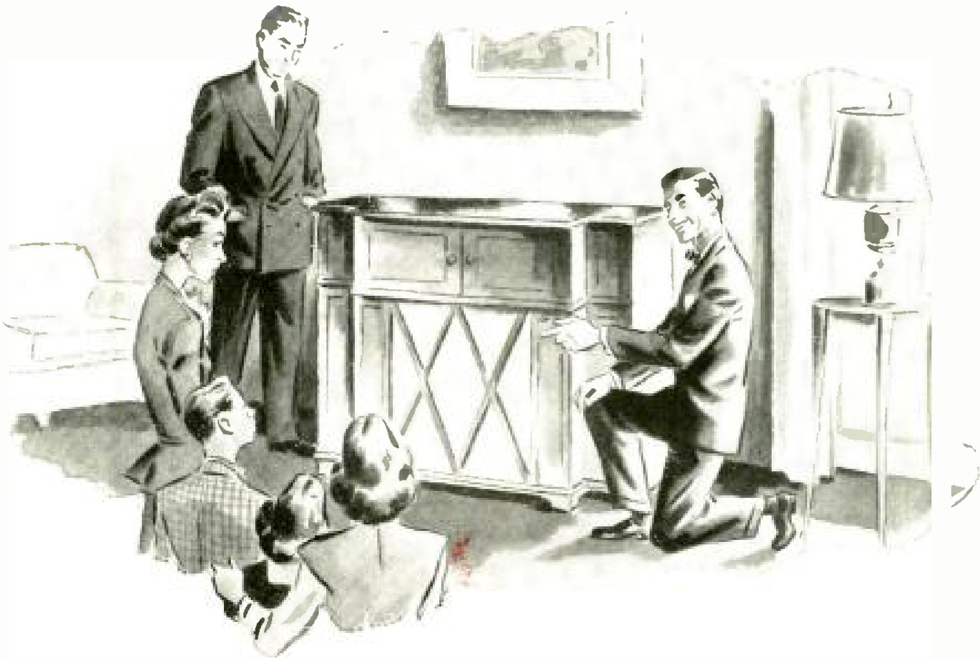
STUDENTS' RADIO QUIZ

(*Continued from page 81*)

are observed through a lens.

25. Cold may be produced by passing direct current through a couple formed by a bar of antimony and one of bismuth, as shown in the drawing (page 81). This is known as the Peltier cross.

Allow 4 points per question and grade yourself. The exact grade is unimportant. *Now divide the examination in two halves.* (For good measure count question 13 in each part). Allow 8 points per question. The first half will give you your grade as a specialized radioman, and should not be below 84. The second half will show your *broad general knowledge* of physics and electronics. A mark of 48 is good; 64 excellent; 72 is the mark for a Doctor of Physics; and 80 is the genius point.



Try This!

Call those of your customers who own fine radios—*people to whom you have sold radios or homes in which you have serviced radios.* Tell them you have a speaker that will make their old sets sound as fine as any brilliant 1947 model. Arrange to demonstrate this Altec Lansing speaker* in their homes. Suggest that they invite neighbors and friends to witness the amazing demonstration. The Altec Lansing Dia·Cone will so greatly improve tone quality and performance that further sales talk will be unnecessary.

Model 600 Dia-Cone  ***12-inch speaker***

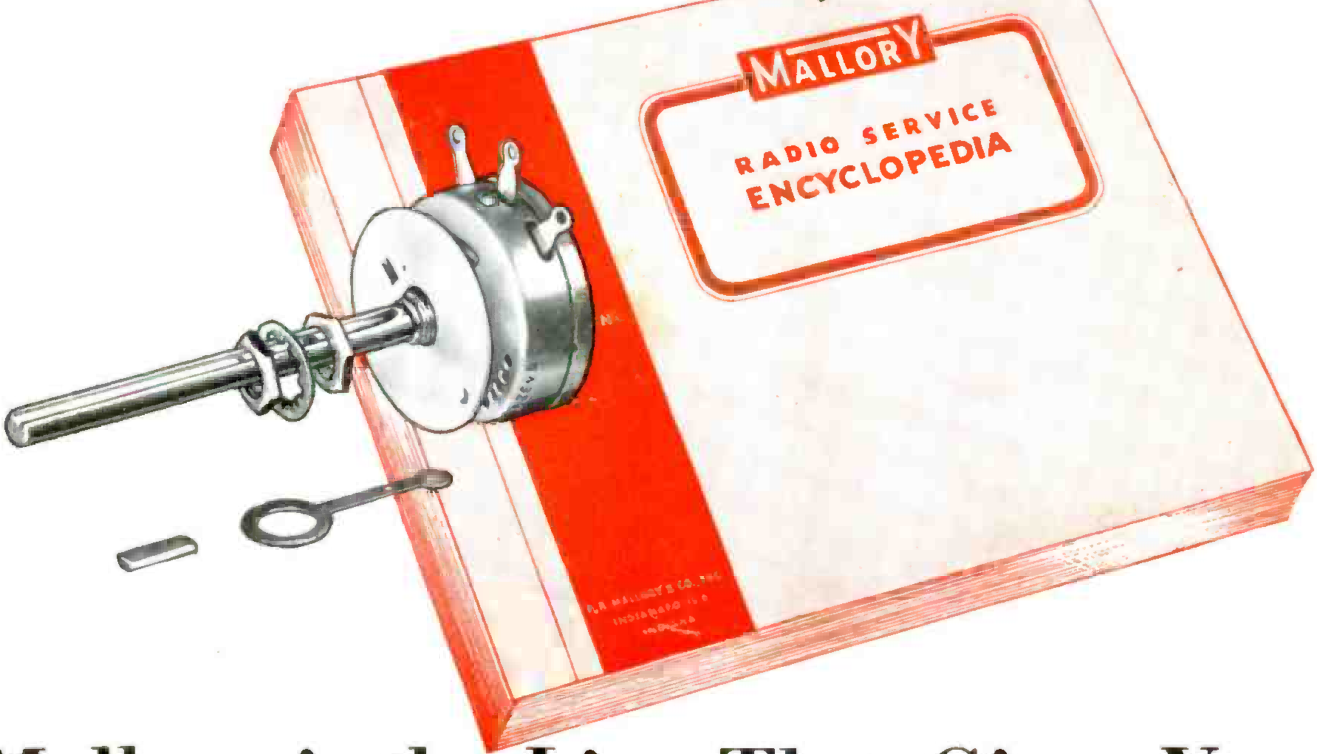
* Designed for installation in those fine sets where ultra-high fidelity sound reproduction is desired. This speaker employs the exclusive Dia·Cone principle, reproducing high and low frequencies from separate diaphragms.

ASK YOUR JOBBER ABOUT AVAILABILITY OF THIS SPEAKER.

ALTEC
LANSING CORPORATION
1161 N. Vine St., Hollywood 38, Cal.
250 W. 57th St., N. Y. 19, N. Y.

"KEEP ADVANCING WITH ALTEC LANSING"

When the Encyclopedia recommends a *WIRE-WOUND* control, remember...



Mallory is the Line That Gives You **ALL** Needed Values

A PROPER servicing job on old type radios often calls for a tapered wire-wound control. The Mallory Radio Service Encyclopedia will tell you just what's needed. And you'll *find* what you need in the Mallory Catalog—and at your Mallory Distributor's.

Fact is, Mallory is the manufacturer who has always made a *complete* line of wire-wound controls. There are thirty-three types covering every resistance value and taper . . . many with the exclusive Mallory adjustable bias feature . . . *all* equipped with the universal channel shaft and insert that fits all types of knobs.

Make it a Mallory wire-wound control, and you can't go wrong.

You Expect More—and Get More—from Mallory

Insist on MALLORY—the Complete Control Line

Mallory is the manufacturer that offers:

- 33 Correctly Tapered Wire-Wound Controls
- 31 Values in Single Tapped Controls
- 10 Values in Double Tapped Controls
- 12 Clutch Type Controls
- 10 Universal Dual Controls
- 92 Popular Special Controls

P. R. MALLORY & CO. Inc.
MALLORY

VIBRATORS . . . VIBRAPACKS* . . . CAPACITORS . . . VOLUME CONTROLS . . . SWITCHES . . . RESISTORS . . . FILTERS . . . RECTIFIERS . . . POWER SUPPLIES.

*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA