Radio SERVICE DEALER

MAY, 1948

IN THIS ISSUE:

FM Alignment
Video Detectors
P & L Statements
Field Findings
Vectors Simplify Servicing
Electronic Maintenance
Power Factor & Q

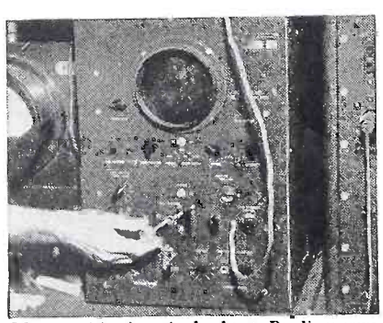
AM-FM-TV-SOUND

Somewhat More Silent Than a TOMB!

It's Impossible to Hear a Mallory Control Operate!

Even super-sensitive meters, built for the U. S. Navy to inspect delicate electronic communication equipment, do not show an audible sound level when Mallory carbon controls are tested.

Mallory carbon controls give you totally silent operation—the tapers are smooth and accurate to assure maximum adjustment in the proper ranges—the overall resistance values are uniform and the life of the control is the longest ever provided. This kind of quality keeps customers satisfied.



Meter used in the noise level test. Readings were taken on volume controls of all leading manufacturers. Mallory controls gave no audible sound, registered 22% below all others in inaudible sound vibrations.

Mallory has given you so many "firsts" in the field of radio-electronic replacement parts that you know Mallory products are the finest that can be produced! Sell them with confidence, install them with ease. The Mallory line of Volume Controls, Capacitors and Vibrators has been standardized; they are a profitable line to stock.

"Good Service for Good Business"

A business plan that will raise the earnings of radio-electronic servicemen. One important item in the plan is a unique system for following up your customers for repeat orders.

And there are ways of linking your name with the Mallory trade mark, to get the benefit of Mallory advertising. Better ask your distributor about it!

P.R. MALLORY & CO. Inc.

MALLORY

CAPACITORS . . . CONTROLS . . . VIBRATORS . . .
SWITCHES . . . RESISTORS . . . RECTIFIERS . . .
VIBRAPACK* POWER SUPPLIES . . . FILTERS
*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

CROSLEY *Twice Tested*

★ RADIO PARTS

for general replacement

IMMEDIATE DELIVERY!

from your nearest CROSLEY Distributor, listed below

LOOK FOR this emblem on the outside of every package of parts you buy. It's your guarantee of quality parts *inside*.

FREE COMPLETE CROSLEY SERVICE PARTS CATALOG

Contains full descriptions and specifications of thousands of Crosley Twice-Tested radio (and refrigerator) parts and accessories for general replacement and repair. Jam-packed with money saving, time saving, business building values. Order your free copy NOW. Fill in the handy coupon today and mail to your nearest Crosley Distributor.

CROSLEY

Division AVCO Manufacturing Corporation
Cincinnati 25, Ohio

RUSH FREE COPY OF BIG NEW CROSLEY TWICE-TESTED PARTS CATALOG TO:

NAME.....

ADDRESS.....

CITY.....ZONE.....

STATE..... RA-0356

Albany, New York.....Roskin Bros.
Amarillo, Texas
Domestic Appliance Dist.
Atlanta, Georgia..Georgia Appliance
Baltimore, Maryland Legum Distributing
Birmingham, Ala. Alabama Service Co.
Boston, Mass.....Wahn Distributors
Buffalo, N. Y.....Western Mdse. Distrs.
Bristol, Tenn.-Va. Interstate Hardware Co.
Carrier Mills, Ill...O'Keefe Distributing
Charlotte, N. C. .Carolinas Auto Supply
Chicago, Illinois...Harry Alter & Bros.
Cincinnati, Ohio...Modern Distributing
Cleveland, Ohio..Frankelite Company
Columbus, Ohio Miami Valley Dist. Co.
Dallas, Texas...Lone Star Wholesalers
Davenport, Iowa...Sieg Home Supply
Dayton, Ohio.....Miami Valley Dist.
Des Moines, Iowa...H. E. Sorenson Co.
Detroit, Mich.....Peninsular Dist. Co.
El Paso, Texas....Vaughan Appliance
Fargo, N. D.....Meyers-Taube Co.
Ft. Smith Arkansas. Eads Bros. Furniture
Ft. Wayne, Indiana..R. M. Kaough Co.
Ft. Worth, Texas .United Appliance Co.
Grand Rapids, Mich.
Independent Distributors, Inc.
Great Falls, Mont..Gt. Falls Paper Co.
Harlan, Ky.....Kentucky Mine Supply
Harrisburg, Pa....Jules Alexandre, Inc.
Hastings, Nebraska....Dutton-Lainson
Hazleton, Pa.....Lehigh Valley Dist.
Houston, Texas
Reader's Wholesale Distributors
Huntington, W.Va. Huntington Wh'e Furn.
Indianapolis, Ind....Capital Paper Co.
Jackson, Miss. ...Southern Wholesalers
Jacksonville, Fla. Graybar Elec. Co., Inc.
Kansas City, Mo....Superior Distr. Co.
Little Rock, Ark.....Wright Service Co.
Los Angeles, Calif.....J. N. Ceazan Co.
Louisville, Ky.....Cooper-Louisville
Manitowoc, Wis. J. J. Stangel Hdwe. Co.
Memphis, Tenn.....National Rose Co.
Miami, Fla. ..Graybar Electric Co., Inc.
Milwaukee, Wis.....Greusel Distr. Co.
Nashville, Tenn.....Nashville Chair Co.
Newark, N. J.....Apollo Service, Inc.
New Haven, Conn..H. M. Tower Corp.
New Orleans, La.
Woodward, Wight & Co.
New York, N. Y....Crosley Distr. Corp.
Omaha, Nebr..Electric Fixture & Supply
Orlando, Fla....Graybar Elec. Co., Inc.
Peoria, Illinois....Johnston-Moody Co.
Philadelphia, Pa...Judson C. Burns, Inc.
Phoenix, Arizona Appliance Distributors
Pittsburgh, Pa...Anchor Distributing Co.
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Portland, Ore....Fields Sales Company
Providence, R. I..Graybar Elec. Co., Inc.
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Reno, Nev....Heat. & Air Cond. Supply
Richmond, Virginia...Louis O. Bowman
Roanoke, Va.....Richardson-Wayland
Rochester, N. Y....O'Donnell-Dunigan
Saginaw, Mich.....J. Fischer & Sons
Salt Lake City, Utah Western Supply Co.
San Antonio, Texas..Alamo Distributing
San Francisco, Calif..California Electric
Savannah, Georgia .Lindsay & Morgan
Seattle, Wash..Commercial Appliance
Shreveport, La.....Electric Supply Co.
Sioux Falls, S. D.....Power City Radio
South Bend, Ind...The Ridge Company
Spokane, Wash....Standard Sales Co.
Springfield, Ill..Central Ill. Wholesalers
Springfield, Mass.....Tarbell-Watters
Springfield, Mo.....Rogers & Baldwin
Sterling, Illinois....Hardware Products
St. Louis, Missouri....ARA Distributing
St. Paul, Minn..Motor Power Equip. Co.
Syracuse, N. Y...O'Donnell Distributors
Tampa, Fla.....Graybar Elec. Co., Inc.
Toledo, Ohio
Walding-Kennan & Marvin Co.
Tulsa, Oklahoma Tom P. McDermott, Inc.
Tucson, Arizona Appliance Distributors
Washington, D.C. American Wholesalers
Watertown, S. D.....Lyle Meyers
Wichita, Kansas..Steve Wise Company
Youngstown, Ohio....Dorrance Supply


Welcome
IN EVERY HOME IN AMERICA
GENERAL ELECTRIC
Electronic TUBE
MADE IN U.S.A.
GENERAL ELECTRIC
FIRST AND GREATEST NAME IN ELECTRONICS
176-GA4-8850

ONE Button—

. . . clears every switch setting
. . . ready for the next tube test

Model 335 Plate Conductance Tube Tester

The Simpson Automatic Reset is just another of the practical refinements that make Simpson tube testers serve you better than other testers. When you finish a test, just press the Automatic Reset button and instantly all switches, both push button and rotary, return to normal. This not only saves time but prevents error due to previous settings being left in position at the beginning of the new test. The Reset mechanism, in whose design and tooling many thousands of dollars have been invested, is Simpson patented. No other switch control mechanism is so completely automatic.

Simpson Model 335 adds the Automatic Reset to its many other features. It tests tubes in percentages of rated plate conductance, also indicating that the tube is good, fair, doubtful, or definitely bad. Only a few settings are necessary for the most complicated tube. Sockets for all types of tubes are provided, including the new 9-pin miniature; also the subminiature as used in hearing aids, etc.

For 105-130 volts, 50-60 cycle. Size: 15½" x 9½" x 6¼"
Dealer's Net Price, complete with 12-page Operator's Manual $85.00

Model 340
SIGNAL GENERATOR—
75 Kilocycles to 120 Megacycles
Fundamentals to 30 MC.

Electron coupled circuit assures extreme stability and output uniformity, throughout the band. Standard 30% modulation at 400 cycles. Coil, attenuator and signal selector individually shielded. Effective shielding throughout. Each coil individually calibrated to close tolerances against crystal standards by means of variable inductance and variable minimum capacitance. For 105-130 volts, 50-60 cycle. Size: 16" x 10" x 6".

Dealer's Net Price, complete with 44-page Operator's Manual $69.85

Simpson
INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPANY
5200-5218 W. Kinzie St., Chicago 44, Ill.

EDITORIAL

by S. R. COWAN

Gleaned From Here and There

During the past month we traveled around the East considerably addressing groups of Service Dealers and technicians at servicemen association meetings held in New York, Pennsylvania and Maryland. A schedule of speaking dates for the Fall months is now being compiled so if you want us to perhaps we can arrange to visit your town. Write for details. An educational and entertaining evening may be arranged provided an audience of 100 or more is assured. If you can't assemble that large a group we may be able to provide a recorded program by means of wire-recording.

Elsewhere in this issue is reported some highlights of our tour. Perhaps there is a "problem" out there in your territory. If so, why not mention the subject in a brief letter? It would be welcome, and might bring beneficial results to the servicing profession as a whole. It is the concensus of Service Dealers whom we've met recently that business is about 15 percent better than ever before, but despite that fact, they have greater and more complex problems than heretofore. You'll appreciate this when you read the article, "Field Findings," page 24, this issue.

Pennsylvania Leads the Way

The several associations of radiomen residing in Pennsylvania have without question admirably coordinated their efforts toward unity of purpose and accomplishment. Not so long ago over a dozen independent, well-established Pennsylvania city associations amalgamated to form the State Federation in which each has a voice. Already the total active membership approximates 4,000 and it is consistently rising. Associations in other states would do well to follow Pennsylvania's lead. Eventually representatives from the various other State Federations could be appointed to meet for a National Convention. As the earning power and living standards of Pennsylvania radio technicians are well above the average for the rest of the country, they must be on the right track. This fact is evidently recognized by other Atlantic Seaboard associations who are now in constant communication with the Quakers. Keep it up! In real unity there is strength. It's high time the radio servicing profession ceased to be fall guynfor groups comprising the rest of the radio industry, who incidentally are thriving as never before. . . .and who seem to hold servicemen in even less regard than ever before.

Member of the Audit Bureau of Circulations

radio service dealer

VOL. 9 NO. 5

SANFORD R. COWAN, *Editor & Publisher*

SAMUEL L. MARSHALL, *Technical Editor*

MAY, 1948

SANFORD L. CAHN
National Advertising Sales Manager

HARRY N. REIZES
Advertising Manager

BRANCH: J. C. GALLOWAY, 816 W. 5th St., Los Angeles 13, Calif., Mutual 8335

Jean M. Wheeler
Circulation Manager

David Saltman
Adv. Production Manager

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RADIO SERVICEMEN! 19 PRIZES FOR 18 IDEAS

HERE'S HOW EASY IT IS TO WIN

Right now, you may have a winning idea at work in your shop. An idea for a simple service tool which makes your work easier, faster, more profitable. Hytron wants to help make such needed tools available to all servicemen — at cost. You can cash in on your idea easily — and also help the other fellow.

Simply obtain an official entry blank from your Hytron jobber — or write us. Answer a few simple questions on the blank. Then include a sketch with constructional details — or a photograph — or a model of your proposed tool. Mail to Hytron Contest Editor. The tool should be simple, practicable, durable, compact, easy and economical to manufacture. Examples: Hytron Tube Tapper and Miniature Pin Straightener.

That's all there is to it. Nothing to buy. Nothing difficult. No fancy writing. And could you use one of those beautiful deluxe test equipments — or one of those crisp new Savings Bonds! Check the easy rules. Get an official entry blank today for full details on how to win. Send in as many entries as you wish — in any or all six contests. Everyone wins a Tube Tapper. Your idea may hit the jackpot. Let's go!

HERE ARE THE EASY RULES

WHO . . . Any bona fide radio serviceman who repairs radios for the general public and who lives in continental United States is eligible for these contests, except employees of Hytron, their advertising agencies, and their families.

HOW . . . Get official entry blank from your Hytron jobber, or write us. Describe on blank your idea for a shop tool for radio servicemen. Include sketch and constructional details — a photo — or model. Make your proposed tool simple, practicable, durable, compact, easy and economical to manufacture (preferably to sell without profit at 50¢ or less) — like the Tube Tapper or Miniature Pin Straightener.

WHERE . . . Mail to CONTEST EDITOR, HYTRON RADIO & ELECTRONICS CORP., SALEM, MASS.

WHEN . . . There are six monthly contests. Opening and closing dates for each contest are the first and last days of each of the months from May through October, 1948, inclusive. The postmark date determines month of entry. Entries for final month's contest must be postmarked before midnight, October 31, 1948, and received by November 15th. At judges' discretion, unsuccessful entries in any month's contest may be re-considered among following months' entries. You may submit as many different ideas as you wish in any or all six monthly contests. Use separate blank for each entry.

PRIZES . . . See special listing of prizes.

JUDGES . . . Entries will be judged on originality, simplicity, practicability, durability, compactness, and ease and economy of manufacture. Judges will be: Sanford Cowan, Editor & Publisher of *Radio Service Dealer*; W. W. MacDonald, Managing Editor of *Electronics*; Oliver Read, Chief Editor of *Radio News*; Joseph Roche, Editor of *Radio Maintenance*; J. L. Stoutenburgh, Executive Editor of *Radio & Television Retailing*; Lewis Winner, Chief Editor of *Service*.

Judges' decisions final. Duplicate prizes in case of ties. No entries returned. Entries become property of Hytron, who may, at its option and by special arrangement with the entrant, pay the cost of a patent application (if the tool is patentable) with the understanding that Hytron is to have a non-exclusive license to manufacture, distribute, and sell the tool without royalties. Contests subject to all Federal and State regulations. Winners will be notified by mail. Grand prize winner will be announced in radio service trade papers shortly after close of final contest. Prize winner list available approximately one month after close of last contest.

HERE ARE SOME EXAMPLES

Hytron's Tube Tapper and Miniature Pin Straightener show you the kind of tool wanted. Check off the qualities. Simple? Yes. Practicable? Usable time-savers. Durable? Built to last. Compact? Carry them in your pocket. Easy and economical to manufacture? Adapted to mass production. Tube Tapper a nickel; Pin Straightener 49¢ — both under 50¢. Tools associated with tubes preferred, but other original service tools also acceptable.

HERE ARE THE PRIZES

First Prizes

MAY	DuMont Type 274 Five-Inch Oscillograph.
JUNE	Radio City Products Model 665-A, the "Billionaire", V-T Volt-Ohm-Capacity Meter, Insulation Tester; and Model 705-A Signal Generator.
JULY	Hickok Model 156A Indicating Traceometer.
AUG.	McMurdo Silver Model 900A "Vomax" Electronic Volt-Ohm-Milliammeter; Model 904 Condenser/Resistor Tester; and Model 905A "Sparx" Dynamic Signal Tracer/Test Speaker.
SEPT.	Jackson Model 641 Universal Signal Generator.
OCT.	Weston Model 769 High Frequency Electronic Analyzer.

Second Prize — Each Month: $50 U. S. Savings Bond

Third Prize — Each Month: $25 U. S. Savings Bond

Grand Prizes

$200 U. S. Savings Bond — to contestant whose idea is judged to be best of the 6 winning monthly first prizes.

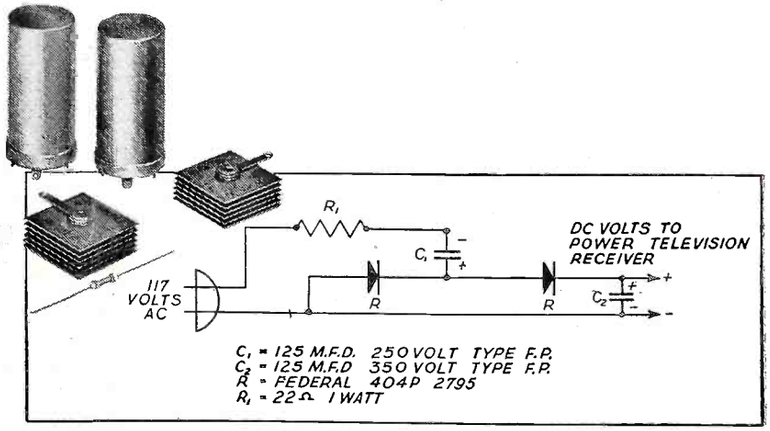
$200 U. S. Savings Bond — to Hytron jobber indicated on entry blank as serving grand prize winner.

Get ready for better television for more people

YOU WILL make more money from television, in both installation and service, when thousands instead of hundreds can afford to buy receivers. *Lighter and more compact television receivers are now a reality!*

The answer is simple. Selenium Rectifiers eliminate power transformers, rectifier tubes and filter chokes in the multiple power supply. Weight is cut as much as 90 per cent in the power supply, because a complete Selenium unit weighs less than half a pound. Operation is cooler. There is the electronic advantage of no interference to the cathode ray tube due to stray magnetic fields. This new power supply can be located almost anywhere in the set.

Now is the time to know more about this new development. Federal, *first* manufacturer of Selenium Rectifiers in this country and pioneer of their many developments, is also *first* in Selenium Rectifiers to power television receivers. Equipment and circuits have been tested in our laboratories. Write today for "Selenium Rectifiers for Television Receivers"—a paper that gives you full information. Address Dept. F985



FTR
An IT&T Associate

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

Federal Telephone and Radio Corporation

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

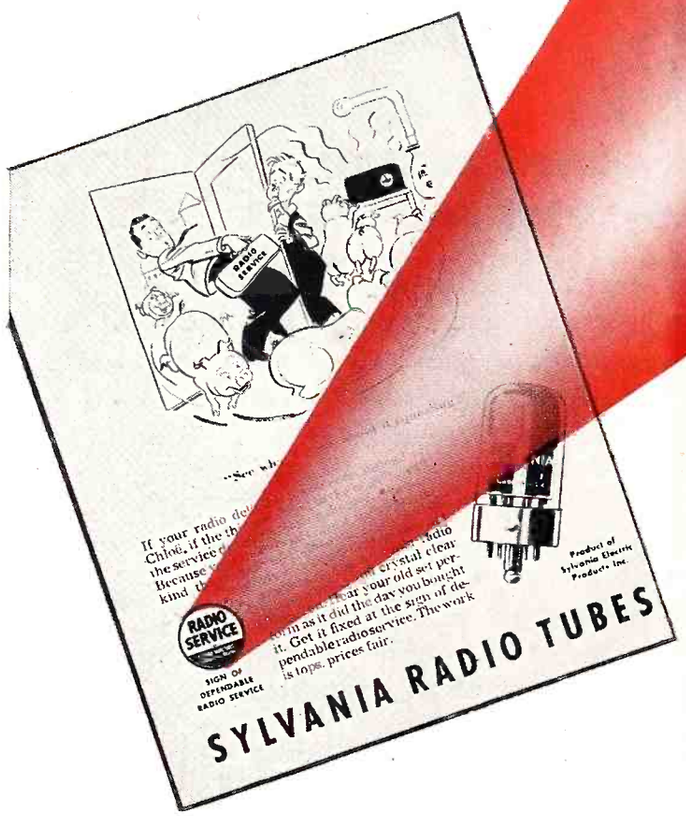
In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal, P.Q.
Export Distributors:—International Standard Electric Corp., 67 Broad St., N.Y.

YOU'LL WANT THIS ON YOUR DOOR!

This five-color decal identifies *you* as the man Sylvania is talking about—in the big new national campaign now under full steam in *Life, The Saturday Evening Post, Collier's, Radio Best.*

Display this decal on your door, your windows, your truck—to hook *your* store up with Sylvania's nationwide advertising.

The decal is *yours for the asking* . . . in 8-inch or 12-inch size . . . in any quantity you want!



RADIO SERVICE

SYLVANIA RADIO TUBES
Authorized *Dealer*

GET THIS DECAL IN 8-INCH OR 12-INCH SIZE

See for yourself how quickly this cartoon ad catches the eye. See how strongly it features the Radio Serviceman's decal—*your decal!*

In *every* Sylvania ad throughout 1948 . . . in four great, nationally-read magazines . . . your customers—and the people you *want* for customers—will see this decal over and over again. They'll *look* for it when their sets need servicing—be sure they *see* it on your store.

LOOK FOR THE JOBBER WHO DISPLAYS THIS COMPANION DECAL

He's the authorized Sylvania Distributor in your locality. He's ready to supply you with top-quality Sylvania Radio Tubes and Test Equipment, for the kind of servicing jobs that will keep your customers coming back to *you.*

Authorized Distributor
OF SYLVANIA RADIO TUBES AND TEST EQUIPMENT

SEND THIS COUPON

NOW FOR THIS FREE

SYLVANIA SERVICEMAN'S DECAL

SYLVANIA ELECTRIC

Radio Tube Division, Emporium, Pa.

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

Sylvania Electric Products Inc.
Radio Tube Division
Advertising Dept., Room R-1405
Emporium, Pa.

Gentlemen:

Please send, *free*, the following quantities of the Sylvania Serviceman's decals:

..... 8-inch decals ..... 12-inch decals

Name.....

Company.....

Address.....

City..... Zone #.....

State.....

Value plus Quality!

Stewart-Warner

"American Group" Combinations

* **ALL WITH FM**
* **STYLE-PROPORTIONED DESIGN**
* **DUAL MATCHED-TONE SPEAKERS**

Acceptance is too common a word to describe the high enthusiasm these new all-American sets generate among dealers . . . *and customers.*

For here, in a remarkable *quality-value* package, is everything millions of Americans want in a new radio: advanced AM reception . . . great new FM performance . . . automatic *noise-free** record playing.

More than all that, you have tremendously popular styling *for today's home* — and prices you are happy to display in big type!

*Stewart-Warner's famous Electro-Hush Reproducer *banishes* needle hiss and scratch.

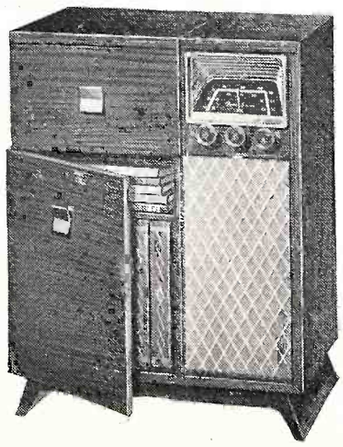
Stewart-Warner

FM RADIOS AM • RADIO-PHONOGRAPHS • TELEVISION

CHICAGO 14 ILLINOIS

18th CENTURY

Gold Coast mahogany styled in the great Hepplewhite tradition:
MT. VERNON—rich, dark finish, hand-rubbed with pure Carnauba wax.

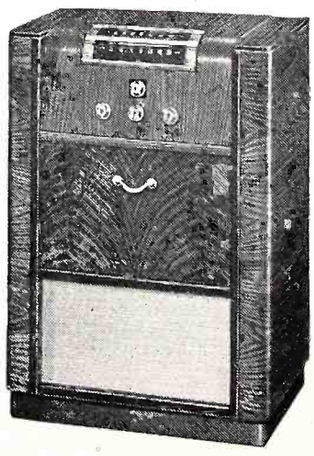


MODERN

Genuine African mahogany, at home in any room.
MANHATTAN—dark, luster-gloss finish.
PALM SPRINGS—blond, hand-rubbed.
SANTA FE—glowing new "blush" finish.

CONTEMPORARY

Fine-grained American walnut with matched crotch-grain panel:
HOLLYWOOD—rich native woods handsomely finished.



The next time you hear voices —LISTEN!

IT MAY BE your conscience speaking.

It may be saying: "Save some of that money, mister. Your future depends on it!"

Listen closely next time. Those are words of wisdom. Your future—and that of your family—*does* depend on the money you put aside in savings.

If you can hear that voice speaking clearly, do this:

Start *now* on the road to *automatic* saving by signing up on your company's Payroll Savings Plan for the purchase of U.S. Savings Bonds.

There's no better, no surer way to save money. Surer because it's automatic . . . better because it pays you back four dollars for every three you invest.

Do it *now*. If you can't join the Payroll Savings Plan, tell your banker to enroll you in the Bond-A-Month Plan that enables you to purchase a bond a month through your checking account.

Remember—better *save* than *sorry!*

Automatic saving is sure saving—U.S. Savings Bonds

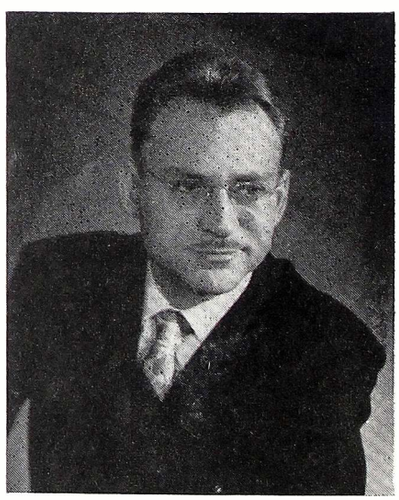
Contributed by this magazine in co-operation with the Magazine Publishers of America as a public service

TRADE FLASHES

Leo B. Pambrum, new sales promotion manager for Crosley Div. of Avco Mfg. Corp.

New Bulletin Offered

The first issue of the Amphenol Engineering News, a monthly bulletin, is now being distributed. Featured are stories describing a new antenna that receives television stations in all 13 channels and compact cathode ray tube sockets prewired for immediate assembly. Future issues will describe in detail latest products and developments in the radio and electronics industry. You can be placed on the mailing list by writing American Phenolic Corporation, 1830 South 54th Avenue, Chicago 50, Illinois.



Smith Now Concord A-M

Harry C. Smith has been appointed Director of Advertising for the Concord Radio Corporation, nationally known radio supply house.

Supreme Instru. Reorganized

A new Mississippi Corporation, Supreme Incorporated, has acquired the

TIPS DO NOT "FREEZE-IN"! CALROD SOLDERING IRONS

REMOVE the tip? With a G-E Calrod Iron it's easy because the tips *just don't "freeze-in."* The special calorization process which prevents "freezing-in" is a leading feature of these G-E irons—a feature that simplifies the care and maintenance of one of your most useful tools.

High Efficiency—Low Heat Loss

The G-E Calrod cartridge-type element is insulated with highly compacted magnesium oxide which maintains full insulation properties. The element conducts heat so rapidly that there is little temperature drop from the resistance wire. The stainless steel barrel which encloses the element has less than half the conductivity of plain steel. Therefore the heat loss through the barrel is very low. By means of the special G-E heat reservoir the heat is efficiently conducted to the calorized conical tip seat. The calorized surfaces of the seat and tip threads retard oxidation of the heat-conducting copper parts, thereby maintaining high-heat transfer to the working tip.

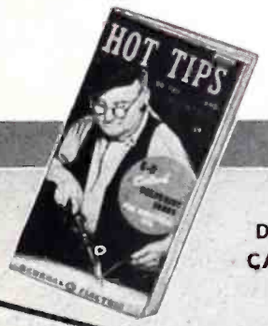
G-E Calrod—The Soldering Iron with Long Life

- The shell material, Type 18-8 stainless steel, will withstand hard usage without collapsing.
- The heater will withstand repeated jarring or rough handling, because it is embedded in highly compacted magnesium oxide.
- The life of the tip is considerably lengthened by the calorized surface. This retards corrosion during long hours of idling.
- The heater is dependably protected against grounding by the highly compacted, magnesium-oxide insulation.

FREE—With each G-E Soldering Iron

Packed with each Calrod Soldering Iron is a booklet that contains a wealth of information about soldering, tips to make the job easier and a flux chart that will be invaluable.

For additional information on G-E Calrod Soldering Irons write: *General Electric Company, Electronics Park, Syracuse, New York.*



GENERAL ELECTRIC

manufacturing rights, facilities and assets of the Supreme Instruments Corporation. The new corporation, composed of executives, representatives and key employees of the old company, will continue to sell test equipment and meters under the name "Supreme." All guarantees of equipment previously sold by Supreme Instruments Corporation will be fulfilled by Supreme, Inc.

Payne Now Air King S. M.

Roland D. Payne, former Sales Manager of Service Equipment for General Electric, was appointed Sales Manager for Air King Products Co., Inc., Brooklyn, manufacturers of radios, combinations, wire recorders and television receivers, David H. Cogan, Air King President announced.

Payne, who recently conducted a series of 33 meetings covering the entire United States on the servicing of FM radio sets, has written numerous articles for trade publications on the serviceman's problems and setting up distribution.

TV Set Output Hits New Peak

RMA reports that production of television and FM receivers in January continued at a high rate, but overall set production as usual fell below the seasonal peak of the last quarter of 1947.

The output of television receivers by RMA member-companies reached a new high of 30,001 last month, exceeding slightly the December production of 29,345 despite the fact that December's total included five work weeks as against four in January.

Total set production by RMA manufacturers last month was 1,339,256—the lowest output since September, 1947—as compared with 1,705,918 in December.

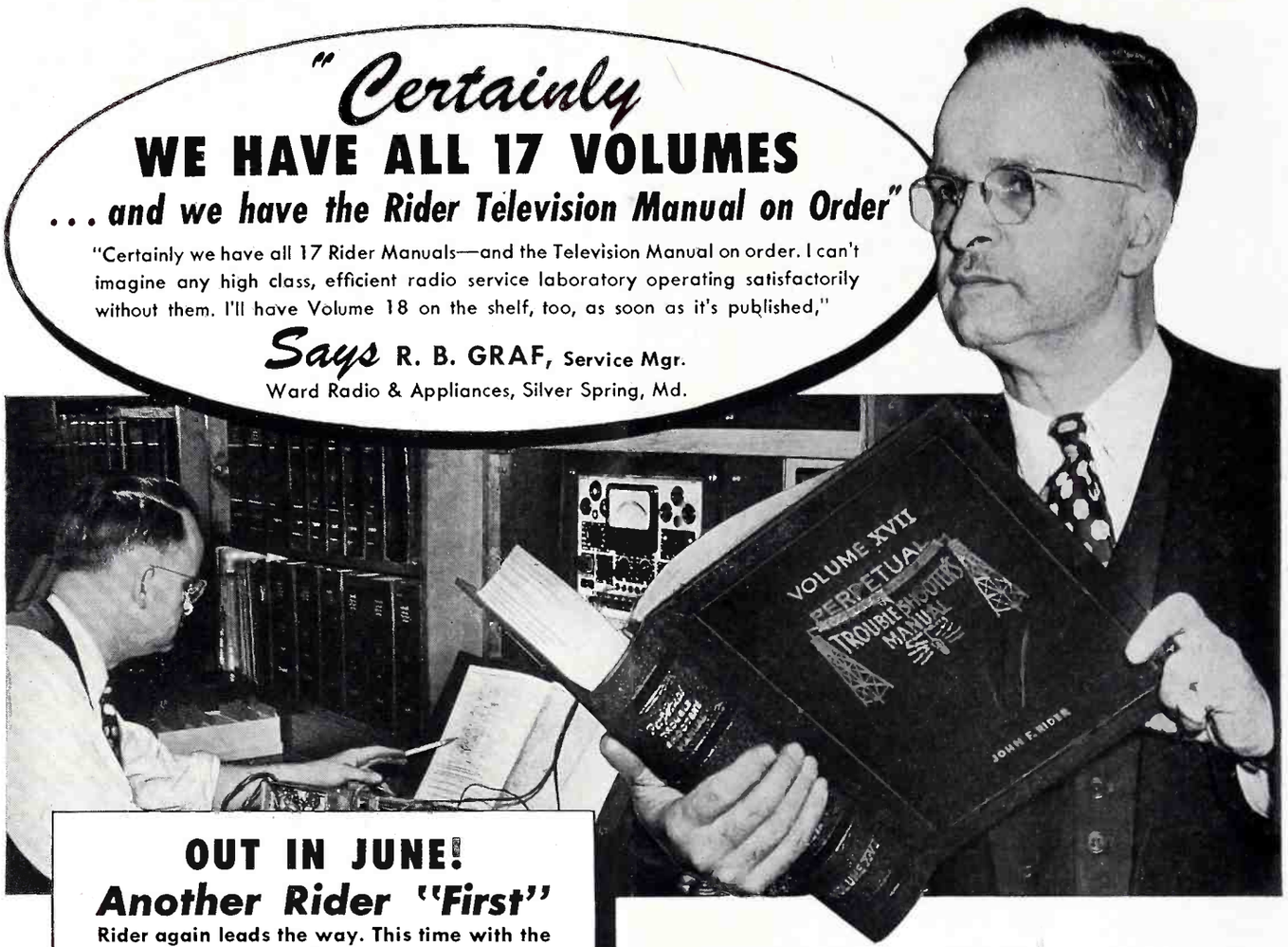
January television set production indicated a proportional increase in console models, the division being 13,261 consoles compared with 16,740

[*Continued on age 38*]

"Certainly WE HAVE ALL 17 VOLUMES ... and we have the Rider Television Manual on Order"

"Certainly we have all 17 Rider Manuals—and the Television Manual on order. I can't imagine any high class, efficient radio service laboratory operating satisfactorily without them. I'll have Volume 18 on the shelf, too, as soon as it's published,"

Says R. B. GRAF, Service Mgr.
Ward Radio & Appliances, Silver Spring, Md.



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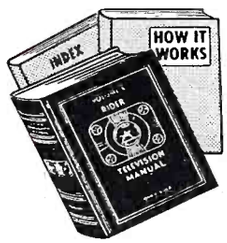

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ADVANCE registration for the Radio Parts Show and Conference to be held at the Hotel Stevens, Chicago, from May 10th through the 15th indicates that all previous records for attendance will be broken.

Nearly 200 member-exhibitors will have display booths. Manufacturers' sales representatives and radio-electronic parts and equipment distributors from all parts of the world will attend. However, in contrast to policy of former years, the 1948 Conference will be "closed" except to certain types of registrants the first three days. For example, the first day only N. E. D. A. members will be admitted, along with Representatives and booth attendants. The second and third days will be "open" to all distributors as well as representatives. The final day will be "open to the entire industry"—radio dealers, servicemen, amateurs, etc.

A complete compilation of exhibitors and their booth numbers is given herewith. Kenneth C. Prince, general manager for the show corporation, stressed that no one will be admitted to the Exhibition Hall without a proper identification badge, except on Friday the 14th which is "All Industry Day" when all people may gain admission.

EXHIBITOR	BOOTH NO.
Aerovox Corporation	86
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Audak Company	135
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Bliley Electric Co.	150
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British Industries Corp.	131
Brush Develop. Co.	130
Bud Radio, Inc.	9
Burgess Battery Co.	113
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Duotone Company	144
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Lechtrohm, Inc.	54
Lenz Elec. Mfg. Co.	60
Maguire Industries	82
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Micamold Radio Corp.	152
Millen Mfg. Co., Inc., James	139
National Co., Inc.	16
Nat'l. Union Radio Corp.	10
Newcomb Audio Prods. Co.	114
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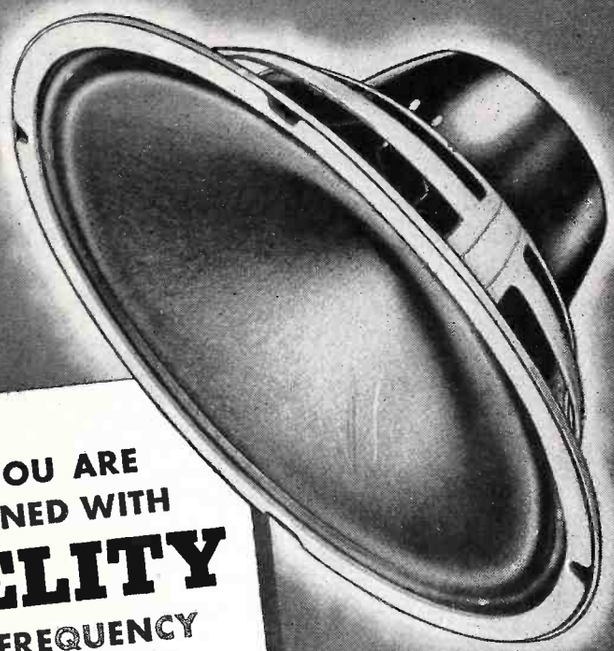

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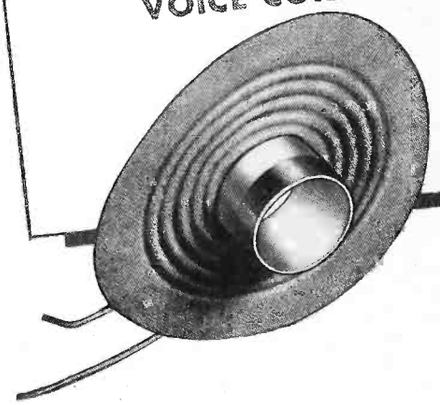

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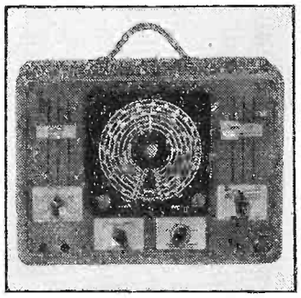

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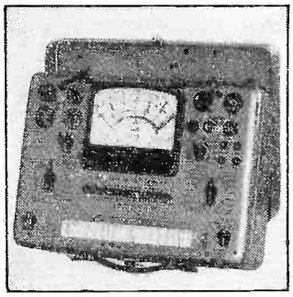

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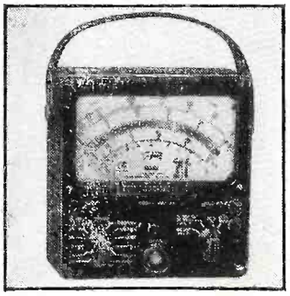

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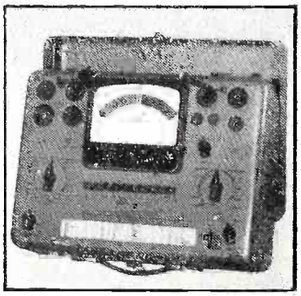

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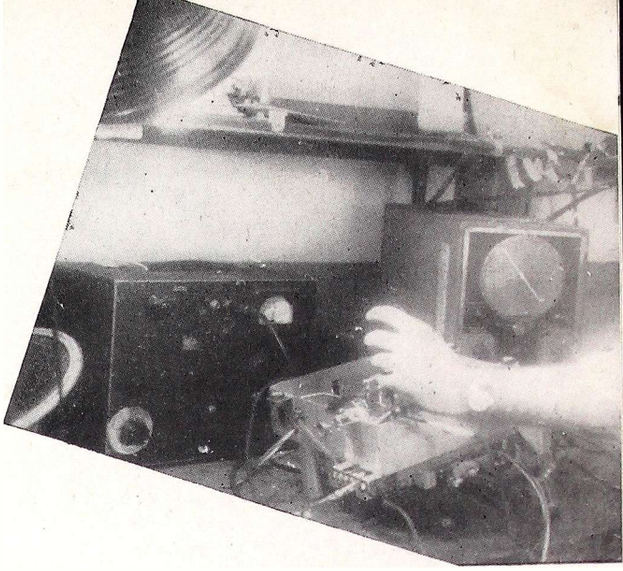


Aligning IF's of Garod FM-11.

by W. H. BUCHSBAUM

Alignment procedure of typical FM sets

BEFORE being able to align any FM receiver properly it is necessary to have a clear idea of the functions and operations of each section. The block diagram, *Fig. 1*, shows the stages in FM receivers. A distinction must be made between those sets employing the Armstrong system—having a limiter and discriminator—and those using the more recent ratio detector circuit. The latter employs no limiter, but otherwise the circuits are very much alike.

Most of the recent FM receivers, except some low cost table models, employ an r-f stage, usually with a broadly tuned antenna transformer and a variable tuned circuit between the r-f amplifier and mixer. Since the r-f stage operates between 88 and 108 mc the gain achieved there is usually very small. The oscillator and mixer can either be separate tubes, or, some new models make use of the newly developed 12AT7, a nine prong miniature duo-triode, or the 6SB7, a regular octal pentode. The mixer is coupled to the i-f amplifier which is of the type used in regular broadcast receivers.

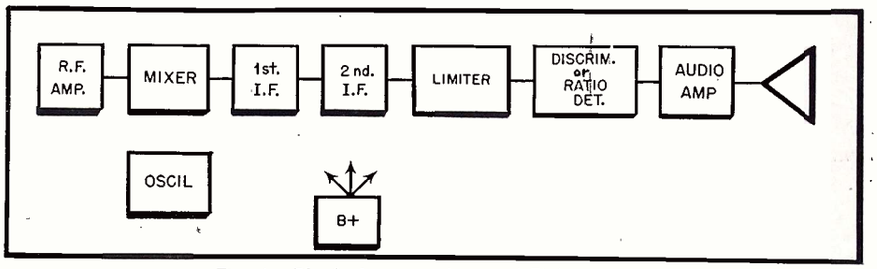


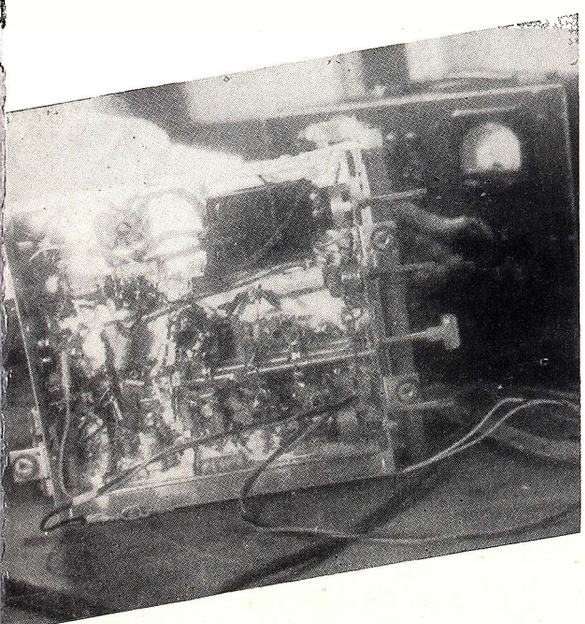
Fig. 1—Block diagram of typical FM receiver.

The standard i-f frequency for present FM receivers is 10.7 mc and since the bandwidth necessary for good sound reproduction is at least 150 kc the i-f transformers have to be either closer coupled or loaded down to give the required response. Most FM receivers use two i-f stages with each giving approximately a gain of 40.

If the Armstrong system is used, the last i-f stage will feed into the limiter, the function of which it is to remove all amplitude modulation by saturation. The limiter can easily be identified by the fact that its plate voltage will be low and it will have some grid bias. The usual practice is to have a resistor condenser combination with a time constant of approximately 2.5 micro seconds in the grid circuit of the limiter. Plate voltages are generally between 50 and 100 volts in a-c receivers and between 25 and 60 volts in a-c d-c models.

The discriminator or ratio detector converts variations in frequency into variations in amplitude, and the latter are then the audio signal. It is possible to explain the operation of either of these circuits with accurate mathematical calculations, but as the purpose of this article merely regards the alignment procedure of the complete FM receiver, no such detailed explanation will be attempted.

Aligning discriminator of same set.



The audio amplifier and output system need no alignment and aside from conventional tone controls no adjustment is necessary. In order to avoid errors and false results it is best practice to start the alignment of any FM receiver with the discriminator or ratio detector and then work toward the antenna input, stage by stage.

Discriminator or Ratio Detector

A conventional discriminator circuit, including the preceding limiter is shown in *Fig. 2*. Verify the low plate voltage on the limiter tube, as provided by *R4* a 100,000 ohm resistor and the time constant of *C1* and *R1*, 50,000 ohms and 47 $\mu\mu$f respectively. *R5* and *R6* represent the diode load with the center tap of the discriminator transformer connected to the electrical center of the diode load, *point A*. Condenser *C4* is an r-f bypass and the *RC* combination *R7* and *C5* constitute the de-emphasis network. The time constant of this network should be approximately 80 microseconds.

Aligning Discriminator Stage

To align the discriminator stage, the signal generator is connected to the grid of the limiter (*point C* in *Fig. 2*) and the vacuum tube voltmeter first to *point A*. At this point a d-c voltage is developed which is determined by the amplification of the injected signal, and therefore, the primary of the dis-

criminator transformer is tuned to give maximum voltage at *A*; next the VTVM is connected to *point B*.

When the secondary is tuned correctly zero voltage will appear at *B*. A small variation in frequency will result in either a positive or negative voltage at *B*, and if the discriminator is adjusted properly an equal frequency change above or below the center frequency, 10.7 mc., should result in a voltage change of equal magnitude but *opposite* polarity. It is possible to plot a discriminator curve like the one shown in *Fig. 4*, by making several such measurements and plotting frequency versus voltage.

If a sweep generator is available it may be connected with an oscilloscope to provide this curve directly on the 'scope. Then it is necessary to insert a small marker signal to determine the center point, as shown in *Fig. 4*. In order to give good fidelity, the straight portion of this curve must be at least 150 kc wide, but the better practice is to make it at least twice as wide to allow for oscillator drift and inaccurate tuning. The frequency difference from one peak to the other ranges from 350 to 500 kc, but some manufacturers prefer even a wider band to facilitate alignment.

Figure 3 shows a typical ratio detector circuit similar to the one used in the well-known Pilot FM tuner. The theory of operation of the ratio detector is such that amplitude modulated signals cancel out and only frequency modulated signals are detected. This eliminates the need for a limiter. At the present a "controversy" bordering on a feud is still going on between those who feel the Armstrong system with its limiter and discriminator is superior and those who believe that the elimination of the limiter is highly desirable and the ratio detector is, therefore, more desirable. (The writer feels that both circuits have merit but that this is not the place to argue about it).

Aligning the Ratio Detector Stage

The ratio detector can be aligned the same way as the discriminator except for the location of the VTVM probe. The signal generator is again connected to the grid of the preceding tube, *C*, and we first tune the primary for maximum d-c voltage at *point A*, this is either the AVC lead or the diode load resistor, if no AVC is employed. Next the secondary is aligned to give zero voltage at *point B*, and from there, as in the discriminator, the audio signal is obtained. *R5* and *C9* are again the de-emphasis filler just as in the discriminator circuit. The response curve of this circuit should be the same as for the discriminator and the same methods for obtaining it apply here.

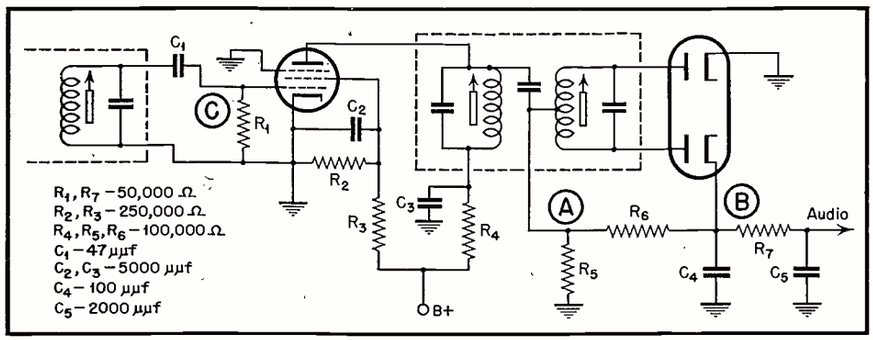


Fig. 2—Limiter and discriminator circuit.

Limiter

The operation of the limiter is best explained by comparing it to a floodgate which lets only a fixed amount of water through, no matter how ligh the reservoir runs. Of course, if the level of water drops below the level of the floodgate, it will no longer emit a full stream. Similarly, the limiter will only function properly when the signal applied to the grid is of sufficient amplitude to saturate the tube at all times. This way any extraneous noise pulses of amplitude modulation are removed from the signal which is then passed on to the discriminator. Therefore, a limiter stage always employs a relatively low plate and screen potential and considerable grid bias. In the circuit shown in *Fig. 2*, this can be seen at once by checking the values of *R1*, *R2*, *R3* and *R4*. As mentioned before, the time constant of the bias *RC* combination is kept in the neighborhood of 2.5 microseconds to provide a constant bias voltage. In checking the operation of the limiter a signal of i-f frequency is applied to the grid and the output can either be measured by placing the r-f probe of the VTVM on the plate or by measuring the d-c voltage at the center tap of the discriminator transformer. (*Point A* in *Fig. 2*). Starting with a small signal, increase the output of the signal generator until a further increase no longer causes an increase in the plate circuit of the limiter. At that point saturation is reached and the limiter will really limit. In most of the present day FM receivers a 1 volt signal on the limiter grid will cause complete saturation. If input versus output voltage are plotted a curve will be obtained similar to the tube characteristic curves found in any tube manual. First the slope of the curve will show a rise, then level off and finally it will run parallel with the axis along which the input voltage is plotted. If it appears that the curve does not level off at about 1 volt input, the limiter is not operating properly and a thorough voltage check should be made.

I-F Amplifiers

The i-f stages have to provide the limiter with a signal of sufficient amplitude to cause saturation, or in the case of the ratio detector, to give enough signal to cause a great enough change in diode current. Usually two stages of i.f. are used and they are always of the transformer-coupled type. The standard i-f frequency for FM receivers is 10.7 mc, but some FM-Television combinations use 21.25 mc, to conform with the sound i-f frequency of the television signal. In either case most sets employ permeability tuned transformers, the most popular of which are standard units, made by Automatic, Sickles, Stanwyk and other well-known coil companies. The over-all gain of the i-f system has to be in the vicinity of about 20,000 to provide enough signal for a limiter of ratio detector. The bandwidth required is at least 150 kc at the half power point. This is the point on the response curve (*Fig. 5*) where the voltage is 0.707 of the maximum. Bandwidth is, sometimes, measured between half voltage points and such a point is made visible by the marker signal in *Fig. 5*. Naturally at the half voltage

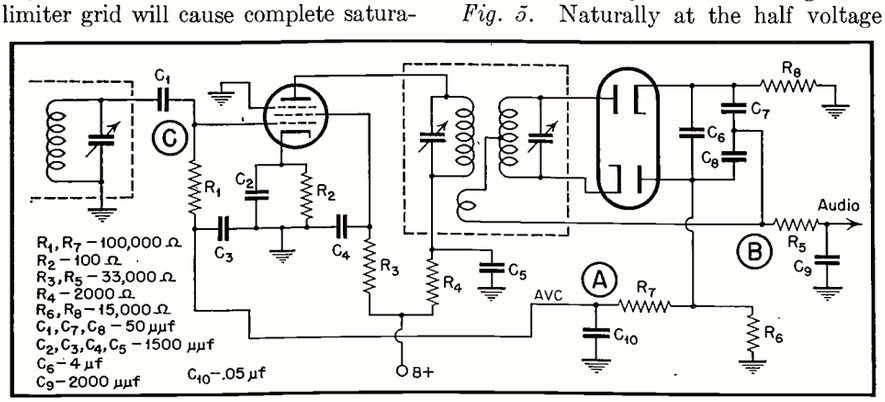


Fig. 3—Ratio detector circuit.

point the bandwidth should be greater than at the half power point.

Aligning I-F Stages

The best procedure for alignment of the i-f stages is to start at the last stage and work back towards the converter. The signal generator, furnishing an unmodulated r-f signal is connected to the grid of the last i-f tube and the d-c probe (of the VTVM) either to the grid of the limiter or the diode load or AVC of the ratio detector.

If a limiter is used only the limiter grid bias will give a true indication since at any point beyond it limiter action takes place. According to latest RMA standards measurements should be made to give 100 microamperes grid current, with the assumption that the limiter will start limiting at about 45 microamperes. If a VTVM is used calculate the voltage across the grid resistor if 100 microamperes flow through it. Tune both primary and secondary of the i-f stage to maximum at the center i-f frequency, then check bandwidth by varying the frequency above and below until the VTVM reads 0.707 or one-half of the maximum voltage. Then move your signal generator lead to the grid of the preceding stage and repeat. Last put the signal generator lead to the converter grid. Naturally the output of the signal generator will have to be decreased as it is moved from stage to stage. The bandwidth will also decrease with each additional stage until at the converter it will be close to the final value.

Stage gain can be calculated easily by dividing the input signal voltage to one stage by the input voltage to the preceding stage, provided that the VTVM reads the same at both times. I-F gain of a single stage is usually around 40, while the i-f gain of the converter is about 10 to 20.

Overcoming Regeneration

One of the major troubles encountered in the i-f stages is regeneration. This may always be suspected when the bandwidth is very small, gain exceedingly high and measurements generally unstable. Regeneration has many causes but in receivers which are known to have operated satisfactorily it is generally caused by a faulty bypass condenser or loose ground connection. A good method of locating such a trouble spot is to measure bandwidth in each stage and thus locate the stage causing regeneration. Next bypass each bypass condenser with one known to be good. Sometimes by passing filament leads for r.f. will cure regeneration. Otherwise all of the methods used on AM receivers can be used. If the i-f frequency is varied, with the input voltage kept constant, a response

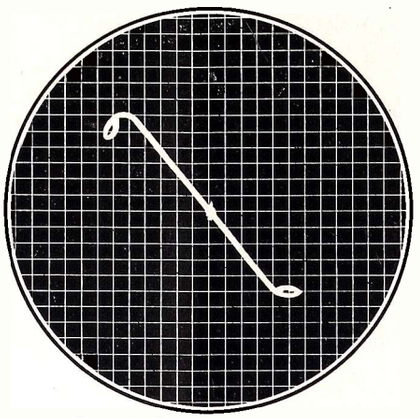


Fig. 4—Discriminator curve.

curve can be obtained by plotting frequency against the VTVM readings. Or if a sweep generator or an FM signal generator is available it can be connected with an oscilloscope to give the i-f response curve directly as shown to the converter grid and the 'scope to the grid of the limiter.

Oscillator

Alignment of the local oscillator in an FM set can be done either directly on a station or with a signal generator or by use of an absorption type wave meter.

To make sure the oscillator operates, measure grid voltage with the VTVM. This is also useful as an indictor if used with an absorption-type wave meter, since "dips" in the voltage can be observed nicely and tuning is very accurate. If some means other than FM stations are available it is usually best to check endpoints first.

Since the oscillator frequency must be 10.7 mc above the incoming signal the range of the oscillator must be from 98.7 to 118.7 mc. Usually both the coil and condenser can be adjusted and this is done just like in AM receivers, adjusting the coil or padder for the low and the trimmer for the high end. Occasionally it happens that the oscillator works well over the entire range except for one or two spots. That is usually due to coupling to some other tuned circuit nearby and to locate this is quite difficult. It is a good rule when working on oscillator circuits to

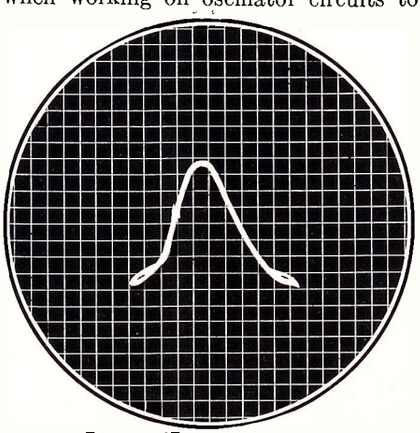


Fig. 5—IF response curve.

keep all leads short and away from other components and, of course provide good and short grounds. Sometimes the braids connecting a shockmounted gang condenser to the chassis are stiff and full of rosin and replacement or relocation of these grounds may clear up the trouble.

Mixer and R-F Stage

Most FM receivers have an r-f stage coupling into mixer, rather than a direct antenna connection to the mixer input, although the gain of the r-f stage is usually quite low. Different types of tuning units are on the market but the most generally used employs a 3 to 15 $\mu\mu$f gang condenser with a fixed padder and a small permeability tuned coil. Tracking procedure is the same as for AM receivers, except for the frequencies involved. The FM band ranges from 88 to 108 mc and most sets require close tracking for best results. A very handy tool in this work is a small tuning wand, preferably flexible and having a copper slug on one end and a VHF powdered iron core on the other. Then tracking can easily be checked just by bringing the tuning wand near one end of the r-f coil.

Antenna matching coils are usually designed to feed into 300 ohm twin lead which is the most widely used antenna wire today. While some receivers, like the Pilot FM tuner, have a variable tuned antenna input coil, the majority employ a coil which is broadly tuned to about 95 mc and pretty well covers the whole band. The bandwidth of the r-f amplifier and the r-f portions of the mixer do not present any problem since at 100 mc even a high Q circuit can easily have 150 kc bandwidth at the half power points. Nevertheless, if the i-f bandwidth at the converter is about 150 kc, then it must be assumed that the over-all bandwidth will be somewhat less than that.

Bandwidth and gain, fidelity and output power are the main problems in FM as well as AM reception. Good bandwidth makes for better fidelity, good gain for less noise, and sufficient output power for proper speaker operation and therefore, good set performance.

No matter how well aligned and how well designed a receiver may be, it will eventually need some repair and some re-alignment. While this alignment is not too difficult if the proper procedure is used, it is still different and more complicated than the "ear" type job frequently done on AM sets. Only a well aligned FM receiver will give the listener the conviction that FM broadcasting is a real advance over AM and that it is very worthwhile for everyone to own and enjoy a modern FM set.

VIDEO DETECTORS

by S. L. MARSHALL

Commercial applications of video detectors.

FOLLOWING adequate amplification of the signal by the i-f amplifier it is fed into a detector which demodulates the signal in the same manner as that employed in conventional AM receivers. Whatever r-f component remaining is then filtered out, leaving only the video signal and the synch pulses.

The video detector is a major point in a TV receiver for it is here that the actual video signal and its accompanying synch pulses may be observed with suitable test requipment. It also serves as a convenient point for injecting an artificial waveform for purposes of testing and checking the following video amplifier stages as well as the horizontal and vertical synch circuits. In addition, it is from this point that the control signal for the Automatic Gain Control Circuit is obtained, the purpose of which is to maintain a constant i-f output over a wide range of input signals. We might observe, therefore, that the video detector is the *hub* of the TV receiver.

Figure 1 illustrates a simplified block diagram of TV receiver showing the relative locations of the video detector and the other circuits mentioned above. Modern receivers employ two general types of detectors, diodes and crystals.

Picture Phase

One of the basic requirements of the signal applied to the grid of a picture tube in that its *picture phase* be *positive*. This means that the video signal itself be positive with respect to the synch pulses, as shown in *Fig. 2*. If this relationship is observed the synch pulses, being negative, will drive the grid of the CRT to cut-off, and the bright portions of the signal, being positive, will produce correspondingly bright traces on the face of the picture tube. It is thus that the effect of "negative transmission" as accomplished at the transmitter is reversed, and the scene originally recorded on the face of the camera tube is reproduced.

Detector outputs may have a *negative* or a *positive* picture phase. It the output of the detector has a negative

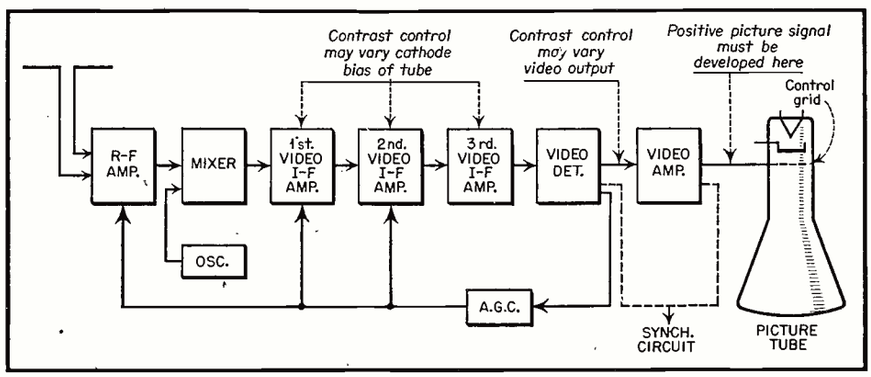


Fig. 1—Block diagram showing relative location of video detector, contrast control, and A.G.C. circuits in a typical TV receiver.

picture phase the detected waveform is a replica of the top half of the modulated envelope, as shown in *Fig. 3b*. A positive phase results in a waveform as indicated in *Fig. 4*b.

Because it is required that the signal applied to the grid of the picture tube have a positive picture phase, the number of signal phase reversals between the output of the detector and the input of the CRT must be carefully observed. Two commercial applications of this principle are shown in *Figs. 3a* and *4a*, accompanied by their respective waveforms in *Figs. 3b* and *4b*.

In *Fig. 3*, which is a simplified schematic of the Dumont detector and video section of Model RA 101 chassis, a 6AL5 is employed as a convention diode

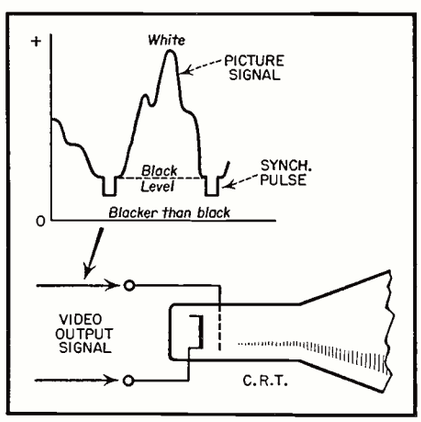


Fig. 2—Positive picture signal polarity required at CRT's input.

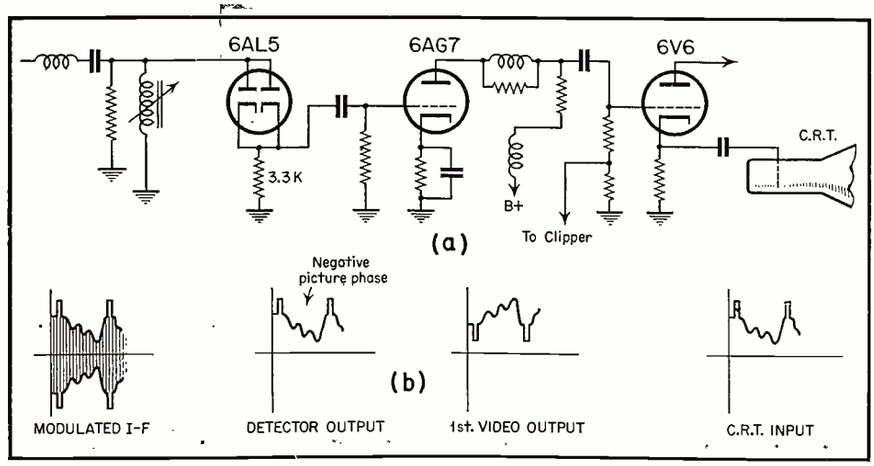


Fig. 3—Basic circuit and video signal phase of the Dumont RA-101 video detector and amplifier.

detector. The output of the detector which has a negative picture phase is then resistance-coupled into a 6AG7 video amplifier where the signal phase is reversed as a result of the 180° phase change which takes place between the grid and plate of a tube. The output of the 6AG7 is resistance-coupled to the 6V6 video output tube. However, because this tube is connected as a cathode follower no signal polarity reversal takes place, and the picture phase at the cathode of the 6V6 which is the same as that at the grid of the CRT remains positive.

A somewhat different arrangement is shown in *Fig. 4* which is a simplified version of the detector and video circuit of the G.E. 802 receiver. Rectification occurs during the negative half of i-f cycle as a result of which the picture signal becomes positive with respect to the synch pulse. The signal polarity on the 1500 ohm load resistance is such that the plate becomes positive with respect to ground. For this reason the signal at this point has a positive picture phase. A phase reversal then occurs in the output of the following 6AC7 video amplifier which is directly coupled to the detector output.

At this point the signal has a negative picture phase. Notice that, although the signal is coupled to the CRT through the capacitor, *C*, the point of signal injection is *not* the grid but the cathode. Thus, the signal polarity of the cathode with respect to grid is negative, resulting in a positive picture phase on the grid with respect to its cathode.

The application of crystal detection in TV receivers is illustrated in *Fig. 5*, the simplified schematic of the Dumont RA-102 detector and video circuit. Basically, the crystal is connected so that a positive picture phase appears across the load resistor, *R*. Customary phase reversal takes place in the following video amplifier, resulting in a signal with a positive picture phase applied to the CRT.

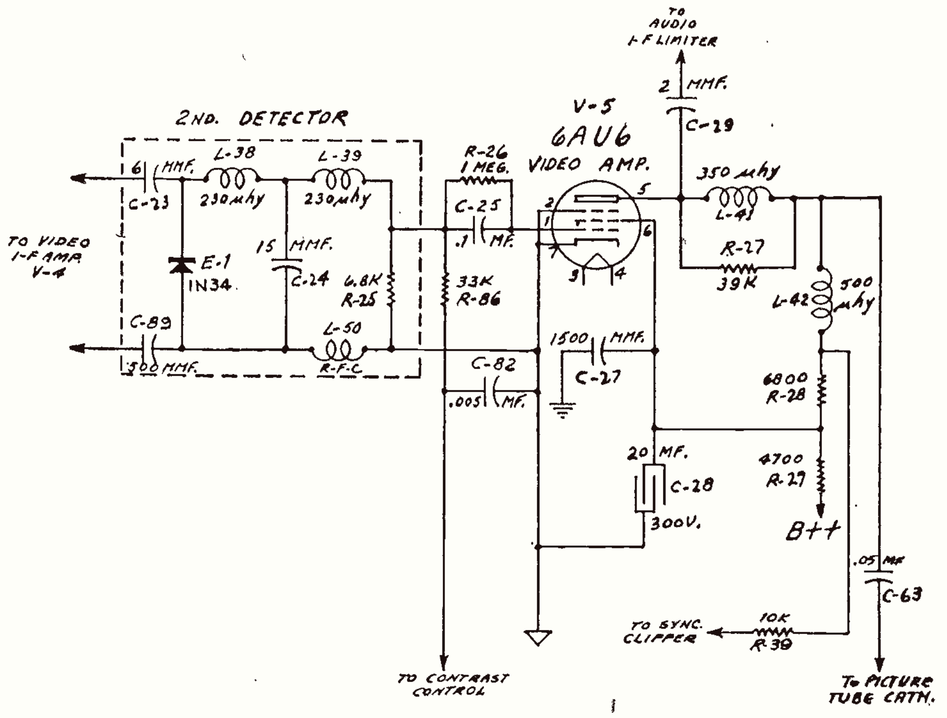


Fig. 7—2nd detector and video amplifier circuit diagram of the Motorola Model VT71.

Detection in Intercarrier Systems

An entirely new method of television reception, under development by many manufacturers, and currently employed by Motorola in their new VT71 receiver is shown in block diagram form in *Fig. 6*. Without going into too detailed a discussion of this so-called "Intercarrier System" the main point of departure of this circuit from the conventional types is in the amplification of both the video and audio signals in common video and audio circuit amplifiers. Separation of the audio signal from the video occurs at the output of the video amplifier after which the audio i-f is fed into an audio i-f limiter.

What is most unique about this system is that the video detector acts as a converter which provides a frequency difference between the video and audio i-f carriers. This difference,

[*Continued on page 43*]

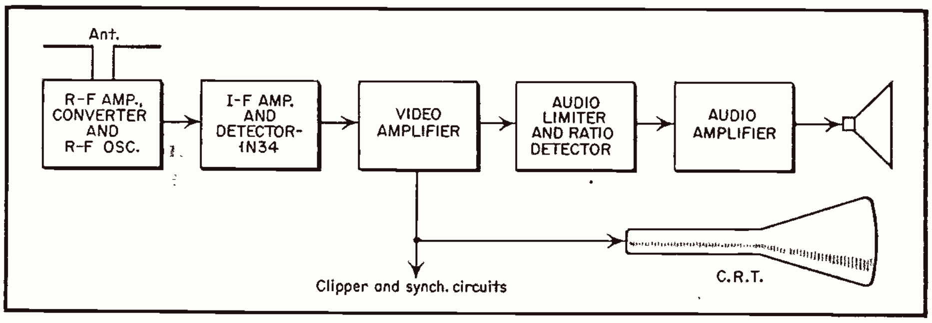


Fig. 6—Simplified block diagram of intercarrier system.

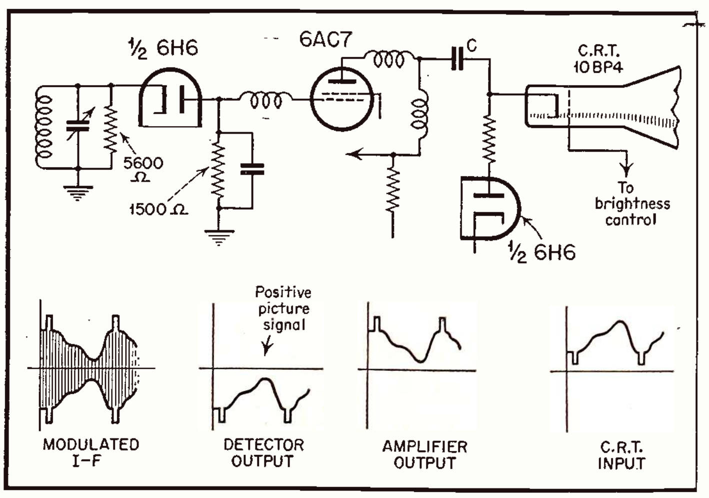


Fig. 4—Basic detector and video amplifier of the G. E. model 802.

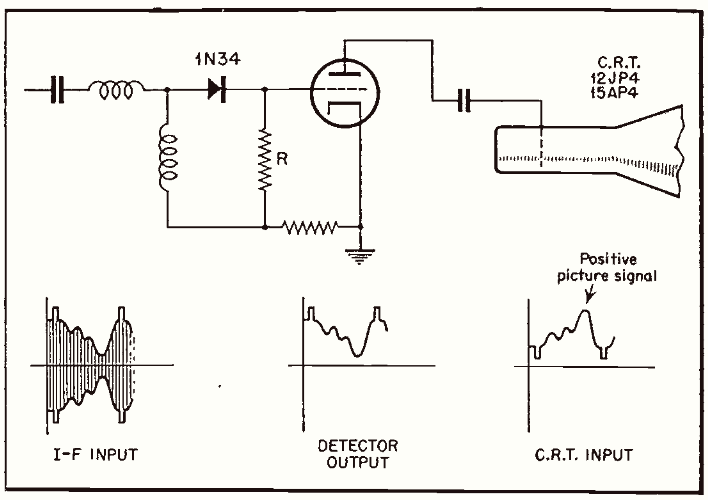
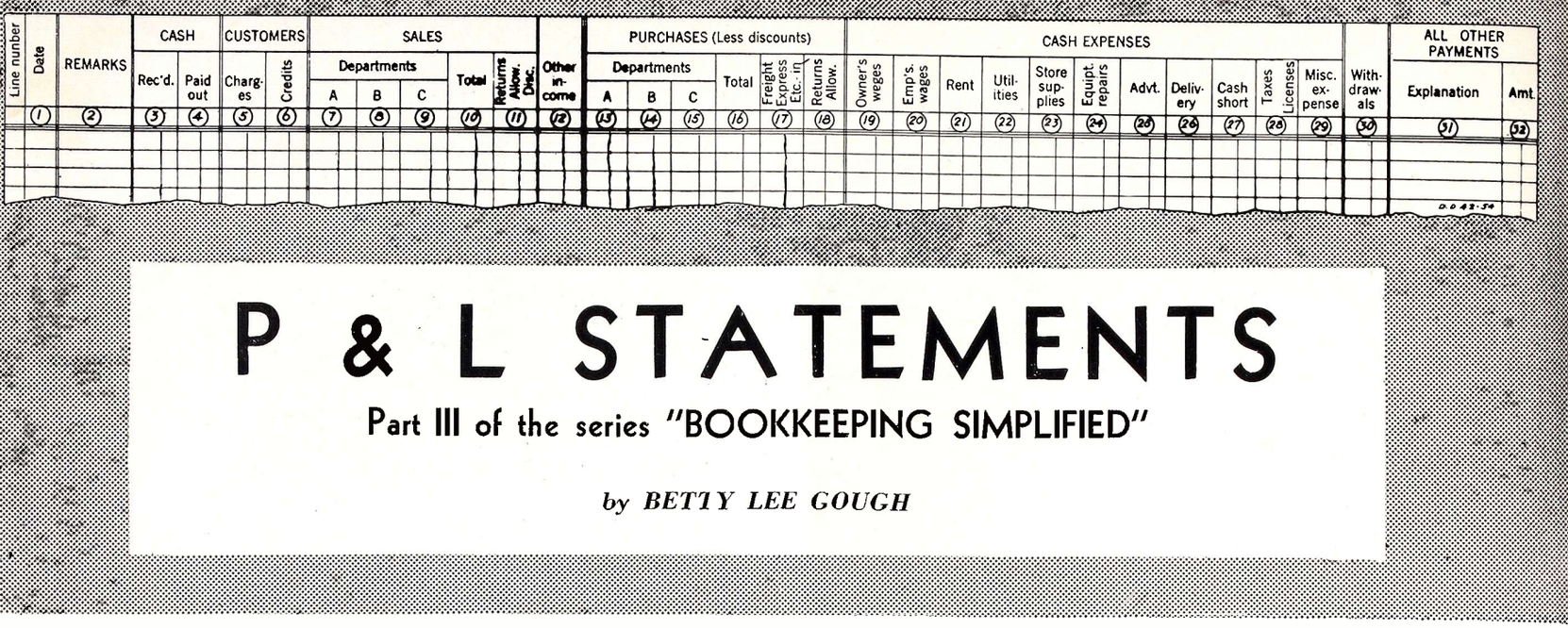


Fig. 5—Basic circuit and video signal phase of Dumont model RA-102.



P & L STATEMENTS

Part III of the series "BOOKKEEPING SIMPLIFIED"

by BETTY LEE GOUGH

Knowing your financial condition at all times is vital to good business management. Here is suggested a pattern to follow

DID YOU know exactly how much net profit you made last year? Or did you have to "estimate" certain items when March 15 rolled around? Lack of detailed knowledge of radio service shop expenses—and of what are legal deductions—has resulted in many a dealer unknowingly overpaying his Federal income tax. It has resulted in others taking deductions to which they were not entitled, or which they could not prove by book entries. The result for these dealers was usually a 6% interest charge—and sometimes penalty assessments as well.

Aside from the fact that it simplifies the filing of tax returns, an accurate profit and loss statement is an indispensiable tool for good radio service shops. It tells not only how much was made or lost, but where it was made and what expenses cut down the net. Essentially, the profit and loss statement is no more than a condensation of the year's records. It can be taken entirely from the monthly master control sheet of the one-book bookkeeping system discussed in two previous articles of this series on simplified bookkeeping.

This is what a profit and loss statement (see illustration) tells you: the net sales. Other income and what the goods sold cost. This gives the *gross* income.

From this figure, the following are subtracted: wages, rent, utilities, telephone, store supplies, repairs, depreciation, advertising, delivery costs, bad debts, cash shortages, taxes and licenses, and miscellaneous expenses such as freight and express. The amount left is the net profit made by the radio service shop for the year.

The illustration shows a profit and loss statement readily adaptable to any radio service shop. These same entries, transferred to the income tax form, give Uncle Sam a clear picture of your business. The one-book system (which should be kept for at least five years) and receipts, cancelled checks, etc., are there to back up claims made on the income tax return.

What expenses are deductible from gross profits on the tax return? Which expenses are not? How fast can a fixture be depreciated?

Any merchandise bought for resale is deductible—but there is a catch! If you purchased $10,000 in merchandise to be resold, and still have on hand $5000 worth at year's end, you have incurred only a $5000 expense because you still have, as an asset, the other $5000 in merchandise.

Store supplies of every kind are expenses of the business. Postage is an expense. If you buy a broom to sweep the floor, that is a supply expense. Freight paid on shipments is deductible. Advertising, entertainment, wages (but not the proprietor's), utilities, gasoline used for delivery, bad debts, cash losses, thefts, rent, repairs, taxes (except sales and income taxes); all are deductible.

INCOME DURING YEAR:		
From sales dep't		$51,000
From service dep't		44,000
Total		$95,000
COST OF OPERATIONS:		
Inventory beginning year	$15,000	
Purchases during year	35,000	
	$50,000	
Less inventory at end of year	6,000	
COST OF SALES		44,000
Gross profit		51,000
LESS—OPERATING EXPENSES:		
Wages	23,000	
Rent, heat, etc.	10,000	
Supplies, repairs	9,000	
Advertising	3,000	
Bad debts & misc'l	1,000	
Total		46,000
Net Profit on Year's Operations		$ 5,000

CONTACT CAR-OWNERS NOW

by D. S. Travis

Helpful tips on a seasonable business now wide open, plus suggested trouble-shooting methods for auto radios.

SPRING and Summer seasons bring people the urge to get out on the highways and go places in their automobiles to see things. While seeing they also like to hear things. That is where you and the car's radio come in. As a radio service dealer it is up to you to contact that car owner, get his radio into your shop and put it into top operating condition.

Folks are by nature forgetful and neglectful. They put off the repair of their car radio. Then they suddenly decide they want it fixed *in a hurry*. That is reason enough for you to copy the politician and start your organized campaign early. Now whenever you see a local car with an antenna on it, get the license number and look up the name of the car's owner. Drop him a line or two on a postal card, in a letter, over your telephone, or better still, pay him a little visit and get acquainted. His radio may not need immediate repairs. It will, eventually.

Auto Radio Service Tools

With the exception of a few special tools, and the willingness to do a bit of crawling into cars to remove and install the radio, the work is little different from the home radio servicing job. A clean white jacket with your name and business lettered on it will keep most of the dirt and grime from getting through the moth holes in your Sunday suit.

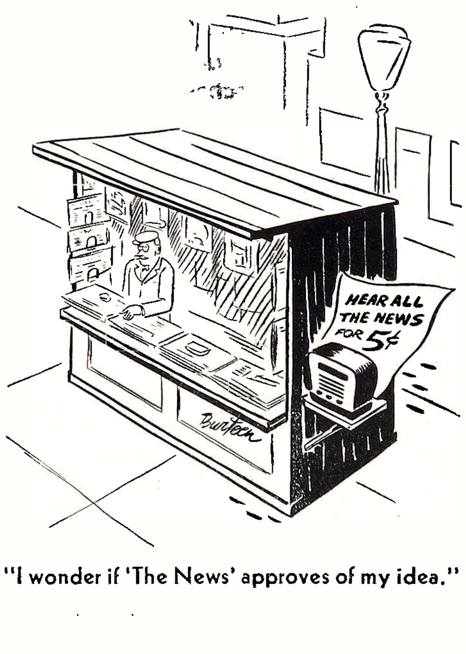
Experience proves that most car radios should be "pulled" from the auto before attempting diagnoses, checks, repairs, etc. The time factor is important, and you should charge prices to compensate you for labor consumed. Service shops that specialize in auto radio repairing have done very well for themselves because most have had a sound cost-computation system in effect. After you have the car radio on your work bench it is a routine matter to check and repair it.

Check Procedure

You must always have six volts d.c. with plenty of amperage available for instant use in your shop. It is a bit embarrassing to have a customer bring in his car radio, and he sees you hook it up to a half charged battery, and you are stopped cold. Small incidents and acts loose good customers for you.

The same test equipment, the same cause-and-effect reasoning, and the same cuss words can be used with both home and auto car repairing. The whole combination of r-f, i-f, a-f, and power circuits add up to a mass of various parts, any one of which may be the root of your trouble. But the way the radio "acts" or its failure to act should furnish you good clues to the criminal part. It isn't necessary to check every part in the radio to locate the one offending part. The only way you can make a living for yourself and the kids is to get the job done real fast so you can get on to the next one.

Suppose we put that dirty old car radio on the workbench and get at it. First we hook up the battery to the radio, turn on the set, and "poof" a blown fuse. Now what will blow a fuse? A short, of course! Very simple deduction. What can cause a short? Several things. A sticky-pointed vibrator is a common cause. Yank that vibrator out, put in another fuse and turn on the radio again. If the new vibrator clears up the trouble, fine. If it is a good name vibrator with the proper characteristics leave it in there.



"I wonder if 'The News' approves of my idea."

Don't waste precious time trying to get the old one in order.

If the second fuse blows, with the new, known good, vibrator in or without any vibrator plugged in the radio, then grab the ohmmeter and get busy. But first check the tubes. Check the speaker field, or better still, remove all tubes and unplug the speaker. Pay close attention to the spark-plate condensers, and the other filter condensers in the filament circuit. Unsolder one end of the primary and one end of the secondary transformer windings and check the transformer. Watch for little, simple things.

When you find it a must to replace a car radio vibrator, always check the buffer condenser or condensers. If they even look like they might be bad actors, remove them and replace with new ones of the same capacity rating and the same voltage rating or higher. The capacity rating is very important since the vibrator power pack is timed. If the buffers look like they were put there by another serviceman, better check with an official diagram of the circuit, or consult *Mallory's Guide*. Be certain *you* do not put in the wrong capacity buffer.

If the radio has excessive hum check the filter condensers. If it is a case of no plate or screen voltage on one or more of the tubes check for a shorted plate or screen bypass condenser. There are other things, but these are the most common

If you must replace a condenser or other part don't leave long leads to dangle around. Don't make "lap-joint" solder connections. Hook that lead in good, squeeze it together with the long nose pliers, and put a good hot solder job to it. Tie-points and soldering is extra important in car radios. They must withstand plenty of rough vibration.

Speakers act up now and then. If rain or car-wash water gets into the cone a few times the cone warps and drags or just plain comes loose. You can re-cone the speaker, or replace it

[Continued on page 48]

Field Findings

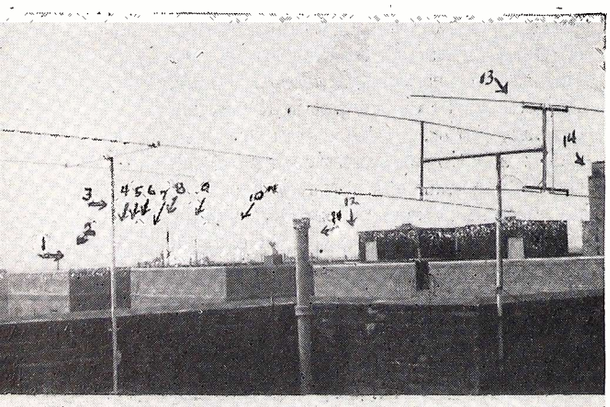
The Editor's views of happenings here and there are of interest to everyone engaged in the radio industry.

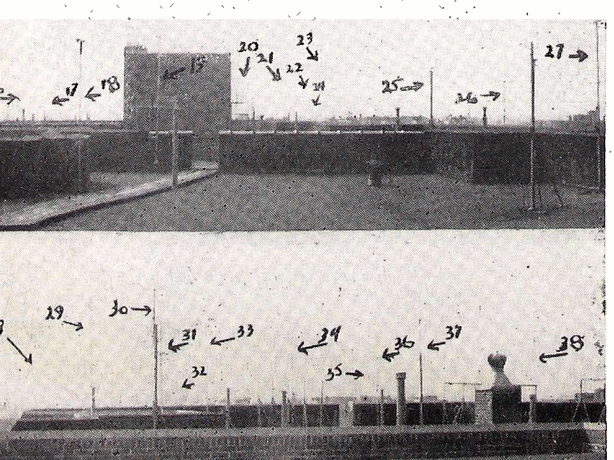
by S. R. Cowan

THE daily routines and problems of service dealers and technicians vary in every community. Thirty miles distance between cities often makes for a tremendous difference in the requirements and working habits of radio technicians. Knowing this, it has been my policy to travel extensively so I'll know what is happening "in the field." As "RSD'S editor I try to make *your* problems *my* problems. Believe me, *we* have too many problems, but many are not insurmountable.

Gyppery and Licensing

New York City's technicians were recently confronted with a threat that a licensing Bill would be enacted unless the servicing trade "cleaned house." The machinery to effect required improvement has been set in motion and mainly through the efforts of the Associated Radio Servicemen, Inc., action on the Bill's introduction has been deferred. The newly former Association has, in less than six months, gotten over 400 members, raised standards of ethics and customer-dealings to an amazing degree; and without doubt, if given sufficient time, will accomplish far more good for both the set-owning public and trade itself than any licensing Bill.





A Brooklyn, N. Y. apartment house with 129 tenants already has 45 television sets in operation. These 3 candid camera shots show 38 of the 45 dipoles. Other tenants are still awaiting their TV installations. Did anyone say TV isn't hot?

Meanwhile, Pittsburgh, Pa. servicemen are being blasted for incompetence and unethical tactics by the Better Business Bureau of that city. The BBB claims to have surveyed the Allegheny County radio service industry by taking 12 new table model sets that were "purposely gimmicked by having a wire loosened or a short-circuit induced" to 68 shops picked at random. It is claimed the sets were carefully checked before and after leaving every store. The BBB findings, as released in the April 6th issue of The Pittsburgh Press are as follows: "Only 28 shops came through with a clear record . . . of the remainder, 5 unneeded condensers were installed and billed; 18 condensers were charged for but not installed; 13 tubes were substituted for other makes; 5 tubes were charged for but not replaced; 1 resistor was installed and 4 were charged for but not put in; 1 oscillator coil was substituted for a perfect one; a loudspeaker was charged for but not installed; in 3 instances excessive fees were charged for inspection and work done; in 3 cases the sets were returned with a report they needed no repairs."

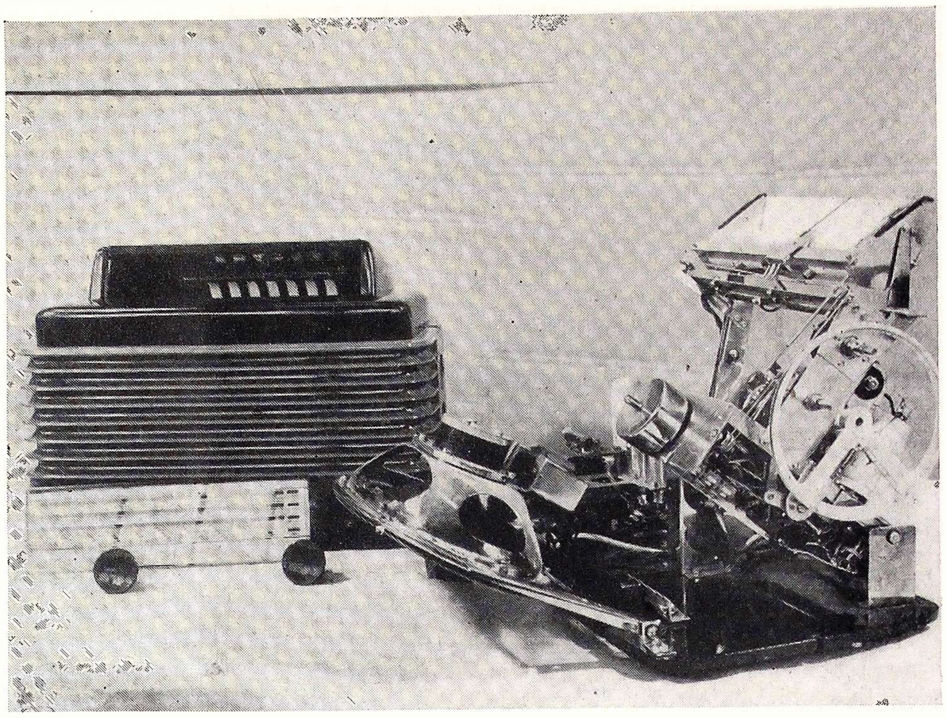
Continuing, the survey showed that in one test, where only a wire had been loosened to create a defect, the itemized bill as submitted totaled $9.50 and read: 2 tubes, $3,00; 1 condenser, 75c; 1 pilot light, 50c; service, $5.00. Note the correct total should have been only $9.25.

From our study of the Pittsburgh survey, the BBB tried to do an honest job and we will not attempt to condone the short-comings of those who were found wanting. It is a pity that only 28 out of 68 shops tested passed. But, already a move is afoot in Pittsburgh to force licensing upon servicers. If this industry does not clean house through its own efforts, inevitably various municipalities will in self-protection effect laws imposing restrictions and penalties against malpractice. One af the best features about New York City's Association is the fact that its membership is functioning as its own and as the entire city's police department, and when *any* technician is accused of malpractice, he is given an opportunity of "be tried" and if found guilty to "make good." Failure to make amends results in prosecution with members of the Association acting as complaining witness. I advocate such policy on a nationwide basis. The first step, of course, is the organization of a proper association. Philadelphia's Association (PRSMA), offers to lend any assitance needed to any group who wants to form an association, and I will gladly act as a liaison officer for you if you merely contact me and make known your plans.

Why There's Gyppery

I believe that as a whole radio technicians, (bosses and employees alike), are not earning enough money and that is a prime cause of gyppery or malpractice. Generally the reason servicers fail to earn enough is simply this: the business manager doesn't know how to establish proper prices for his services. (This subject was covered in the article, "*How to Compute What Prices to Charge*," *April "RSD"*). Sometimes wrong prices are charged because a firm hires technicians to work on percentage basis, giving the employee a commission on replacement parts used in a repair job, and relying upon

the integrity of the employee. Sometimes a servicer inadvertently gives a customer an estimate that is too low, takes a licking on a job, and then tries to "level off" by over-charging the next customer. Such practices can never be condoned. The key to successful business management is *be right,* right from the start of every transaction, so that both operator and customer gets fair equity. I urge all readers to study their own present method of doing business, immediately take necessary corrective steps . . . and if you have a problem you can't lick by yourself, write to me about it. I'll get an authority to help you solve it.



As is described in the text, this is a view of the new British Ultra receiver which can be removed from the cabinet with amazing ease, and which, when a single bolt is removed, opens like a flower, exposing all sections, so that repairs can be made without difficulty.

Educating the Public

Frequently I've heard it said that the public don't appreciate radio servicemen, their big investment in time, experience and money, etc. I'll buy that to *some* extent, but believe it can be eliminated from the scene by the trade's own efforts toward public education.

Addressing groups of servicemen in all parts of the country I meet all types of fellows. Almost every one is a grand guy in his own way. But, I find as a general rule, at meetings, the fellows who attend all dressed up as dignified businessmen are the really successful men, with the biggest earnings, in their particular community. The fellows who come clothed in dungarees, wearing torn and tattered sweaters, no ties, looking like common laborers . . . they're the ones who have the biggest gripe about repairmen not making enough money,—that they, and the servicing profession, are being oppressed by a public that "don't appreciate them."

It is my opinion that every radio set owner who enters any shop immediately gets a strong impression of that shop's personnel *and* integrity *and* liability *and* capability *and right* to charge certain prices merely from what his eyes observe. I've gone into shops that were so sloppy and disorganized in outward appearance, whose personnel looked so dirty and disreputable, that my first impression was, "I wouldn't trust this outfit with my enemy's radio." And, I have visited shops that were so neat and properly manned that I've said to myself, "Here's a fine example of what all service shops *should* look like, but unfortunately don't". And I've found that some of the "messy" shops are run by exceptionally competent, honest service dealers while some of the "fine" shops are run by men of such low integrity and competence that they should be legally barred from public-dealing.

The only lesson one can gain from the above factual statements is that it pays to be honest, practice high ethics, and at the same time dress up your shop and be clean, neat and presentable. I'll restate my findings in this manner: I believe without qualification that the country's most successful radio shops and radiomen are the neat, clean ones, and the biggest gripers and least successful men are those who look the part. *Educate the public to respect you because of your very appearance and business-like manner and you've undoubtedly taken step 1 to success.*

Educating the public to be willing to pay you higher prices for radio service requires step 2 (if step 1 is to be a better appearance) and by that I mean a service shop operator *must* see to it that he gets paid a proper rate for *every* service he renders, from testing tubes down to making an estimate as to what he will charge for fixing any given receiver. There's never need for gyppery or evasion. If one knows his costs, explains clearly to every set-owner what potential other faults might be found in any set, and if he convinces the customer to accept a proposition to the effect that he will do *everything* required to put a set in optimum operating condition for a certain, agreed-upon-in-advance stipulated maximum fee, then, from that point on, every service transaction can and should be carried on to a proper and profitable conclusion for all parties alike, the set repairer and set-owner included. A sick person never bargains with a doctor to "partially fix him up" for a certain fee, and there's no reason why a radio repairman should do it either in "treating a sick radio set."

When doing business with a customer, do it thoroughly, cover *all* contingencies, take nothing for granted, make sure the customer knows what the score is, price your work right, charge enough and you'll both get along harmoniously.

TV-FM and "Fringe" Areas

Visiting eastern cities I find the trade enjoying "mixed emotions." So many cities are being served with TV and FM programs, so many other towns are just on the "fringe" of TV or where FM has just become programmed, that there is a lot of optimistic feeling . . . with a gripe against TV set-makers because of their present service policies, the big news.

Service dealers located in FM areas, and on the fringe, report FM set sales are booming; that FM set-owners like the new receivers so well they are washed up on AM. To date, most FM models give excellent service with most breakdowns or troubles arising in the discriminator or limiter section, depending upon the set's type circuit. Repairing FM is hardly more difficult than AM if one is careful. Don't disarrange wiring, trouble-shoot in the regular approved manner, stage-by-stage. Aligning and corrective methods for FM, as covered by articles in "RSD" are proving to be the fastest and most efficient.

FM sets give better service when a dipole is used, but many sales are consumated without a mention being made that a proper antenna installation for an additional fee would be mutually beneficial to seller and buyer alike.

[*Continued on page 46*]

HOW VECTORS

This article makes clear the operations involved in the solution of mathematical problems related to radio. Most radiomen lacking sufficient mathematical knowledge appreciate their handicap but usually do nothing about it. Knowing how to use vectors eases their job.

AT PRESENT an understanding of complicated radio circuits requires a fundamental knowledge of mathematics so, unless a radio technician acquires this knowledge, he must take a back seat. With this in view, and remembering that the radio electronic technician is primarily interested in the *applications* of mathematics related to his trade, we will try to make this presentation as practical as possible.

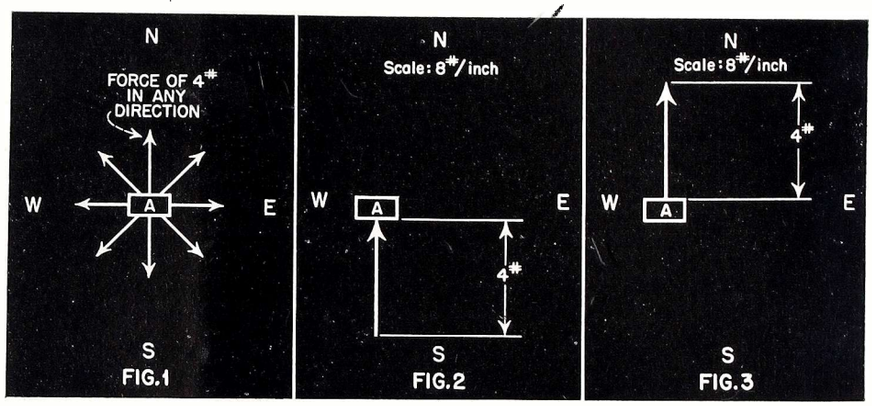
Those who work on FM receivers know that they make use of a means of detection which is entirely different in principle to the conventional AM detectors. Most likely, in their efforts to understand the theory underlying this circuit, they have read many articles on the subject. These articles are followed with varying degrees of understanding, depending on their mathematical backgrounds. If they lack sufficient background they usually came up against a blank wall. This blank wall involves the use of vectors, those little lines tipped with arrows, the language if which is so strange to the layman.

Those who work diligently and master this subject soon learn to their amazement that it is not only exceedingly simple, but a means by which certain other vague radio fundamentals suddenly take on a more significant meaning.

Consider a small object placed upon a smooth ballroom floor as in *Fig. 1*. The floor is assumed to be almost frictionless; that is, it offers very little resistance to any object moved about the floor. Consider, also that someone is pushing this object with a force of 4 pounds. What do we know about this situation that can be represented symbolically? We can do nothing more than make a statement to the effect that some object is being moved about a frictionless floor with a force of four pounds. We know nothing of the direction of this force, since it may be in any of the directions indicated in the diagram.

Now, suppose that the object is moved in a definite northerly direction with this same four pound force. Would this help us be more explicit in our description of the existing conditions? Most assuredly, for we can substitute for this object, a line, the length of which represents the applied force. Thus, if the line has a certain length, dividing it by four lbs. results in a unit of length which symbolizes a force of one pound. This unit of length may be inches, feet, yards or any other unit that would serve our purpose best. At the proper end we then place an arrow indicating the *direction* of this force. Thus, referring to *Fig. 2*, the arrow (*A*) tells us that a force of four pounds is being exerted on an object in a northerly direction.

In *Fig. 3* the arrow (*B*) tells us the same story. Therefore, either of the two figures can be used to indicate the conditions obtained. Now what are the distinguishing characteristics of these arrows? First, they have a definite length which indicates a definite force. Second, they have a definite direction. We have, therefore, evolved a symbol which indicates not only the force that acts on an object but the direction as well. We call this symbol a *vector*. Fundamentally, it performs some operation just as any other of the mathematical symbols. Thus, the plus (+) sign between two numbers indicates that they are to be added; the square root ($\sqrt{\ }$) sign over a number indicates that the square root of it is to be taken; and a vector indicates a definite force on an object applied in a definite direction.



Vectors "in Same Line"

Vectors can be employed to indicate voltage and current in resistors, coils, condensers, or any other components through which electrons flow. Thus, referring to *Fig. 4*, vector, *A*, represents an emf of 3 volts in one direction; vector, *B*, represents an emf of 4 volts in the opposite direction; vector, *C*, represents a current of 2 amperes in the same direction as vector, *B*; and vector, *D*, represents a current of 5 amperes in the opposite direction to vector, *C*.

Let us now see what the procedure is

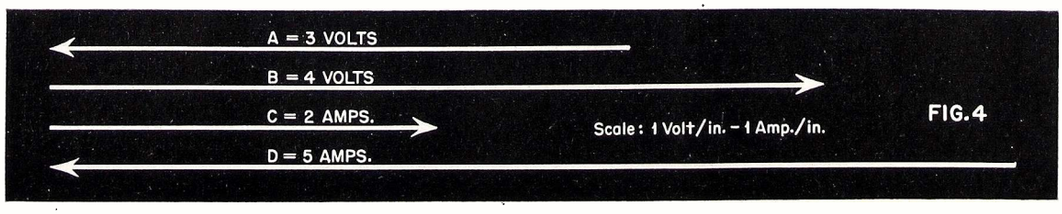
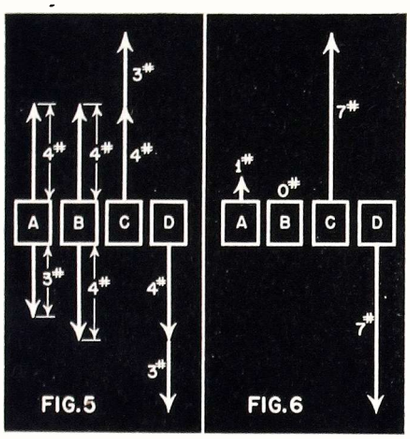


Figure 4. Is drawn to actual scale.

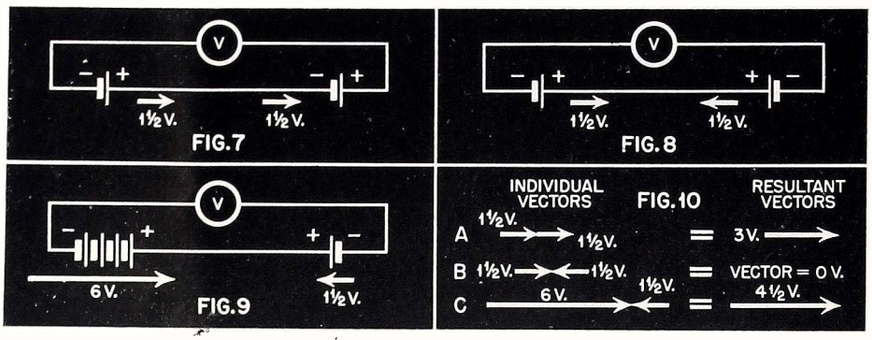
SIMPLIFY SERVICING

by S. L. MARSHALL



when dealing with two or more forces applied to the same object. Consider object, *A*, in *Fig. 5*. Onserve that it is being acted upon by two forces, one of four pounds to the north, and the other of three pounds to the south. The net result is a force of one pound to the north on object, *A*, which is indicated in *Fig. 6*. Similarly, the resultant forces on objects, *B*, *C*, and *D* are zero, seven pounds to the north, and seven pounds to the south, respectively. The special case where the resultant is zero is usually troublesome to the beginner who usually cannot understand how a zero force is obtained as the result of two forces acting upon the same object. However, this is exactly what takes place in a tug-of-war, where both groups of opponents exert the same pull in opposite directions, which results in no movement in either direction.

Electrical analogies can be made to dry cells connected to one another as in *Figs. 7*, *8*, and *9*. In *Fig. 7*, two 1½ volt dry cells are connected in series, resulting in a force of three volts as indicated in *Fig. 10A*. *Fig. 8* shows two batteries of equal voltage connected in series opposing. This results in a zero potential as indicated in *Fig. 10B*. In *Fig. 9* two batteries of different potentials are connected in series opposing, resulting in a net force of 4½ volts as indicated in *Fig. 10C*.



From a consideration of these illustrations we can arrive at a significant conclusion concerning vectors which lie in the same straight line; i.e., *the resultant vector of several vectors lying in same straight line is the algebraic sum of all the vectors.* By algebraic sum is meant adding all the vectors which are in one direction, then adding all which are in the other, and finally substracting the sum of one group from the other.

Thus, the algebraic sum of the following forces:

7 Lb. N., 3 Lb. S., 4 Lb. N., 6 Lb. S., 5 Lb. S., and 8 Lb. N., is

North	South	
7	3	
4	6	19 Lb. N.–14 Lb. S. equals
8	5	5 Lb. North. *Ans.*
19 pounds	14 pounds	

This is a very important rule and should always be in the background of one's mind when working with vectors.

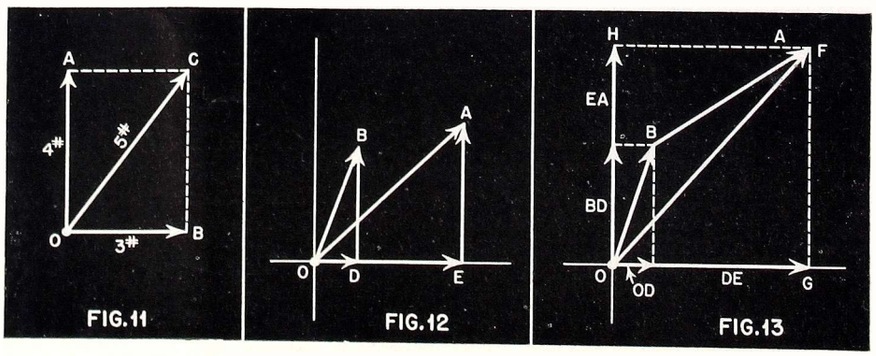
Vectors Not in Straight Line

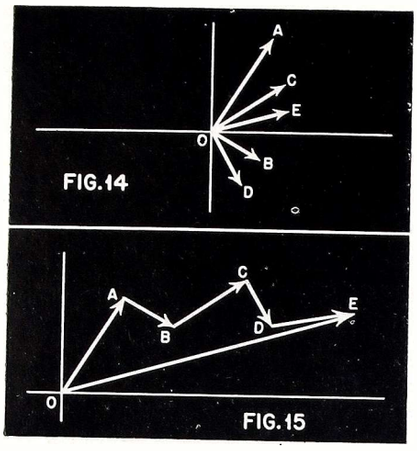
Up to now we have been primarily concerned with examples involving vectors lying in the same straight line. We will now work out problems where the forces are not in the same straight line. These conditions occur mostly in circuits involving capacitors and inductors. They also occur in complex form in transformer action.

Let us consider two forces, *A* and *B*, as in *Fig. 11*, acting on an object under circumstances similar to those in *Fig. 1*. *A* is a force of 4 pounds acting north and *B* is a force of 4 pounds acting east. What is the resultant force on the object now? What is its direction?

Experience tells us that if the forces, *A* and *B*, are both equal, the direction of the resultant force will favor north as much as east. The object will therefore move in a northeasterly direction. A direction not quite northeast applies to this problem. This direction can be obtained by the following construction. Draw a line *AC* parallel to *OB*. Draw a similar line *BC* parallel to *OA*. These lines will form a rectangle which will give us the resultant force if we connect *O* and *C*. This line is called a *diagonal*. If measured to scale, it gives us the resultant force. Measured carefully with a ruler the length of this line should be 5 inches. Since our scale is one pound equals one inch, the net force is 5 pounds. Thus, when two forces act at right angles to each other, the resultant force acts along the diagonal and is measured by its length. This is the second important rule that must be learned.

Just as two forces can be resolved into a single diagonal force, so can a single force be resolved into two single forces at right angles to each other. This enables us to break up complicated





forces acting in all directions, and resolve them into a single force.

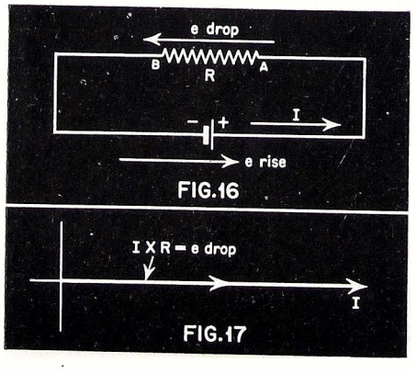
Thus, in *Fig. 12*, force *OA* can be resolved into the vertical component *EA*, and the horizontal component *OE*. Similarly, force *OB* can be resolved into the horizontal component *OD*, and the vertical component *BD*. Applying the first rule, (referring to the addition of vectors in the same straight line), the horizontal vectors will add up to *OG* (See *Fig. 13*), and the vertical vectors will add up to *OH*. Applying the second rule, the resultant diagonal is found to be equal to *OF*. This diagonal can also be found by laying off force *OA* on *OB* as shown, and drawing a connecting line from *O* to the tip of *OA*. This line will then coincide with the original diagonal *OF*. Thus, *no matter how many vectors are involved*, the resultant of all is obtained by placing them end to end and drawing a line from the beginning of the first to the tip of the last.

Referring to *Fig. 14*, the vectors *OA*, *AV*, *BC*, *CD*, and *DE* add up to the resultant vector *OE*.

Typical Practical Applications

We are now ready to apply these newly developed principles to practical situations. First, let us consider the case of a resistor connected across a battery as in *Fig. 16*, and the corresponding vector diagram in *Fig. 17*. The vector at the bottom describes the voltage generated in the battery and the one on top describes the voltage drop in the resistor.

It is customary, in series circuits, to



draw the direction of current along the horizontal reference line, as indicated in *Fig. 17*. The voltage drop, I_xR, will therefore be along the current line. Observe that voltage drop in this case is equal to the applied voltage.

Let us now consider the next case, that of an inductance connected across a battery as in *Fig. 18*. Oscillograms of current against time, as in *Fig. 19*, indicate that when the switch is closed, it takes time for the current to build up. This is in accordance with Lenz's Law which states that the changing current through an inductance sets up a flux which produces a voltage or counter emf opposite to the applied voltage. This is an electrical counterpart of the ordinary laws of action and reaction we experience in everyday life. This counter emf is greatest at the instant the switch is closed, and gradually becomes equal to zero as the current approaches a steady value.

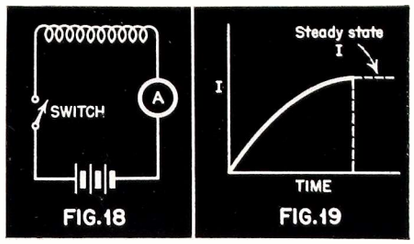
Fig. 19 tells us that in an inductance the current lags behind the applied voltage. In a pure inductance connected to a.c. this lag is equal to one quarter of a cycle or 90 degrees.

Let us now connect a source of a.c. to the inductance which we will assume has zero resistance. We can express the voltage and current by vectors as in *Figs. 20 (a)* and *(b)*. *Fig. 20 (a)* represents common method of showing a complete cycle of current and voltage in an inductive circuit, while *Fig. 20 (b)* represents the vector method of presenting these conditions. In *Fig. 20 (a)* we show the voltage and current as they vary throughout the cycle. In *Fig. 20 (b)* we give the voltage and current vectors definite values, preferably the effective, and indicate their relative positions at any instant. This relative position is called *phase*. Thus, the voltage is 90° out of phase with the current.

A careful study of *Fig. 20*, indicates that we assume a time rotation in a counter clockwise direction. It is evident from the figure, that any phase relation between the voltage and current, can be shown by means of a vector diagram.

If the coil has zero resistance, the voltage drop across the coil or the counter emf will be equal to the applied voltage. This is in accordance with Kirchoff's second law, which states that the algebraic sum of the voltages around a circuit is equal to zero.

In a previous paragraph it was pointed out that the current in an inductance lags the applied emf by 90°. This is explained as follows: If we assume, *x*, as the starting point in *Fig. 20*, we can go around the various boxes (or quadrants as they are called) until we come back to the original point, *X*. In doing so, we describe a complete cycle corresponding to 360



degrees. Thus, a quarter of a cycle represents 90°.

In any coil, the counter emf, *e* will be proportional to $2\pi fL \times I$, (abbreviated X_L x I) where π equals Pi or 3.14.

f equals the frequency in cycles

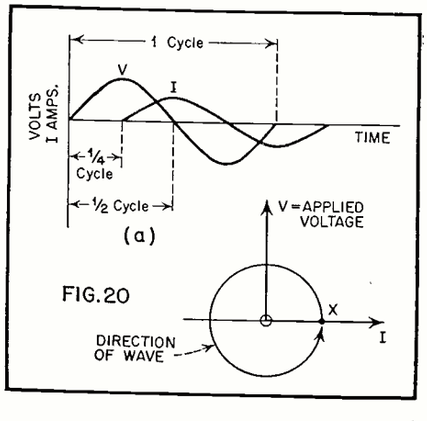
I equals the current in amperes

L equals the inductance in henrys

The quantity X_LI expresses a voltage drop across an inductance in an a-c circuit. The expression, IxR describes the voltage drop across a resistance in a d-c circuit. The quantity X_L can therefore be considered similar in many respects to d-c resistance, except that it is strictly a function of a.c. We call this quantity *Inductive Reactance.*

We are now in a position to analyze the vector diagram of a coil, with due consideration to its d-c. resistance. It should be pointed out, at this stage, that no coil is devoid of resistance, and that assumptions made otherwise, are for purposes of explanation only. Referring to *Fig. 21*, we note that the inductive voltage drop, X_LI is laid off 90 degrees ahead of the current. On the other hand, the voltage drop due to the d-c resistance of the coil is directly a result of the current flowing through the coil, and is in phase with this current. It is, therefore, laid off along the current line.

We have now two voltage drops in the coil at right angles to each other which make up the total voltage drop across the coil. Applying the methods of adding vectors, previously explained, we obtain the voltage drop across the coil by drawing the diagonal of the rectangle formed by IR, IX_L and their corresponding parallel lines. This voltage E, we note, is greater than either IX_L or IR, yet smaller than their sum. It will also be noted that this resultant voltage across the coil is neither in phase with IR or IX, but at some



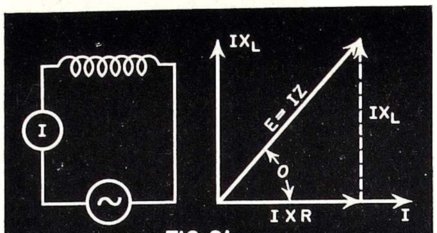


FIG. 21

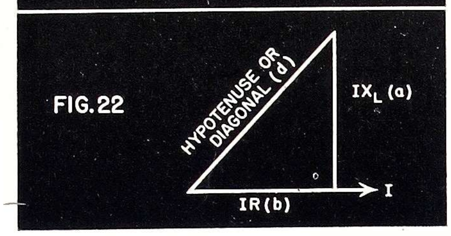


FIG. 22

angle ahead of the current.

It can be shown by geometry that the length of the diagonal of a rectangle is related to the sides by the following formula:

$$d^2 = a^2 + b^2 \quad (1)$$

If we consider only two sides and the diagonal, we will note, as in *Fig. 22*, that they form a triangle. Since this triangle contains a right angle, we call it a right angle triangle. The diagonal is called the hypotenuse.

Taking the square root of both sides of equation (1),

$$d = \sqrt{a^2 + b^2} \quad (2)$$

An interesting and easy illustration of the proof of this equation is the triangle with the smaller sides equal to 4 and 3 respectively. The hypotenuse in this case will be equal to 5. The reader should work out this problem from equation (2) and by measurement as well.

Referring back again to *Fig. 21*, we note that the resultant voltage, E, by equation (2) is,

$$E = \sqrt{(IX_1)^2 + (IR)^2} \quad (3)$$

Equation (3) gives us the relationship that exists between the voltage across the coil and its component voltage drops due to the d-c resistance and the a-c reactance. Equation (3) can also be written as follows:

$$E = \sqrt{I^2 (X_L^2 + R^2} \quad (4) \text{ or,}$$

$$\frac{E}{I} = \sqrt{X_L^2 + R^2} \quad (5)$$

The quantity $\frac{E}{I}$ in equation (5) represents the total effect of resistance

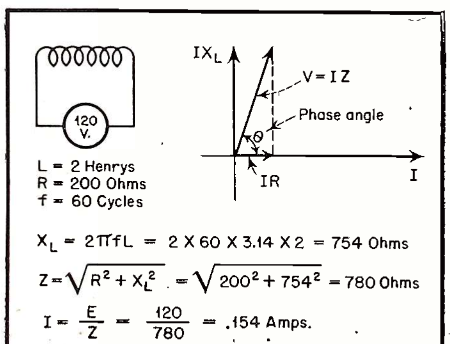


FIG. 23

and reactance in the circuit, and is called the impedance, Z. Z is therefore equal to

$$Z = \sqrt{R^2 + X_L^2} \quad (6)$$

and is the vector sum of the resistance R, and the reactance X_L

It will be noticed that due to the d-c resistance in the coil the current lags the applied voltage by less than 90 degrees. The impedance, Z, can be obtained by measuring the current and voltage in the circuit, and dividing the former into the latter, or by applying formula (6), knowing X_L and R. Formula (6) is one of the most important relationships in a-c circuits, and its derivation indicates only one of the many applications of vectors. The angle θ in *Fig. 21* is referred to as the phase angle.

Example

Given a coil with an inductance of 2 henrys, a resistance of 200 ohms, and applied across a 120 volt—60 cycle source of a.c. Find the impedance, Z, the current, I, and show by means of a vector diagram the relative phase angle of the circuit. See *Fig. 23*.

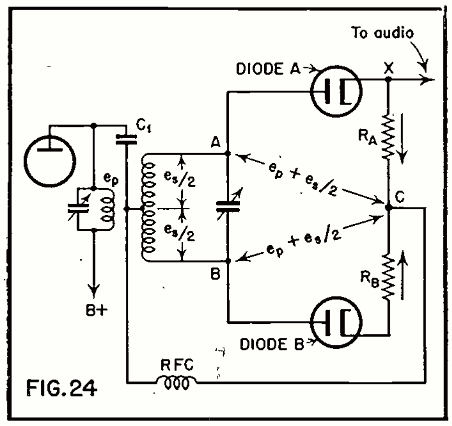


FIG. 24

We are now ready to explain the operation of discriminator circuits employed in FM and television by means of vectors. *Fig. 24* illustrates a typical discriminator circuit. Without going too deeply into the mechanics of the circuit the FM signal from the final i-f tube which is transferred into the discriminator transformer and twin-triode rectifier is changed into an AM signal. The discriminator transformer is similar in all respects to an ordinary i-f transformer, except that its secondary is center-tapped. At this point a connection is made to the primary through a small coupling capacitor. Energy from the primary is thus transferred to the secondary inductively and capacitively.

The signal applied to the plates of the two diodes is the result of the induced voltage drop, e_s, across the secondary, and the applied voltage, e_p, appearing in the primary. A diagram of the vector relationships of this circuit for resonance is given in *Fig. 25a*. The voltage applied between each diode plate and point, C, is the vector

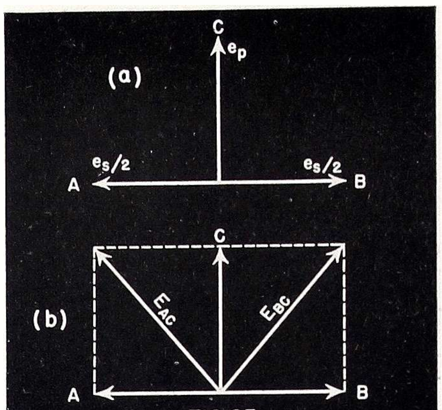


FIG. 25

sum of e_p and $e_s/2$. Notice that the primary voltage is applied to the center of the secondary. Since the ends of the secondary are 180° out of phase with each other, the center of the winding is 90° degrees out of phase with each end. This means that the primary voltage, e_p, will also be 90° out of phase with each end of the secondary.

In *Fig. 25b*, the vector sums of these voltages are shown to be E_{AC} and E_{AB}. These voltages, at resonance, are equal. Therefore, the opposing voltage drops across the diode load resistors, R_A and R_B are also equal, and the rectified signal voltage between *points* X and ground is zero.

Fig. 26 illustrates the vector diagrams corresponding to the condition where the signal frequency is lower than the resonant frequency of the secondary. In a circuit of this type X_C is greater than X_L, and the secondary voltage *lags* the current, is. The resultant voltages E_{AC} and E_{BC} are indicated in *Fig. 26b*. Notice that these voltages are no longer equal.

Since more current flows in *diode A* than in *diode B*, a net voltage will be produced between points X and ground which is proportional to the frequency deviation of the signal. In this manner frequency variations are con-

[*Continued on page 45*]

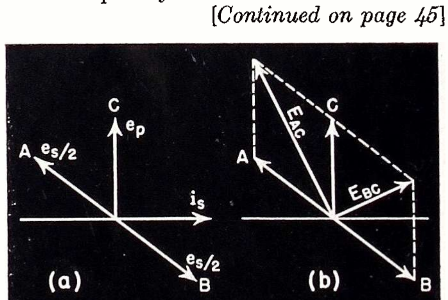


FIG. 26

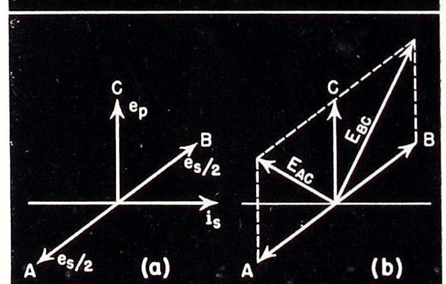
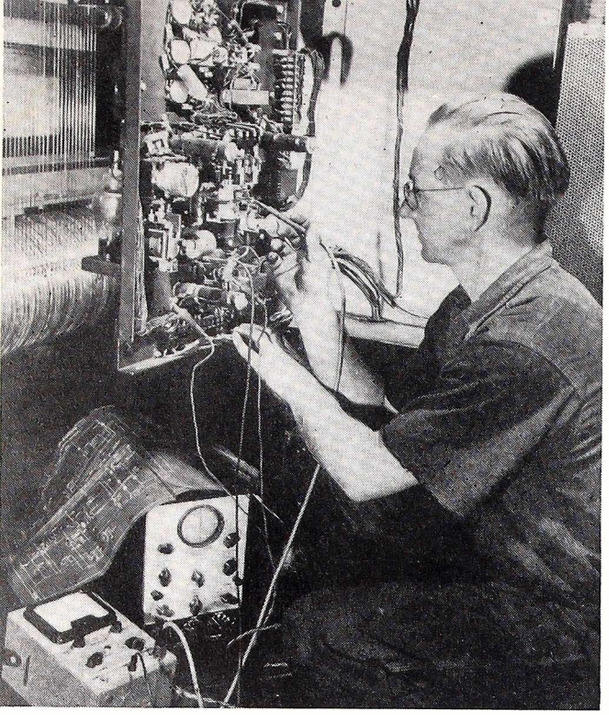


FIG. 27



Electronic

This article, presented under the title "Electronics Through The Crystal Ball" at the Philadelphia Town Meeting outlines requirements for preventive maintenance business and sales in industrial electronics.

IN ALL technical arts, the standards of practice adopted in the service and maintenance of equipment are determined by the standards of the manufacturers of the equipment. For many years the manufacturer of radio receivers has been characterized by intense price competition. As a result components employed in the garden variety of receiver are purchased on a price basis. It has had a depressing effect on the radio service field. A receiver which retails for 20 dollars or less must be repaired at a small fraction of this cost, and this leaves a small margin for the service engineer.

The advent of f-m and television receivers has done much to correct this situation and to improve the status of the service technician. The general price level of such receivers is higher, and the quality of materials is better. A considerably broader knowledge is required to service these sets, and many additional items of test equipment are needed, which must be used with a more precise technique. Thus, while the service job is somewhat more difficult to perform, the return is proportionately higher. The man who is willing and able to make the investment in additional equipment and knowledge removes himself from the over-crowded, too-competitive field of general radio servicing, and he tends to attract to himself a larger proportion of remunerative jobs.

My purpose is to urge members of the radio service profession to consider another step in the same direction, that is, to enter a less competitive field. . . . the service and maintenance of industrial electronic equipment. There is a great need for properly trained technicians in this field in every industrial community. To qualify for this work, some additional knowledge and equipment is required, but a general basic training in radio servicing, particularly if it includes television receiver servicing, constitutes all the preparation needed for 90 per cent of the jobs which offer themselves.

The primary qualification for the job is a new point of view, one which parallels the point of view of the manufacturer of industrial electronic equipment. The emphasis in this field is not on the price of the equipment, but on the savings made possible by the use of the equipment. The highest quality components, with adequate safety factors, must be used. The design aim is reliability, steady performance with adequate advance warning of impending failure of tubes or components. The initial price of the equipment is high, to cover the costs of adequate engineering, small production, and high quality components. When service of such equipment is required, be it preventive maintenance or outright repair, the return is commensurate with the initial cost, and in line with the high professional standards required of the service technician.

Few members of the radio profession understand the extent to which vacuum tubes and other electronic devices have penetrated the great industries of our country. One interesting comparison is between the broadcast stations and the high-frequency heating equipment used in the plastics, wood, tinplate, and metal working industries, in the medical profession and elsewhere. There are approximately 1800 AM and 500 FM stations now in operation or under construction in this country. And yet, in 1948, according to suppliers, there will be more high-power tubes sold to fill sockets in r-f heating equipment than there will be sold to the 2300 broadcast stations. R-f heating equipment of 200 kw capacity, or four times the size of our most powerful broadcast station, are being manufactured and sold today.

Principal Divisions of Industrial Electronics

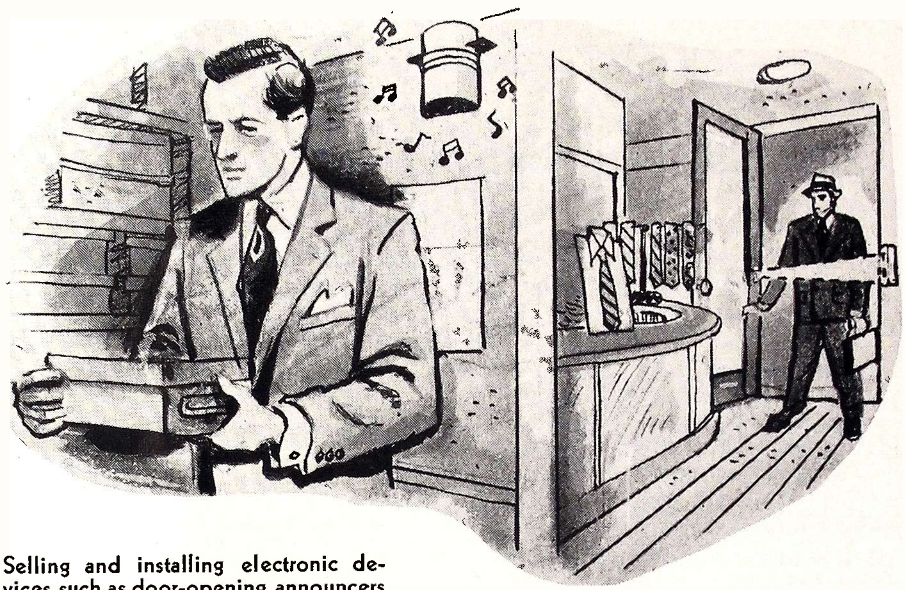
Let us review briefly the principal types of electronic equipment used in industry.

The oldest large-scale application of electronics to industry is the control of resistance welding. To secure uniform strength of spot and seam welding, performed by passing current through the pieces to be welded, the strength and duration of the current must be precisely controlled. This is done by inserting thyratron or ignitron tubes in the primary of the welding transformer and applying control voltage to the control electrode of the thyratron or ignitron. Once a few elementary facts about thyratron and ignitron tubes are mastered, there is nothing about this equipment which should give the well-trained radio service technician any trouble.

The most widely used industrial electronic device is r-f heating equipment. There are two basic types: the dielectric and the induction. Both types use transmitting-type vacuum tubes to generate radio frequency energy, in many respects similar to a radio transmitter. The energy is applied to the plates of a capacitor of the dielectric type, and the material to be heated is placed between them. In the induction type, the r-f current is passed through a coil which surrounds the material. The radio frequency generated varies from a few thousand CPS, for heating large metal pieces to several hundred megacycles, for heating high quality plastics and foodstuffs. The power level runs from a few watts, for small installations, to 200 kilowatts for large tinplate flowing heaters. Here again, nearly all the basic knowledge required for servicing is possessed by the well trained service technician, if he follows the maintenance manuals prepared by

Maintenance

by Donald G. Fink
Editor, Electronics



Selling and installing electronic devices such as door-opening announcers is logical business for Service Dealers to solicit.

the manufacturers. A healthy respect for high voltage with plenty of current behind it is required, and methods of applying test equipment to high power circuits must be understood. But any man who can locate and correct trouble in the local oscillator of an FM or TV receiver can, with a moderate amount of extra training, qualify himself to locate and correct faults of r-f heating equipment.

A third group of electronic devices of very wide application are the supervisory and protection controls which make use of phototubes. In these devices, a beam of light (or invisible infrared radiation) shines into a phototube sensitive to the light. Any interruption of the beam causes the phototube current to drop and, through an amplifier, to actuate a relay which sounds an alarm or cuts off the power to a piece of machinery. Protection of property against burglars and other intruders is one large scale application. Another is the protection of the operators of punch presses and other large, dangerous machines. Knowledge of phototubes and associated amplifier-relay circuits suffices to qualify the technician for the maintenance of this class of equipment.

The foregoing brief outline of industrial electronic applications is a bare outline of a large and diverse field. Its purpose is to suggest ways in which basic radio service knowledge and test equipment may be applied, where the professional requirements are high, but the competition is low and the rewards generous. If I have succeeded in interesting any of you in investigating the possibilities, you will no doubt want to know how to get started. The following suggestions may help:

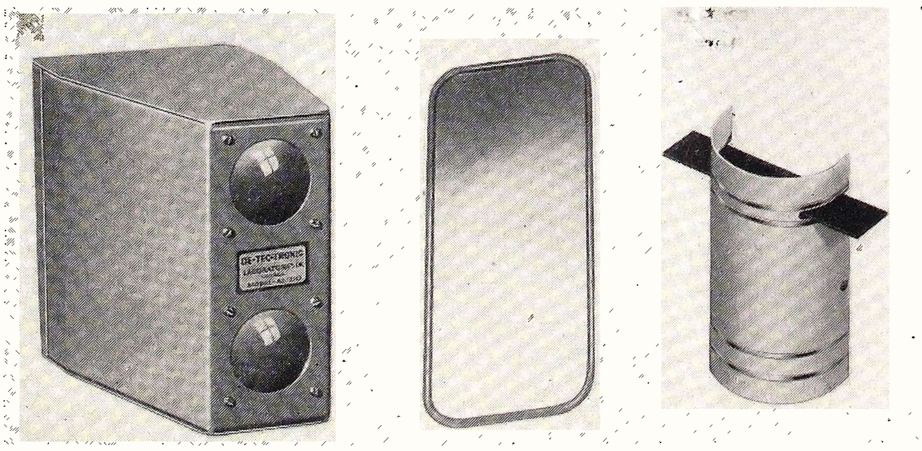
First, prepare for the job by study. There are half a dozen excellent textbooks on industrial electronics. Get one or more. If the local trade schools or University extension programs offer courses in non-radio electronics (and many do), take the course at night. Pay particular attention to the tubes and components used in industry but not used in radio, FM or TV receivers, thyratrons, ignitrons, phototubes, photocells, high power triode and tetrode tubes. Study electro-mechanical devices, such as relays, contact switches, motors, and devices which link the electronic circuit with the industrial equipment to be controlled.

Second, cultivate a new point of view on components and costs. The electrolytic capacitor has no place in industrial equipment merely on the basis of cost. Oil-filled paper or plastic capacitors are to be preferred. In all cases of replacement the component must have quality and ratings at least equal to the original part. Put in the best and charge the standard mark-up.

Third, when you feel you are properly prepared, canvas plants in your vicinity, ask for the plant superintendent or chief electrical or mechanical engineer, if the plant has electronic equipment in key points. Sell the virtues of *preventive maintenance.* Get permission to test the emission of tubes and check the voltages applied to them during shut-down hours. If the plant manager reports trouble in an electronic equipment, get the facts, study the circuit and mechanical layout, then test tubes and circuit values and voltages. If there is no maintenance information available at the plant, contact the manufacturer of the electronic equipment and ask for the information.

A final word about the serviceman-manufacturer relationship in this field. Some manufacturers are skeptical that they can trust the maintenance of their

[*Continued on page 44*]



A commercial "electronic eye" unit that rings a chime when light circuit is broken. Shown are the master unit, mirror and chime.

TECHNICAL QUIZ NO. 6

Subject: Frequency Modulation

BEFORE ANSWERING THE QUESTIONS—READ THESE RULES:

There are 20 questions. After each question, preceded by a letter *a*, *b* or *c* are optional answers. In each case one answer is basically correct. You are only allowed 20 minutes time in which to mark the letter *a*, *b* or *c* which you believe represents the correct answer.

For each correct answer to a question you are credited with 5 percentage points. Thus 19 correct answers would give you 95% or 17 correct answers would rate you 85% on the examination. Answers to the questions are given on Page 37.

RATINGS FOLLOW: *100% = Perfect, 90% = Excellent, 80% = Good, 70% = Fair, 60% = Passing Any score below 55% is failure. Tests must be completed within 20 minutes.*

How much do you know about FM? Listed below are a number of questions, each of which has but one correct answer. The accuracy of your answers, and the relative speed with which you can complete this quiz is a measure of your theoretical knowledge and practical experience.

QUESTIONS 1 to 6

1. Pre-emphasis is:
   A. *The process of attenuating the high audio frequencies at the transmitter in order to obtain a high signal-to-noise ratio.*
   B. *The process of increasing the relative strength of the high audio frequencies at the transmitter in order to obtain a high signal-to-noise ratio.*
   C. *The process of increasing the relative strength of the middle audio frequencies at the transmitter in order to obtain a high signal-to-noise ratio.*
2. De-emphasis is:
   A. *The process of reducing the relative strength of the high audio frequencies at the transmitter in order to obtain a high signal-to-noise ratio.*
   B. *The process of reducing the relative strength of the high audio frequencies at the receiver in order to compensate for the transmitter characteristic.*
   C. *The process of reducing the relative strength of the low audio frequencies in order to compensate for the transmitter characteristic.*
3. The Standard value of time constant for a de-emphasis network is:
   A. *75 usecs.* B. *100 usecs.* C. *150 usecs.*
4. The standard value for a pre-emphasis network is:
   A. *75 usecs.* B. *100 usecs.* C. *150 usecs.*
5. In FM the deviation from the center carrier frequency depends primarily upon:
   A. *The frequency of the modulation component.*
   B. *The amplitude of the modulation component.*
   C. *The equal influences of both the frequency and the amplitude of the modulation component.*

QUESTIONS 6 to 11

6. The standard value of frequency deviation from the center frequency of the carrier for 100% modulation is:
   A. *75 kc.* B. *100 kc.* C. *150 kc.*
7. The "guard band" frequency on either side of the maximum deviation frequency, as established by the FCC is:
   A. *25 kc.* B. *50 kc.* C. *75 kc.*
8. The bandwidth, or separation between stations in FM is:
   A. *150 kc.* B. *200 kc.* C. *250 kc.*
9. It has been proven that, in general, where two FM stations of the same frequency but differing carrier levels are being received, no interference will take place from the weaker station if the relative strength of the stronger one over the weaker one is greater than:
   A. *1.25/1* B. *1.5/1* C. *2/1*
10. The mean frequency to which a broad band FM antenna should be designed in order to cover the complete FM band is:
    A. *97.5 mc.* B. *88 mc.* C. *108 mc.*

QUESTIONS 11 to 16

11. The correct length of a dipole designed to the mean frequency of the FM band is:
    A. *3 ft.* B. *3.8 ft.* C. *4.8 ft.*
12. The most popular i-f frequency employed in modern FM receivers is:
    A. *4.3 mc.* B. *8.3 mc.* C. *10.7 mc.*
13. Stagger-tuned i-f transformers as employed in FM receivers are aligned so that:
    A. *The transformers are single-peaked to the same i-f frequency, however; different values of damping resistors being employed in order to provide the required bandwidth.*
    B. *The transformers are double-peaked in some stages and single-peaked in others in order to obtain the required bandwidth.*
    C. *The transformers are single-peaked at different resonant frequencies in order to obtain the required bandwidth.*
14. The purpose of the limiter stage in an FM receiver is to:
    A. *Limit the amplitude of the incoming signal to a certain value so that the signal applied to the following detector does not overload it.*
    B. *Limit the amplitude of the incoming signal so that the proper bandwidth frequency is obtained.*
    C. *Clip off the amplitude variations of the incoming signal so that the output amplitude is maintained constant, in this manner reducing noise effects which are primarily amplitude pulses.*
15. The most popular type of discrim-

[*Continued on page 45*]

What Do You Know About Power Factor and Q?

by Rufus P. Turner

A down-to-earth explanation of two important quality factors not too well understood by many Service Dealers.

THERE appears to be widespread misunderstanding among radio servicemen as to the real significance of the terms *power factor* and *Q* used in rating coils and capacitors. We talk freely about the advantage of low power factor in capacitors and of high Q in coils. Radio Service Dealers measure capacitor power factor with their bridges without knowing too much about this quantity that they measure. And while only a few technicians outside of a laboratory actually measure Q values, we do know, from previous training, that the best coil for conventional circuits is a high-Q coil. This is an opportune time to explain the meaning of power factor and Q.

The Ever-Present Bugbear of Resistance

We would have no need for power factor and Q ratings if a capacitor had capacitance only if a coil had inductance only. But unwanted *resistance* is ever-present. By that, we mean that a capacitor has a certain amount of resistance as well as capacitance, and a coil has a certain amount of resistance as well as inductance. Coils also have *inductive reactance*, which we want; and capacitors have *capacitive reactance*, which we want also. (Of course, coils have a certain amount of unwanted capacitance, and capacitors have a certain amount of unwanted inductance. But we are not concerned with these items in this discussion). We can't squeeze all of the unwanted resistance out of a coil or capacitor in our design and manufacturing, but we can keep this resistance fairly low. Nevertheless, even a small amount of this resistance is worthless to us, and troublesome. Consequently, the more resistance we have, the poorer our coil or capacitor. It is easy to see, then, that a good way to measure coil or capacitor quality is to compare the resistance (which we don't want) with the reactance (which we do want).

The particular kind of resistance we are talking about is a tricky thing which cannot be measured with an ordinary ohmmeter. This is because such resistance is an a-c effect (entirely apart from reactance and impedance) which may be many times higher than the value shown by an ohmmeter. This peculiar resistance is due to a combination of many factors such as ordinary ohmic resistance; skin effect; the presence of shields or metallic containers; effect of insulating materials such as coil forms, capacitor dielectric films, capacitor impregnating compounds, wire covering, and coil adhesives; conductivity of metallic parts; and to some extent upon the size and shape of metallic parts. The higher the operating frequency, the higher this resistance will be.

[*Continued on page 44*]

CIRCUIT COURT

Philco 47-1227

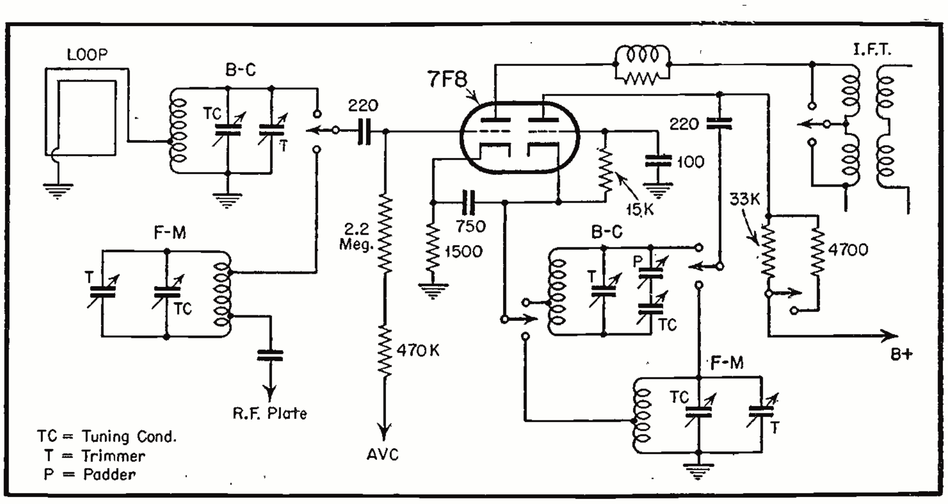
The use of triode oscillator circuits is generally desirable in superheterodyne receivers but triode mixer circuits are not so common in home receivers. The advantage to be gained is in a better ratio of signal to noise. This is particularly true at high frequencies such as the new FM band.

A simplified version of a combination of triodes as oscillator and mixer is found in the Philco 47-1227. In this case a dual triode tube, type 7F8, serves both purposes. A schematic of the circuits under discussion is shown. It should be noted that on the AM band the antenna is coupled to the grid of the mixer section, but on FM there is a 6AG5 r-f stage ahead of the mixer. The r-f circuit is conventional and is not shown.

A section of the range switch serves to select the tuned circuit which feeds signal to the mixer grid for either range. AVC is applied to the mixer grid on both bands. Bias is also developed across the 1500-ohm resistor in the cathode circuit.

A Hartley oscillator circuit is used and two switch sections choose the appropriate coil and connect the cathode tap to the active inductance. Separate tuning condensers are used for all coils. Plate voltage is applied to the oscillator via a resistor chosen to develop the desired voltage on the mixer cathode. A 750 $\mu\mu f$ capacitor transfers the oscillator voltage to the mixer. It connects between the two cathodes.

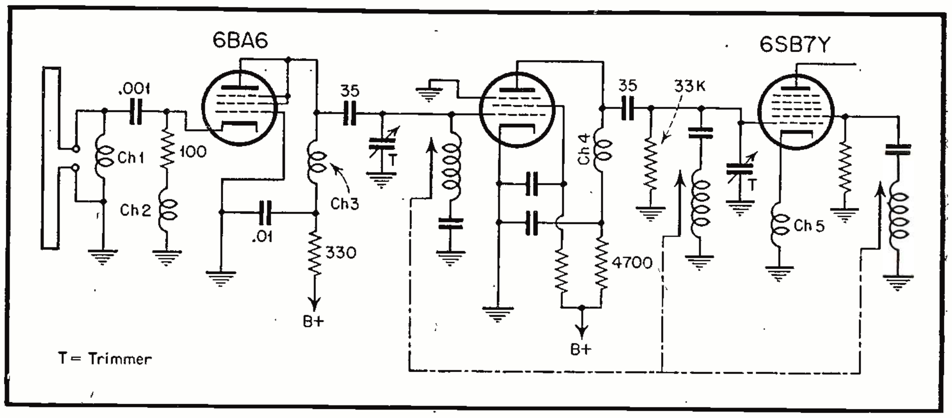
In the schematic illustration the AM position is with the switches on the upper contacts. The loop used for AM reception is of the low impedance type and is coupled to the mixer grid by being tapped up from ground to the proper impedance on a tuned coil. Note that 150 volts is applied to the mixer plate (via the primaries of the two i-f transformers) and 75 volts serves to actuate the oscillator section.



Philco model 47-1227, partial schematic.

Admiral 7C73

An unusual r-f stage is found in the Admiral 7C73 when the set is switched to the FM position. A partial schematic is shown and indicates the path of the signals from the antenna to the convertor.



R-F stage of Admiral model 7C73.

A built-in folded dipole is connected to the antenna terminals and feeds its voltage across *Ch1*. An isolating capacitor serves to transfer the signal to the cathode of a 6BA6 tube. Bias is developed across a 100-ohm cathode resistor, and *Ch2* prevents loss of signal voltage in the resistor.

The control grid of the 6BA6 is grounded and serves to shield the input (cathode) circuit from the output circuit. The plate is tied to the screen and suppressor to make a triode out of what would normally be a pentode tube. This grounded-grid tube circuit was widely used during the late war and has several advantages.

At high frequencies where stability is often difficult to achieve this circuit can easily utilize degeneration and operate with freedom from feedback. It also serves to match a low impedance input, such as the folded dipole, to the next stage with a good efficiency. The ratio of signal to noise is generally at a better level than in a pentode stage. The gain of the stage suffers by comparison, but the several advantages make its use worthwhile.

In this particular set, the grounded grid stage is followed by a pentode-connected 6BA6 tube with variable inductance-tuned input and output circuits. A 6SB7Y pentagrid convertor completes the high frequency layout. The oscillator section is also tuned by a variable inductance. The three inductances are tuned by slugs which are ganged to slide in and out of the coil forms as the dial is turned.

Airline 74BR-2707B

One of the troubles frequently encountered in FM receivers on the new high frequency band is interference from stations operating on or near the i-f channel. Most of the current receivers use an i.f. of 10.7 mc and any listener on the usual short-wave bands is well acquainted with the fact that many stations, and many types of emissions, can be heard around that frequency. The broad band of frequencies over which the FM receiver i-f stages must provide gain makes them susceptible to pick-up of a great variety of interfering stations. This is particularly true where no pre-selection exists between the antenna and the grid of the mixer tube. So great is the problem that in New England it is possible to hear broadcast (BBC), code and scrambled telephone interference all at once, and loud enough to make FM reception useless, when propagation is good.

In the Airline model 74BR sets use is made of a trap circuit, tuned to the i-f frequency, coupled to the antenna

[*Continued on page 42*]

SHOP NOTES

Write up any "tricks-of-the-trade" in radio servicing that you have discovered. We pay from $1 to $5 for such previously unpublished "SHOP NOTES" found acceptable. Send your data to "Shop Notes Editor".

General Electric Magnetic Reproducer, High Frequency Response

From G.E. comes the following service note pertaining to their Models 12, 303, 417, Musaphonic. The phonograph high frequency response may be lowered or raised by changing the value of the resistor which connects directly across the reproducer unit. This resistor is usually contained in the preamplifier unit at the input jack. Making this resistor a larger value or removing it will raise the highs. A good compromise value may be 10,000 ohms.

Negative Temperature Coefficient Resistor Application

An interesting application of the new negative temperature coefficient resistors is offered by Federal, in conjunction with their miniature selenium rectifier, in eliminating certain disadvantages associated with the use of the 35Z5. By this method, high initial currents, pilot light burnouts, and tube burnouts are minimized. These resistors have a resistance of 1400 ohms when cold and 200 ohms when hot.

It is well known to all servicemen that the major cause of tube and pilot light burnouts is the large initial current flowing through the filament string when the set is turned on. This

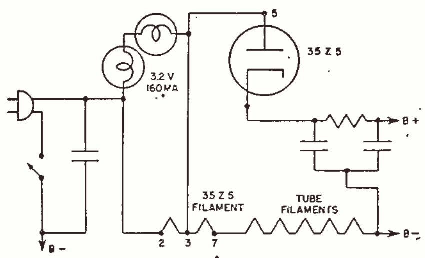


Figure 1

initial current is high because the filaments, when cold, have a very low resistance. However, with this negative coefficient resistance in the circuit, the resistance of the entire string is virtually independent of temperature. High initial currents are prevented, with a resulting increase in tube and pilot light life.

Negative temperature coefficient resistors can be obtained from the Keystone Carbon Co., St. Marys, Pa. (Type 791), and the Carborundum Corp., Niagara Falls, N. Y. (Type F). In either case the cost of the resistor is not much more than that of any standard type 200 ohm resistor.

The following six steps are required

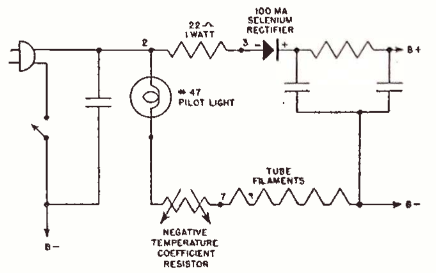


Figure 2

to install the Federal Miniature selenium rectifier and the Negative temperature coefficient resistor in a typical 35Z5 power supply (see *Figs. 1 and 2*).

Step 1—Add extension leads to the selenium rectifier. It is recommended that the positive lead be a red wire and the negative lead a yellow or black wire.

Step 2—Solder red lead to pin 8; yellow lead to pin 5.

Step 3—Solder one end of negative coefficient resistor to a No. 47 pilot light. If desired, two 3.2 volt, 160 ma pilot lights in series can be used instead of the No. 47 pilot light.

Step 4—Solder open end of pilot light to pin 2.

Step 5—Solder open end of negative coefficient resistor to pin 7.

Step 6—Solder a 22 ohm, 1 watt resistor across pins 2 and 3.

Admiral Chassis 7C1, Model 7C63 Replacing Tuning Slug

Admiral gives the following information on the correct procedure for replacing the tuning slug in the above receiver. Set the gang to its wide open position, unsolder and remove the old slug. Set the slug adjusting screw about half way open. Place the new slug in such a position that 1 3/8 inches of its length is above the coil form. Solder it in this position making sure that it does not slip during the operation and that the slug wire is straight. Realign receiver.

General Electric RPX-010

A loose pyralin damping block may be re-cemented into place by application of nail polish remover to the cemented surfaces of the block.

General Electric Model 250—Battery Doesn't Charge—Battery Support

If the fuse checks o.k. and the rectifier discs are not defective, check continuity of the power cord. A few isolated cases have been found where the power cord has opened up where the cord fastens to the prong in the molded plug.

On particular rough handling, the battery may be cracked while in place in the battery compartment. To forestall this failure, an additional strip of sponge rubber may be installed at the bottom of the battery cover to give added padding.

Crosley Models 56PA, 56PB—Prevention of 3S4 tube Burnouts

Crosley recommends the following operations for prevention of 3S4 tube burnouts in the above receivers. Referring to *Fig. 3*, remove the wire that con-

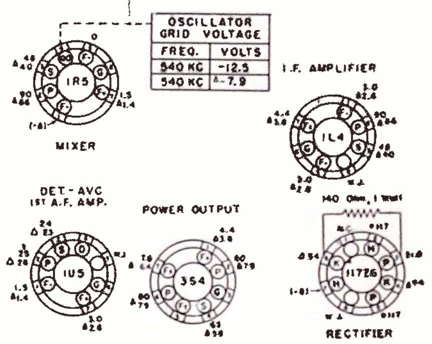


Figure 3

nects the plate lug, 3, to the cathode lug, 8, of the 117Z6 tube socket. In its place solder one end of a 47-ohm, 1 watt resistor to the plate lug. The other end of the resistor should be soldered to the cathode lug.

The socket voltages to be used with the receivers incorporating these alterations are indicated in *Fig. 3*.

Zenith 7S260—Loses Sensitivity

When this model loses sensitivity on the high end of the broadcast band look for an untwisted inductive loop around the 6A8 grid lead. Wrap several turns and fasten by means of a tiny drop of cement.

Submitted by John Lubinsky, Cleveland, Ohio.

Delco Auto Radios

Some of these receivers use glass OZ4s and contain sockets that are drilled for prongs 1, 3, 5, 7, and 8. When replacing with metal OZ4, it is necessary to cut off pins 2, 4, 6. This does not hurt the tube in any way *Contributed by Ed. Christner, Middletown, Ohio.*

Auto Radio Receivers

Many whip antennas come equipped

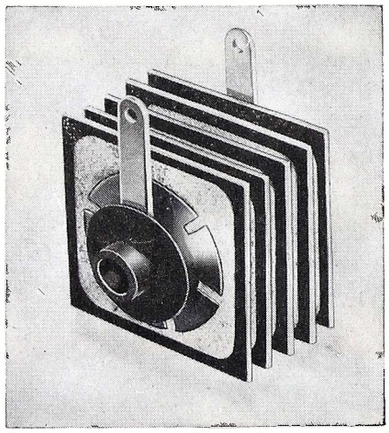
[*Continued on page 42*]

NEW PRODUCTS

G-E Adds Selenium Rectifiers

Two models of selenium rectifiers, for radio receivers and other electronic applications, have been made available to distributors by the Tube Division of General Electric Company's Electronics Department at Schenectady, N. Y.

Both models, 6RS5GH1 and 6RS5-GH2, are one-inch square and have a high inverse peak voltage rating with a low inverse current, even with peak voltages up to 350 volts. The latter type, four-sixteenths of an inch shorter than the former, is recommended for limited-space applications.



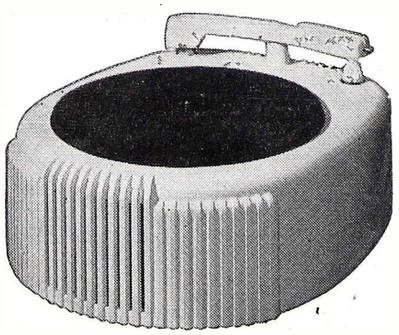
Each rectifier will withstand safely the inverse peak voltages obtained when rectifying (half-wave) 110-125 volts, rms, and feeding a capacitor as required in various radio circuits. The values of rms current and peak current are consistent with the d-c current ratings in all cases.

The forward voltage drop through the rectifier is approximately 5 volts at rated current output.

Further information and a specifications sheet on the new selenium rectifiers are available on request to the G. E. Electronics Department, Tube Division, Schenectady 5, N. Y.

New Audar Phonograph

An all-plastic amplified phonograph, has been added to the Telvar line of radios and record players manufactured by Audar, Inc., of Argos, Indiana.



This new unit will be known as the Model P-10 Telvar Amplified Phonograph. It has an electronic amplifier, and the arm is equipped with a crystal pickup. Either ten- or twelve-inch records may be played.

Housed in an attractive walnut or ivory plastic cabinet, the new unit lists for $19.95.

Portable Wire Recorder-Phono-Combination

The Air King Portable Wire Recorder and Phono-Combination model A-750 is now ready for delivery. It is a 5-tube (including rectifier) amplifier with radio attachment cord, plays either 10 or 12 inch records and comes equipped with permanent needle. Recordings from the phonograph or radio can be made directly through the amplifier without using the microphone. Voice can also be dubbed through the mike while recording from radio.

Built in a sturdy luggage-type carrying case, the unit has a automatic shut off whereby the motor turns off, after the wire rewinds. A safety lock prevents accidental erasures. The visual tone indicator controls proper level when recording.

Walsco Offers "No-Ox"

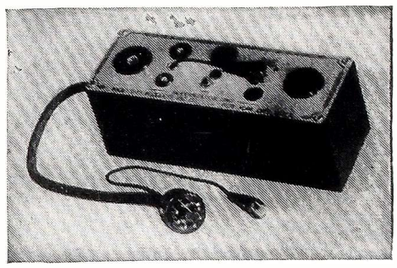
No-Ox Contact Cleaner, a chemical cleaner and lubricant will now be manufactured and distributed nationally by the Walter L. Schott Co. of Beverly Hills, Cal.

"No-Ox" contains no carbon tetrachloride, dissolves corrosion, will not gum and performs as a lubricant for delicate bearings and shafts. Its main uses are for noisy volume and tone controls, band switches and push button tuners, etc. in radio sets, on wipers of tuning condensers, in broadcast, sound and motion picture equipment and on electrical relays, cable connectors, sockets, etc.

The product will be distributed through all parts jobbers handling the nationally known "WALSCO" line. Dealers, technicians, etc. may secure further information by writing the manufacturer.

Tube Tester Modernizer

Radio City Products Company, Inc., announces the Model 120 modernization unit that has been designed to bring up-to-date many tube testers —those made by other manufacturers as well as by RCP. So many tubes have appeared on the market in the last year that a large percentage of testers made and shipped up to about April, 1947, are now obsolete to some degree. Alert to this situation, RCP has two models in its new modernization unit—Model 120 and 125—that will meet 90 per cent of the trade's obsolescence problems. Model 120 is in a steel case 3 x 8 x 2¾ inches.



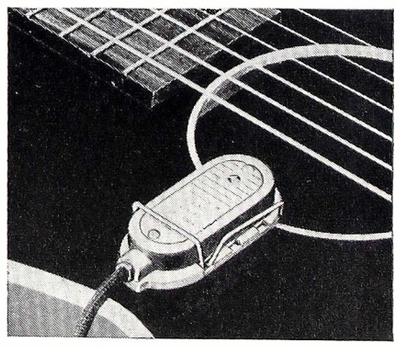
Each model has a flexible cable with a plug that is inserted into the loctal socket of the old tube tester. After this, the new tubes are then tested in the sockets provided in the units. With an eye to the future, RCP has in addition, provided extra blanket sockets and spaces for additional new sockets, should new types of tube bases be brought out in the future. Tube testing charts and data are supplied with the unit.

New miniature and sub-miniature sockets are provided.

Complete description of this tube tester modernization service may be obtained without cost by writing to Radio City Products Company, Inc., 152 West 25th Street, New York 1, N. Y.

New Contact Pick-up

A new contact crystal pick-up microphone, E-V Model 805, is announced by Electro-Voiec, Inc., Buchanan, Michigan.



Frequency response 40 to 8000 c.p.s. Can be used with any amplifier having a high impedance input. Snap-on clip attaches or detaches to instrument in a few seconds . . . holds unit securely in place. No tools necessary. Pickup weighs 2 ounces and measures 2 1/4" x 1" x 7/16". Finished in bright chrome.

New Battery Eliminator Switch

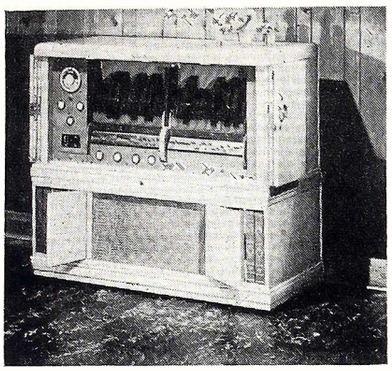
Electro Products Laboratories has designed an "on and off" switch for their line of Battery Eliminators that mounts on the panel of the radio. Heretofore, such switches have been placed in the cord in a position that usually forced the user to grope behind the radio near the floor to reach the button.

Another change in this line is the use of the Selenium Rectifier in the new Model "S," which operates 4, 5

and 6 tube radios from 115 volt, 60 cycle sources. For more details, write the manufacturer at 549 W. Randolph St., Chicago 6, Illinois.

14 Hour Record-Player

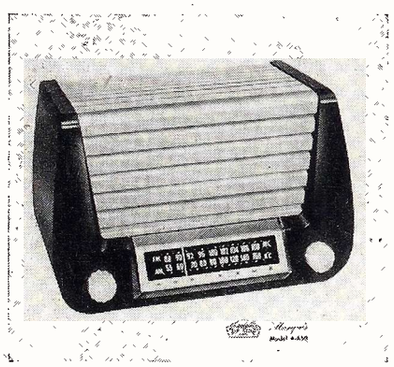
The new Seeburg Select-O-Matic "200" Library solves the problem of record storage. Designed so that selection of one or more of any number of records can be made by merely flicking a switch. The model shown



is complete. Seeburg is also producing other models for use with existing amplification and speaker systems or for use with regular radio receiving sets. The machine plays both 10-inch and 12-inch records in any order without adjustment. It will play more than fourteen hours of continuous music without repeating a selection. J. P. Seeburg Corporation, 1500 N. Dayton St., Chicago 22, Ill.

FM-AM Air King

Available in a choice of 3 striking color combinations the Air King "Marquis," Model A-650, is a new FM-



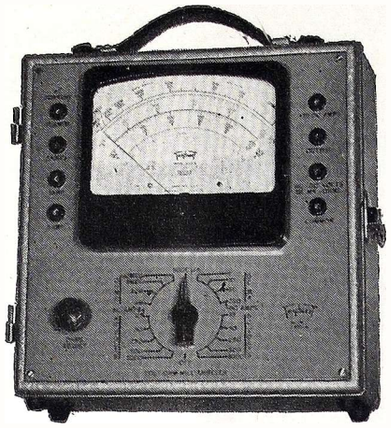
AM table model, having 6 tubes including rectifier, Alnico V speaker, provision for an outside antenna for both FM and AM plus a self-contained AM loop antenna.

The tuning range: AM 550-1700 kc; FM 88-108 mc. Tube complement includes: 14F8, 12SK7, 12SA7, 12SQ7, 35L6, 35W4.

New Triplett Volt-Ohm-Mil-Ammeter

A perfect combination—ultra-sensitive—20,000 ohms per Volt D.C., multi-range, extra large 6" meter with long, easy reading scale.

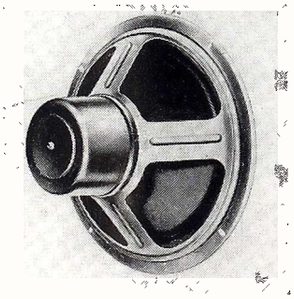
Thirty-five Ranges include voltages to 1000-D.C. at 20,000 Ohms/Volt and A.C. at 1000 Ohms/Volt; D.C. Current ranges from 0-50 Microamperes to 10 Amps.; A.C. Amps. to 10; Decibels −10 to +55. Output and condenser tests.



Plug-in, pre-calibrated rectifier simplifies replacement. Ruggedly constructed selector switch. "OHMS ADJUST" provides adjustment for all resistance ranges with maximum accuracy. Low contact resistance jacks. "Square-Line" metal case, with detachable, hinged cover for portable or counter use. For further details write Triplett Elec. Instru. Co., Bluffton, Ohio.

New Hi-Fidelity Speakers

Hi-fidelity De Luxe speakers designed especially for extended range use in installation requiring improved, more accurate and more efficient sound reproduction, have been introduced by Permoflux Corporation, 4900 West Grand Avenue, Chicago and 236 South Verdugo Road, Glendale, Cal.

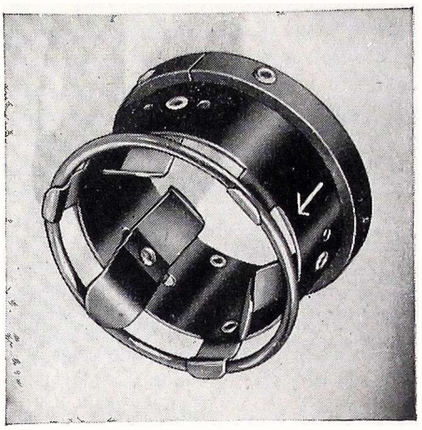


Ranging in size from 10" to 15", these Hi-fidelity De Luxe speakers come in both Permanent Magnet and Electro Magnet types, with power handling capacity up to 25 watts. The P.M. type features a heavy ring magnet and oversize voice coils. With suitable baffling the audio range of these units is approximately 30 c.p.s. to 12,000 c.p.s.

TV Tube "Beam-Bender

The Clarostat Beam-Bender is used with television cathode-ray tubes requiring some external means of controlling loose ions. This permanent-magnet type unit is entirely self-contained and can be applied without tools.

Manufactured by Clarostat Mfg. Co., Inc., 130 Clinton St., Brooklyn, N. Y., the Beam-Bender consists of two ring magnets held in a non-magnetic mounting collar. Three spring fingers provide a frictional yet adjustable fit on the neck of the usual 7" or 10" tube. The Beam-Bender is simply slipped over the base of the tube and on to the right position on the neck. The permanent ring magnets provide magnetic flux proportional to the required beam-bending function in the tube. The forward magnet, indicated by the arrow stamped on the



mounting collar, is adjustable. The Beam-Bender can be readily installed out in the field. It comes individually packaged.

"3-in-1" Bulb Merchandiser

Sylvania Electric Products, Inc. have introduced a "3-in-1" carton merchandiser containing an assortment of 120 of the most popular size bulbs packaged in the company's

Handy-5-Packs. Each carton, when set up by the dealer according to simple directions, is a complete display and sales unit and encourages the sale of five bulbs at a time instead of the one or two bulbs usually purchased.

"Pockette" Portable

Ready for immediate delivery is this Air-King "Pockette" portable, tiny enough to fit in the palm of the hand. The new 4-tube radio measures 3" x 5-¾" x 3-⅝" and weighs 1 lb., 11 oz. net, available in 3 color combinations: Ebony with nickle trim, maroon with gold trim and ivory with gold trim.

When the lid opens the set is "on," when closed the "Pockette" automatically shuts off. It uses two standard batteries, one ordinary flashlight battery and a standard 45 volt "B" battery. Built in is a loop antenna. The case is polystyrene with a vinylite carrying strap. The shiny metal grill is especially treated to withstand all outdoor elements.

TRADE FLASHES

[*from page 12*]

table models. The total output represented a rise of 101.6 percent over the monthly average for 1947.

A little less than half or 65,166 of the FM-AM receivers reported for January were table models or converters.

Air King Promotes Kay

Leopold M. Kay has been promoted to Vice-President in Charge of Engineering by Air King Prods. Co., Inc.

The 1948 Air King line will include FM receivers, phonograph combinations, popular priced television sets in addition to wire recorders.

New Karet Rep. Setup

Bob Karet announces the formation of R. M. Karet Associates, Inc., a firm of manufacturers representatives with offices at 510 N. Dearborn, Chicago 10, Illinois.

Bob was formerly sales manager of the Thordarson-Meissner-Radiart Divisions of Maguire Industries and, prior to that, was for many years sales manager of the jobber division of the Utah Radio Products Company.

John S. Margolin, formerly with Stromberg-Carlson, is vice-president of the company.

In addition to the main office at Chicago, resident sales offices have been established in St. Louis and Minneapolis.

Stewart-Warner Adv. Plans

Advertising expenditures of the Radio Division of Stewart-Warner Corporation, based on present production schedules, will be slightly in excess of $1,000,000 in 1948, including cooperative expenditures of distributors and dealers, Fred Cross, Stewart-Warner advertising director, has announced.

A total of 28 four-color insertions in the combined schedules appearing in Colliers', Time, Saturday Evening Post, Better Homes and Gardens and Country Gentleman comprise the national magazine advertising, Cross said.

In addition, six dealer trade publications and three export publications will be used.

Direct newspaper advertising will be placed by Stewart-Warner in major markets during the year, and the factory is participating in local cooperative newspaper, billboard, radio and other promotional work with the trade.

Hotel Offers TV Rental Service

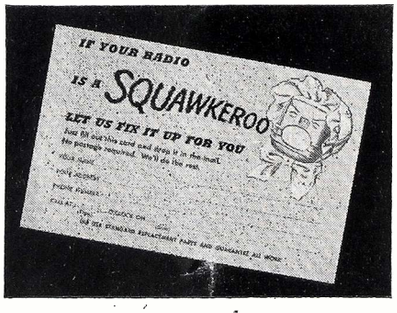
The average traveler will soon be able to rent up-to-the-minute television equipment in his hotel room at $1.00 per day it was made known in an announcement by Alfred Lewis, manager of New York City's 2,000 room Hotel Taft. The rental of portable television receiving units by the hotel guests will be $1 per day.

When a guest orders the unit an attendant will deliver it to his room, plug it into a wall outlet and immediately television service will be available. The unit itself will have fool-proof and tamper-proof controls which the guest can operate and which will permit him the choice of programs on a variety of television stations. A single dial will also make it possible for him to regulate the brightness of the image on the screen to his particular taste.

The installation calls for the erection of a comprehensive master control panel in the radio room of the hotel. Here, a television engineer will exercise complete control of the reception and monitor it for the channeled outlets throughout the building.

Business Booster for Servicemen

"If Your Radio Is A Squawkeroo— Let Us Fix It Up For You"— is the selling message on a new business boosting post card available to all servicemen through IRC distributors. To help servicemen stimulate business in their own communities, IRC de-



signed this card for use as an envelope enclosure or for door-to-door distribution. The serviceman pays postage only on those mailed back to him.

The cards, attractively printed in blue and yellow, are imprinted with the serviceman's name and address. There is no IRC advertising on the card. They may be ordered in any quantity through IRC distributors at a slight charge to cover the cost of individual imprinting.

G. E. Ups TV Set Production

General Electric will produce more radios in 1948 than during any year in its history, I. J. Kaar, manager of the Receiver Division, has announced. "At the present time we are setting new production records each week and we have not yet reached our peak," he said. "We have seven lines in operation in the receiver building at Electronics Park. By early 1948 this productivity will be doubled."

FM Traveling Workshop Meetings

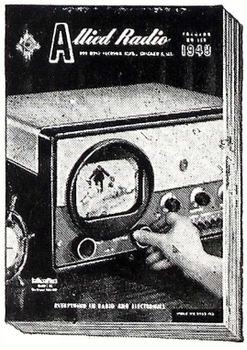
A total attendance of 10,607 for the General Electric traveling FM radio workshop at 30 meetings in 24 states and the District of Columbia was reported at Electronic Park, Syracuse, N. Y., by R. D. Payne, who was in charge of the tour.

High attendance marks for the over-10,000-mile tour, which concluded this week after almost three months, were made at Minneapolis, 830; New York City, 725; Cleveland, 690; San Francisco, 600; Boston, 570.

A feature of the tour, Payne said, was the interest shown by the radio servicemen in visual alignment of receivers. "The trip proved that visual alignment is the fastest and most reliable means of servicing FM and television sets, and that method soon to be widely accepted," he stated.

Allied Releases 1948 Catalog

Allied Radio Corp. Chicago, announces the release of its new 1948 catalog, a 172-page buying guide to "Everthing in Radio and Electronics." The new catalog (No. 115) contains



more than 10,000 items with complete listings of radio and electronic parts. All items are arranged in clearly defined sections and are carefully indexed for speedy reference. This new 1948 radio catalog is available free on request from Allied Radio Corporation, 833 West Jackson Boulevard, Chicago 7, Ill.

S-W Ups TV Production

Stewart-Warner Corporation television production by the end of 1948 will be increased to 2500 sets a month, ten times its current 250 sets a month, it was announced by Samuel Insull,

More EFFICIENCY APPLICATIONS VALUE----?

by using these NEW RACON SPEAKERS and HORN UNITS

NEW SPECIAL PM HORN UNIT, having Alnico V magnet ring, completely watertight, housed in a heavy aluminum spinning. Provides extremely high efficiency reproduction with minimum input. Handling capacity 35 watts continuous, 60 w. peak.

NEW SMALL RE-ENTRANT HORNS, extremely efficient for factory inter-com and paging systems; for sound trucks, R.R. yards and all other industrial installations where high noise levels are prevalent. Watertight, corrosion-proof easily installed. Two new models—type RE-1½, complete with Baby Unit, handles 25 watts, covers 300-6000 cps.; type RE-12, complete with Dwarf Unit, handles 10 watts, freq. response of 400-8000 cps.

NEW RADIAL RE-ENTRANT SPEAKER, excellent for all types of industrial sound installations. Provides superlative and complete 360° speech intelligibility by efficiently over-riding factory high noise levels. Frequency response 300-6000 cps. Handling capacity 25 watts continuous 35 w. peak. Has mounting bracket. Size 12″ wide by 12⅝″ high.

Other RACON products now available:

PM Horn Driving Units, 10 types.
Reentrant Trumpets, 7 types.
Tweeter & High Freq. Speakers, 3 types.
Radial Horns and Speakers, 3 types.
Straight Trumpets, 21 types.
Re-entrant Cone Speakers, 7 types.
Flat bell straight trumpets, 2 types.
Armored Cone Projectors, 7 types.

Also—cellular and auditorium horns, inter-com, paging, monitor, and dwarf speakers, cone speaker housings, etc., besides all basic accessories such as swivel brackets, mounting units, cone housings, multiple horn throat combinations, etc.

To the more than 60 different type and size speakers and horn units that already comprise the RACON line — these new models have been added. There is a RACON speaker and horn unit ideal for every conceivable sound system application.

RACON has not only the most complete line, but also the most preferred line. For over 20 years leading Soundmen have recognized and specified them because of dependability, efficiency and low-cost, and because the reproducers are trouble proof.

ASK YOUR JOBBER, OR—*Write today for full details*

RACON ELEC. CO., INC., 52 E. 19th ST., N. Y. 3, N. Y.

RACON

Jr., Stewart-Warner vice-president for radio. A new line of television sets with "unique features and innovations" not currently available probably will be ready for trade showings by mid-summer, he said.

Kits Aid TV Students

The Espey Television Training Kit has been adopted as the basic training tool in the television courses given at the DeForest Resident Training School of Chicago, it was announced by Walter W. Jablon, vice-president of the Espey Co.

Intended principally for servicemen and trainees, the kit is so designed as to give the student a practical outlook on commercial television assembly line practices and basic TV circuits. The student practically starts from scratch, just receiving a punched chassis with only the transformer mounted. In completing the television course at the DeForest Resident School, the student will thus be able to check in the laboratory all of the television theory learned in the classroom, and receive better understanding of modern production methods.

RCP Offers Bulletin

Radio City Products Company, Inc., now has available Bulletin No. 132, which is expected to prove especially valuable to service men and dealers because of its complete information on four new RCP units. These new items are: Model 720 FM Signal Generator, Servishop Model 8073, the new Servicette—Models 4410, 4420, and 4712, and the Modernization Unit for tube testers, Models 120 and 125.

In each case, full information is not only given as to specifications of the unit, but pictures and tables give all details of construction and design. The accompanying test explains fully the service performed by the new units, as well as the more familiar ones which have been brought up to date for 1048 and future needs. Bulletins may be had by writing to: Radio City Products Company, Inc., 152 West 25th Street, New York 1, New York.

The decals given to members of the New York City's new Radio Servicemen's Association induce customer confidence.

Hytron "Idea Contest"

Radio service dealers and technicians are invited to participate in a novel "idea" contest that starts in May and runs for six consecutive months. Sponsored by Hytron Radio & Electronics Corp., Salem, Mass., manufacturers of radio tubes, the contest has simple rules.

Starting in May, each month is in effect a contest by itself. The entrants simply describe on an official entry blank (available at all Hytron jobbers without cost), their idea as to what is a worth-having tool for radio shop use. Along with the suggested idea should be a rough sketch or photograph of a finished model, if one was made, and the idea should be for a practical tool that can be manufactured to sell for 50 cents or thereabouts. (Hytron's Tube-Tapper and Pin Straightener are typical).

Each of the contests will close on the last day of each month starting in May. There will be three prizes monthly, consisting of various types of radio test equipment and U. S. Savings Bonds and a final Grand Prize, a $200 Bond, will be awarded to the contestant whose idea is judged to be the best of the six winning monthly prizes. (The Grand Prize winner's jobber will also receive a $200 Saving Bond).

The Contest Judges are all editors of radio publications. Entries will be evaluated on originality, simplicity and practicability. Contestants may submit as many entries as they wish, and as often as they wish, for each month represents a contest in itself. Full details about the contest, prizes and rules are contained in the Hytron advertising now appearing in this magazine.

Rider to Speak on TV Techniques

Over 1000 radio service dealers and technicians residing in the metropolitan New York area are expected to attend an open meeting being held by the Associated Radio Servicemen of New York, Inc. on the evening of May 20th at 8 P. M.

The meeting will be held at the Manhattan Center, 34th St., west of 8th Ave., N. Y. C. John F. Rider and several other radio service technique authorities will speak on such subjects as "The Theory of Television" and "Necessary TV Service Techniques." Slide films will be used to illustrate the various technical lectures. All servicemen are invited to attend this meeting.

Sylvania Promotes Sommers

George R. Sommers, formerly Pacific Coast Manager of lighting products for Sylvania Electric Products, Inc., has been appointed Director of Sales for all product divisions of the company in that area.

In his new capacity Mr. Sommers will be responsible for directing all sales activities, distribution policies and merchandising programs. He will continue to make his headquarters at Sylvania's San Francisco office.

Chertok Promoted

Sidney L. Chertok is promoted to the newly-created post of Sales Promotion Manager of Solar Manufacturing Corp. and its distributing subsidiary, Solar Capacitor Sales Corp., it was announced by W. C. Harter, executive vice-president. In addition to his new responsibilities, Mr. Chertok will retain supervision over Solar's Advertising and Technical Service Departments.

TV Tube Production Upped by Sylvania

Production of television viewing tubes during the first six months of 1948 will be expanded several times by Sylvania Electric Products, Inc., according to a statement released by H. Ward Zimmer, vice-president in charge of manufacturing. The majority of tubes produced will be of the ten inch direct view type although there is increasing demand for larger direct view and projection tubes.

Reduces Price on Rural Sets

Westinghouse announced recently a price reduction of 10 per cent on the Division's radio receivers especially designed for rural and farm use. This is a compact, five-tube battery radio known as the Ruralist.

Service Manuel Offered

An up-to-the-minute compilation of all standard type radios in current use, is offered in the new or 7th Edition Clarostat Service Manual just off the press. The 127 pages of this handy manual are packed with solid listings including such vital information as the set manufacturer and model number, the original part number, the Clarostat type designation, shaft, total resistance value, how used, and special notes. Priced at 50 cents per copy, the manual is obtainable either through the Clarostat distributor or direct from Clarostat Mfg. Co., Inc., 130 Clinton St., Brooklyn 2, N. Y.

RWT Names Edwards

Radio Wire Television, Inc., 110 Federal St., marketers of Lafayette Radio and sellers of radio-electronic parts, PA and "ham" equipment, announces the appointment of Mr. Don J. Edwards to the post of general manager in charge of the Boston and New England sales area.

Speaker Repair Catalog

Waldom Electronics, Incorporated, 911 N. Larrabee, Chicago, Illinois, offers a new reference catalog, fully illustrated and devoted to the proper methods of replacing and repairing speakers. This catalog is available free upon request.

VISIT RSD—BOOTH 51 1/2

SHOP NOTES

[*from page 35*]

with shielded lead-ins which contain solid, stiff connecting wires. These wires occasionally become loose at the bayonet connections, causing noise, intermittent reception, etc. It is good practice to inspect these whenever possible.

Price Increase

McMurdo Silver Co., Inc., Hartford, Conn. announces increase in the net selling price of the Model 906 FM-AM Signal Generator from $99.50 to $116.50.

New Arvin Distributor

Coast Radio Supply Company, 50 Otis Street, San Francisco, has been appointed to distribute Arvin Radios and electrical appliances in the San Francisco and northern California area.

Baxter Made Jensen Rep.

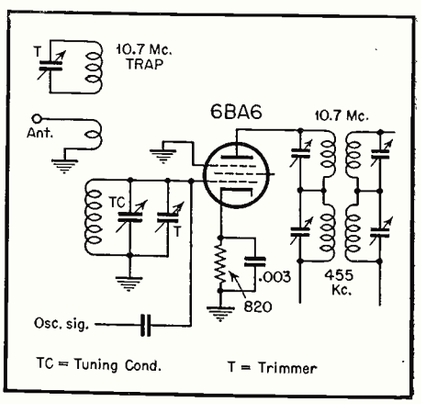
J. M. Baxter, Ft. Wayne, Indiana, has been appointed by Jensen Manufacturing Company of Chicago, as sales representative for the Jensen line of acoustic equipment in the states of Indiana and Kentucky.

CIRCUIT COURT

[*from page 34*]

coil and its adjacent grid circuit. In this particular set a 6BA6 miniature type pentode tube is used as the mixer and its grid is connected directly to the input tuned circuit.

There are three coils wound on the same form. One serves to couple the signal from the antenna or transmission line to the others. One is the grid



Partial Schematic of Airline 74BR

coil, tuned by one section of the tuning gang. The other is the trap circuit coil, tuned by a trimmer condenser. After alignment of the set is completed a signal of 10.7 mc is coupled to the antenna coil and the trap tuned for minimum output from the speaker. The parallel tuned circuit is capable of absorbing a considerable portion of the undesired signal.

VIDEO DETECTORS

[*from page 22*]

which is essentially 4.5 mc., becomes the new intermediate frequency of the FM audio signal. The second detector and video amplifier circuit diagram of this receiver is shown in *Fig. 7*.

The detector used is a 1N34. The purpose of *L38*, *L39*, and *C24* is to provide a low-pass filter for the i-f harmonics. A small biasing voltage for the video amplifier is provided for by the combination of *C25*, and *R26*. This combination also prevents the contact potential of the video amplifier from biasing off the crystal. thereby resulting in a loss of sensitivity on weak signals. Regeneration is prevented by *L50* and *C89*.

Distortion

Two types of distortion are present in video detectors, amplitude and phase. Of amplitude distortion it might be said that although this type is considerably higher in a video system than in an audio, its visual effects on the face of the picture tube are unnoticeable. This is due to the fact that such distortion results in a small increase or decrease in relative light between areas. On the other hand phase distortion can result in serious blurring of certain portions of the image. For this reason peaking circuits are almost always employed in the output of video detectors. Their job is to pass

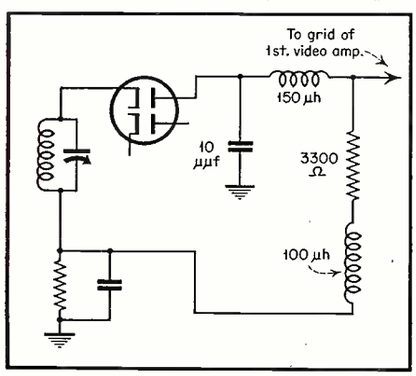


Fig. 8—Typical video detector peaking coil circuit.

frequencies up to 5 mc with negligible attenuation. A typical circuit of this type is shown in *Fig. 8*.

Test Point

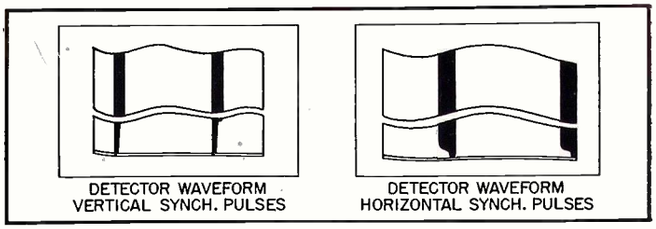
The output of the video detector is an excellent test point for checking the response characteristic of the r-f and i-f sections. This is most effectively done by the following general procedure.

1. Connect a suitable sweep generator to the grid of the r-f or i-f tube which immediately precedes the circuit up to the detector to be checked. Suitable marker frequencies should be inserted to check the limits of the response characteristic.

2. Connect the vertical input terminal of the oscilloscope to the detector output. Connect the horizontal input terminal of the oscilloscope to the sweep generator sweep-output terminal.

The image observed on the screen is the response characteristic.

Fig. 9—Detector Waveforms. (Left)—Vertical synch. pulses; (Right)—horizontal synch. pulses.



Another effective test at the detector output is to observe the waveform of the signal transmitted by a station test pattern. This is done by connecting an oscilloscope directly at the output terminal of the detector and setting the horizontal sweep of the oscilloscope at half the vertical sweep rate of the

incoming signal, and then at half the horizontal sweep rate of the incoming signal. Test patterns such as those shown in *Fig. 9* will be observed.

To test the video amplifier, sweep circuits, and CRT circuits, an audio signal is injected at the output of the detector. If all of these circuits are operating, alternate black and white horizontal bars will appear on the picture tube.

The output of the detector becomes a convenient point, therefore, of dividing the video receiver into two sections. A quick check on either is, thus, readily available.

POWER FACTOR-Q

[*from page 33*]

The unwanted resistance present in all coils and capacitors combines in a complicated way with the desired reactance of these components to give the effect we know as *impedance*. Thus, impedance is the grand total of all characteristics which tend to oppose the passage of current in coils and capacitors.

With the preceding information in mind, we now are ready to tackle definitions of power factor and Q with better understanding.

Power Factor

Power factor is equal to the unwanted resistance divided by the impedance value. The equation is: p. f. = R/Z. Power factor is expressed as a percentage. *The LOWER the power factor, the better the coil or capacitor.* It has already been mentioned that the resistance cannot be measured simply. Bridges, and some other special instruments, however, are arranged to give power factor indications directly and we can, if we desire, solve the power factor equation for the resistance value.

We usually employ power factor in rating capacitors, although we can rate coils in the same way. When your test bridge shows a low power factor for a capacitor, what is meant by the indication of the instrument is that the losses due to unwanted resistance in the capacitor are small compared to the capacitor reactance. Power factor ratings of mica capacitors might be as small as a few hundreds of one percent, while electrolytic capacitors may show power factor values as high as 5 to 10 percent and still be useful.

"Q"

Q measurements are employed in rating both coils and capacitors. But unlike power factor; *the HIGHER the Q, the better the coil or capacitor.* Q is expressed simply as a number, and is equal to the reactance divided by the unwanted resistance. Thus; the equation is: Q=X/R. Like power factor, Q also varies with frequency. It is difficult, therefore, to say whether or not a certain Q value is satisfactory unless we take into consideration the operating frequency, since a good Q at one frequency is totally unsatisfactory at another frequency.

A special test instrument—the Q-meter—is used for direct-reading measurements of Q. However, a makeshift Q testing setup may be made with an oscillator and a-c vacuum-tube voltmeter if the operator does not object to making calculations.

ELECTRONICS

[*from page 31*]

equipment to outsiders. But the majority of industrial electronic equipment suppliers know that they cannot sell a device widely enough to make it pay, if dependence is placed solely on their own service organization. They are looking for fully qualified service technicians in every large city, whom they can trust to handle the maintenance of their equipment. When you're sure you fill the bill, contact the manufacturer's local representative and lay your story before him. Chances are you'll get a trial, and if your work is right, you will get regular

assignments. The field is already big, and it's growing bigger. It takes good men to qualify. But the work has a variety and fascination not offered by the radio branch of the field, and the reward is definitely worth the effort.

TECHNICAL QUIZ

[*from page 32*]

inator in present use is known as:

A. *The Crosby or double-tuned type of discriminator.*
B. *The Foster-Seeley or phase discriminator.*
C. *The Armstrong Discriminator.*

QUESTIONS 16 to 20

16. The principle of operation of a typical discriminator is:
    A. *When the incoming carrier frequency is equal to the resonant frequency of the discriminator transformer a maximum audio voltage is developed across the both ends of the diode load resistors.*
    B. *Each diode circuit produces an audio signal in the cathode load resistor which is proportional to the deviation frequency; the total voltage across both ends of the diode load resistors being equal to the voltage difference in both.*
    C. *Each diode circuit produces an audio signal in the cathode load resistor which is proportional to the deviation frequency; the total voltage across both ends of the diode load resistors being equal to the sum of the voltage drops across both resistors.*
17. In the ratio detector:
    A. *The two diodes are wired so that the audio voltages developed with respect to the load are in series aiding.*
    B. *The two diodes are wired so that the audio voltage developed with respect to the load are in series opposing.*
    C. *The audio voltage developed across the load resistor is dependent on the ratio of the output to the input capacitance.*
18. The discrimination of the ratio detector against noise impulses, which are sudden increases in the amplitude of the FM carrier is due primarily to:
    A. *The action of the large capacitance connected across the output maintaining the average voltage across the output constant.*
    B. *The ratio of the output to the input capacitance.*
    C. *The diode current which is limited to a certain value.*
19. In aligning an FM receiver's limiter stage:
    A. *The output, as indicated by a d-c microammeter inserted in the grid return, should be adjusted for maximum response.*
    B. *The output should be adjusted for minimum response.*
    C. *The output should be adjusted for a minimum between two maximum points.*
20. In aligning the secondary of a Foster-Seeley discriminator transformer, the output as indicated by a suitable VTVM connected across the load resistors should be adjusted for:
    A. *Maximum response.*
    B. *Minimum response.*
    C. *A minimum between two maximum points.*

See page 48 for answers

VECTORS

[*from page 29*]

verted into amplitude variations, which is the purpose of an FM detector.

Fig. 27 illustrates the vector relationships of voltage and current when the incoming frequency is *higher* than the resonant frequency of the circuit. In this case the voltage across the secondary *leads* the current. *Diode B* now has a greater voltage applied to its plates than *diode A*, and the net voltage drop between *points X* and ground is opposite in polarity to that which existed in the previous case.

As the signal is frequency modulated

in both directions of the carrier corresponding amplitude variations appear across *points* X and ground. The frequency of these variations corresponds to the modulation frequencies contained within the carrier, and the deviation of the modulation frequencies from the center frequency determines the amplitude of detected audio signal.

Space does not permit further treatment of this subject. However, the applications of vectors in the radio are so numerous, that further investigation of this powerful mathematical tool certainly merits consideration on the part of the radio technician. Those interested can obtain this information in the many excellent texts on the subject now available.

FIELD FINDINGS

[*from page 25*]

Wholesale Service Jobs

Service organizations who do repairing for dealers on a wholesale basis must, since the advent of FM, review their price scales as the time required to troubleshoot and repair FM models as compared with AM types will run them into losses unless they make provision against the extra time factor.

Most technicians are squawking that set makers are cramming so many components into such small chassis space that the job of getting at buried parts, when they require replacement, is untenable. Customers don't seem to realize, and never will until it is shown to them, that a small set can be more difficult to repair than a big one. Set makers do NOT intend to revise their production methods and set designs for the serviceman's benefit so you may as well work accordingly. However, I can't resist and must show you a picture of a new British-made set now on the export market. This set opens like a flower exposing the entire innards when the technician releases one bolt. Look at the Ultra radio. Just remember, American set makers are not going to ease your job of getting chassis out of consoles, nor of getting at overlaid, stacked-up parts.

Video—The Lifesaver

Where video is telecast, TV sets are selling like hot-cakes. New Yorkers are waiting up to six weeks to get their installations completed. TV has given many retailers an excuse for giving up their service departments. But the average service dealer is burned up at manufacturers because he is not being given a chance to get his share of TV installation and service work.

It seems unreasonable that the average service dealer who usually

obtains approximately half of his income from both retailing and servicing activities on AM and FM sets should be restricted from TV installing. It's like having the set maker say, "You fellows are smart enough to sell and service all our sets except video models. As for TV sets, you are not technically competent, so lay off them. Let one of you competitors take this sort of gravy business." Of course the competitor isn't entitled to that business so why should service dealers be happy about such an arrangement? What's your opinion?

On the other hand, every service dealer must, by law of nature, welcome video, because in time it will take the $9.95 and other cheap sets out of the field, and on that type of set no servicer could hope to make a suitable living.

It might be timely to mention that New York's Better Business Bureau now reports that the majority of complaints being received are directed against retailers and not service organizations. The dealers aren't living up to the warranty terms on many set sales.

Back to TV service policies. Speaking to heads of TV service organizations I can't find one who will admit that his is a profitable undertaking, but every one has a waiting list of jobs to install. Strange, despite the fact that all cry the "blues," not a single TV service outfit will admit that they are going to give up and get out of the business. Guess the big losses these fellows are taking are so profitable that they don't want to share them with other technicians. Such is competition!

Getting into TV is not as costly as one might imagine. Experts on test equipment claim that a service dealer now set up and operating a 2-man shop with a properly equipped service bench can obtain for less than $500 more all instruments needed to really modernize the shop and prepare it to handle TV jobs for 5 years or more to come. Or, a man, starting from scratch, intending to set up a TV-FM shop need spend less than $1500 to completely equip it with all the necessary latest design test equipment. However, no 2-man shop can indulge in TV activities as the average job needs 2 outside installers and 3 or more men in the shop. If you want to expand, do it the TV way, but do it right, don't skimp. Be sure to get your servicing franchises lined up first, and more important, learn all there is to know about TV and FM, and convince TV set makers to throw the whole deal wide open to all who wish to compete, so that TV is no longer a closed fraternity from which all of us might soon be barred.

In subsequent issues I'll cover other findings obtained out in the field.

CONTACT CAR-OWNER

[*from page 23*]

with a new one. If the old one was a dynamic you can use either dynamic or P.M. The P.M. speaker draws no current from the battery.

Intermittent operation is a common complaint in car radios as well as home radios. The OZ4 tube is a great offender in the car radio. When an OZ4 comes into your shop bad, and if the socket is filament wired, replace with a 6X5. The 6X5 draws some current from the car battery but with the car's generator working the extra tube current drainage will not be noticed

Reassembly Hints

After the radio has been put back into the car make sure all power leads are as short as possible, and that the antenna lead-in is well shielded. Check the antenna itself—for it might be a fine idea to replace an old rusty one with a nice new type. Check spark plugs for suppressors if there is too much noise coming through from the car's motor. Check the distributor hot lead for suppressor, and the generator, meters and gauges for condensers. Joints in the car body should be bonded, using half inch copper braid. The fuse-coupler, the antenna plug-and-socket at the radio, and the ground clamps of the radio mounting should be firm and tight. Nothing should be overlooked that will swing, vibrate, or otherwise work loose under any and all types of driving conditions.

A good car radio is a good traveling companion, and the owner becomes your friend when you keep that companion operating efficiently for him. He also owns one or more home radios that need service now and then. It all boils down to darn good business, and you want more *good*, profitable business. The little amount of extra efforts and work on your part will repay you well in cash returns. When the cars go your business will grow if you will get busy and CONTACT THAT CAR OWNER.

TECHNICAL QUIZ No. 6 ANSWERS

Do NOT read or study these answers until you have finished marking down your answers to the "Quiz" given on page 32 of this issue. When that is done, compare your answers to these correct ones.

ANSWERS

1-*B*; 2-*B*; 3-*A*; 4-*A*, 5-*B*;
6-*A*; 7-*A*; 8-*B*; 9-*C*; 10-*A*;
11-*C*; 12-*C*; 13-*C*; 14-*C*; 15-*B*;
16-*B*; 17-*A*; 18-*A*; 19-*A*; 20-*C*;

Ad Index

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