FISHY PUBLIC ADDRESS

20-INCH TELETUBE!

"DEAD OR ALIVE!"

50-KW. "BOTTLES"!
-KDKA's New Xmitter.
See Page 527

SERVICING MARINE RADIOPHONES • NEW OSCILLATOR CIRCUITS
HOME-MADE ELECTRONIC ORGAN • AMPLIFIER TESTS AMPLIFIERS

MACHINE-GUN SPEAKER!
DACO 1940 117 volt TUBE TESTERS

obsolescence proofed FOR EVERY PURPOSE
made up to the minute and into the future
DACO

DACO leadership in 1940 is assured with nine AMAZING models of series 303 TUBE TESTERS

IMPERIAL 303CC COMBINATION TUBE TESTER AND DISPLAY CONSOLE
Will Display up to 400 Tubes
24" x 21" x 35" High. Shipping Wt. 50 lbs.

STANDARD DE LUXE IMPERIAL

STANDARD TUBE TESTERS
Same as De Luxe Tube Tester Volt Ohmmeter Model,
Except Reference Chart Replaces Index Chart, Volt Ohmmeter and Chrome Trim Eliminated (Screened panel).
Black or Blue.

DE LUXE TUBE TESTERS
Beautifully Streamlined, Beautifully Finished.
Black, Blue or Rust.

DE LUXE TUBE TESTER VOLT OHMMETER
This Combination Tube Tester Volt Ohmmeter.
Black, Blue or Rust.

IMPERIAL COUNTER MODEL
Flashing Red and Green Windows and Radio Plug-in.
Finished in Crystal Gray.

IMPERIAL COMPLETE TESTER AND DISPLAY
Laminated Wood Shelves with Natural Finish Fibre Tops.
Edges Crystal Gray.

STANDARD TUBE TESTERS
De Luxe 303C or Portable 303P $19.90

DE LUXE TUBE TESTERS
De Luxe 303C or Portable 303P $29.90

DE LUXE TUBE TESTER VOLT OHMMETER
De Luxe 303C or Portable 303P $29.90

IMPERIAL COUNTER MODEL
303C $39.90

IMPERIAL COMPLETE TESTER AND DISPLAY
303CC $59.90

WHY BUY A CHEAP TESTER AT A CHEAP PRICE — BUY A DACO HIGH QUALITY AT A LOW PRICE

The Famous DACO-DAYRAD Engineered Circuit
Is in All Models—Tunes All Elements Separately at Correct Load in All Tubes from 1.0 to 117 Volts, Including the New Bistatic and RST Midgets and Built-in Beautiful Etched Aluminum Panels—Two Spare Sockets—Rotary Index Lighted Chart—Push Button Element Selector Switches—Parsonal Meter Movement—All Counter Models 15" x 12" height 5½" x 3½"
401 SIGNAL GENERATOR, $34.90
401 VOLT OHMMILLIAMMETER, $39.90

ALL DACO INSTRUMENTS ARE FULLY GUARANTEED. HOWEVER, YOU CAN OBTAIN AN ADDITIONAL FOUR-YEAR WARRANTY THAT COVERS ALL REPAIRS, EXCEPTING ACCIDENT OR ABUSE, AND ALL MODERNIZATION—ALSO NEW CHARTS EVERY SIX MONTHS, $7.50 FOR FOUR YEARS—OPTIONAL.

Daco Easy Payment Terms
Standard Models, $6.60 Down
De Luxe Models, $10.00 Down
Imperial Counter, $13.30 Down
Imperial Console, $20.00 Down
401 Signal Generator, $11.62 Down
521 Volt Ohmmeter, $13.30 Down
ADD 10% TO BALANCE AND PAY IN TEN MONTHLY PAYMENTS
ALL PRICES F.O.B. CINCINNATI
SEE YOUR JOBBER OR WRITE US

DAYTON ACME CO. 2339 Gilbert Avenue Cincinnati, Ohio
WE WILL MODERNIZE YOUR DAYRAD EQUIPMENT AT LOW COST

DE LUXE 303CS COUNTER TYPE
FINISHED IN BLACK, BLUE OR RUST

DE LUXE 303PS PORTABLE TYPE
BEVELED FACE LEATHERETTE CASE
FOR COMBINATION COUNTER USE

SPECIAL
A Limited Number of Factory Rebuilt and Modernized Up to 117 Volt Tube Testers and Combination Tube Tester Volt Ohmmeters Available at Low Price—New Guarantee

DACO and DAYRAD
You Can Train at Home for Radio and Television

Clip the coupon and mail it. I'm so certain I can train you at home in your spare time to be a Radio Technician that I will send you a sample lesson free. Examine it, read it, see how clear and easy it is to understand. See how my course is planned to help you get a good job in Radio, a young, growing field with a future. You don't need to give up your present job, or spend a lot of money to become a Radio Technician. I train you at home in your spare time.

Jobs Like These Go to Men Who Know Radio

Radio broadcasting stations employ engineers, operators, technicians and pay well for trained men. Radio manufacturers employ test engineers, inspectors, foremen, servicemen in good-paying jobs with opportunities for advancement. Radio jobbers and others employ installers and servicemen. Many Radio Technicians open their own Radio sales and repair business and make $50, $100, $150 a week. Others hold their regular jobs and make $5 to $10 a week fixing Radios in spare time. Automobile, police, aviation, commercial Radio; loud-speaker systems, electronic devices are never fields offering good opportunities to qualified men. And my course includes Television, which promises many good jobs soon.

Many Make $5 to $10 a Week Extra in Spare Time while Learning

The day you enroll, in addition to my regular course, I start sending you Extra Money Job Sheets which start showing you how to do actual Radio repair jobs. Throughout your course I send plans and directions which have helped many make $200 to $500 a year in spare time while learning. I send special Radio equipment: show circuits. This home interest course, fascinating, practical, I devote more than 10 Lessons and applications, and cover Television fundamentals thoroughly in my Course.

Also Give You This Professional Servicing Instrument

Here is the type of instrument Radio Technicians use—an All-Wave Set Servicing Instrument. It contains everything necessary to measure A.C. and D.C. voltages and currents; to check resistances; adjust and align any set, old or new. It satisfies your needs for professional servicing after you graduate—can help you make extra money fixing sets while learning.

Get Sample Lesson and 64-page Book

Act today. Mail coupon now for Sample Lesson and 64-page book, They're FREE. They point out Radio's spare time and full time opportunities and those coming in Television; tell about my course in Radio and Television; show many letters from men I trained, telling what they are doing and earning. Read my money back agreement. Find out what Radio offers you. Mail coupon in envelope or paste on penny postcard—NOW!

J. E. SMITH, President
Dept. OCX, National Radio Institute, Washington, D.C.

Mr. J. E. SMITH, President National Radio Institute, Dept. OCX Washington, D. C.

Dear Mr. Smith: Send me FREE, without obligation, your Sample Lesson and 64-page book, "Rich Rewards in Radio," which tells about Radio's spare time and full time opportunities and explains your 50-50 method of training men at home to be Radio Technicians. (Write plainly)

Name
Age
Address
City
State

14X-1

Please Say That You Saw It in RADIO-CRAFT
Contents MARCH, 1940 Issue
VOLUME XI -- NUMBER 9

News From Abroad
Editorial: Radio in 1950
The Radio Month in Review
Building An Amplifier to Test Amplifiers!
Build Your Own Experimental Electronic Organ
Marine Radio Telephone Installation and Servicing
How to Select and Place Sound Equipment—Part III—Placement of Equipment
The "New" KDKA
Public Address in Oceanarium
Converting a 5-Inch Telly Kit for Receiving a 9-Inch Image—Part II
Sound Engineering—No. 3
New Circuits in Modern Radio Receivers—No. 30
Servicing Puzzlers—No. 3
Recent Advances in Oscillator Circuits
Servicing "Orphans" and Private-Brand Sets—Part I
A.F. Amplifier Load-Matching Technique
Servicing Questions and Answers
Case Histories of P.A. Sales—No. 6
The Beginners' All-Waver—Build This 2-Tube Plug-in-Coil Breadboard Receiver

RADIO SERVICE DATA SHEETS:
No. 272—Stewart-Warner Models 01-5H1 to 01-5H9 (Chassis Model 01-5H)
No. 273—Zenith Model 6MF490 Auto-Radio (Ford Radio Model 91A-18805 Roto-matic)
3 New Tubes
Radio Trade Digest
Latest Radio Apparatus

514
SSSS or SOS?

News dispatches from the war zone report that 'SSSS' is rivaling 'SOS' as the international distress call. The operators call it 'the signal SSSSS.' The explanation is that the dot-dot-dot group, 4 times repeated (-----), represents these letters, having a characteristic swing and through common understanding and usage identifies the nature of the distress case.

"In any event, the 'SSSS' does not officially mean 'Submarine Sighted' or any other possible world's beginning with 'S.' The explanation is that the dot-dot-dot group, 4 times repeated (-----), representing these letters, has a characteristic swing and through common understanding and usage identifies the nature of the distress case."

Far-away Indians are so remote that it has not constituted a market for American radio products. However this state of affairs may not long continue if the Bengal Board of Industries succeeds in its plans to sell to the Government of Bengal the idea of fabricating every radio component, "except, of course, the valve."

"It has been decided with regret to suspend publication of The Marconi Review during the war," reads a release received last month from Marconi's Wireless Telegraph Company, Ltd., London, England, publishers of this interesting technical house-organ.

Dear Listener: Due to the delay in foreign mails at the present time, it has been impossible for us since October to send you our printed programs," reads a release from Reisch-Rundfunk G.m.b.H., Deutscher Kurzwellensender (the German Short-Wave Station), received by Radio-Craft last month. Report, in continuing statements instead, that American listeners tune in the daily program previews at a stated time each day.

A British Broadcasting Corp. overseas press bulletin reports that 6 private houses, "somewhere in England," comprise the group to which the B.B.C. evacuated 300 members of its staff and artists when war broke out, and where they will stay for the "duration." In one house the studio is a room, safeguarded by a shop and a roof-top machine-gun post, in which 75 members of the B.B.C. Symphony Orchestra rehearse and play for listeners daily.

Domestic TID-BITS

According to a newspaper columnist last month, Mayor LaGuardia is becoming quite chummy with the 2-way short-wave radiophone in his car. The item points out that the Mayor's calls are routed through Fire Headquarters rather than Police Headquarters because a 2-way system is utilized by the firemen for their boats. Since there is no speech-scrambling device in the fire-fighting radio system, this channel is virtually a party-line for the Mayor's conversations.

Seedlings of corn germinated in wet sand and exposed to strong doses of 2½-meter radio waves for about ½-hour, then replanted, resulted in dwarf growths, Science News Letter reported last month. Similar stunting effect as observed in the application of heat to germinating seedlings. Experiments were conducted at the California Institute of Technology.

Please say that you saw it in Radio-Craft.
For Better Servicing—For Bigger Profits—
USE GERNSBACK MANUALS AND BOOKS!

SINCE 1931 Servicemen have been buying more GERNSBACK OFFICIAL RADIO SERVICE MANUALS year after year. The authentic material, easily accessible diagrams and complete service data make them invaluable to dealers and radio Servicemen. Without a Gernsback Service Manual at the repair job, there's time and profit lost. Your service kit or laboratory is incomplete without all the GERNSBACK OFFICIAL RADIO SERVICE MANUALS. There are GERNSBACK MANUALS for servicing auto-radios, also refrigeration and air conditioning equipment.

VOLUME 7 OFFICIAL RADIO SERVICE MANUAL
Over 1,600 Pages • Over 3,000 Illustrations • Stiff, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 4 lb.
$10.00

1936 OFFICIAL RADIO SERVICE MANUAL
Over 1,500 Pages • Over 2,000 Illustrations • Stiff, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 4 lb.
$7.00

1935 OFFICIAL RADIO SERVICE MANUAL
Over 1,500 Pages • Over 2,000 Illustrations • Stiff, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 4 lb.
$7.00

1935 OFFICIAL AUTO-RADIO SERVICE MANUAL
Over 240 Pages • Over 360 Illustrations • Flexible, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 2 lb. 4 oz.
$2.50

1934 OFFICIAL RADIO SERVICE MANUAL
Over 400 Pages • Over 3,000 Illustrations • Flexible, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 3 lb. 4 oz.
$3.50

1932 OFFICIAL RADIO SERVICE MANUAL
Over 1,000 Pages • Over 2,000 Illustrations • Flexible, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 4 lb. 4 oz.
$5.00

OFFICIAL REFRIGERATION SERVICE MANUAL
(Volume II)
Over 255 Pages • Over 300 Illustrations • Flexible, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 1 lb. 6 oz.
$5.00

OFFICIAL AIR CONDITIONING SERVICE MANUAL
Over 252 Pages • Over 300 Illustrations • Flexible, Leatherette
Looseleaf Covers • Size 9 x 12 inches • Net Weight 2 lb. 6 oz.
$5.00

To order these famous Manuals, see or write to your jobber or favorite mail order house. If more convenient, mail coupon directly to publishers.

RADCRAFT PUBLICATIONS, Inc.
99 HUDSON STREET NEW YORK, N. Y.

Please Say That You Saw It in RADIO-CRAFT

Many New Books Have Been Added to RADIO-CRAFT LIBRARY SERIES

Get into the swing of reading instructive, authoritative books on technical subjects—radio, air conditioning and refrigeration. It's the easiest, quickest and most inexpensive way to improve your knowledge on these topics.

In this series, popularly known as the RADIO-CRAFT LIBRARY SERIES, are all the titles necessary to your personal advancement. Only by careful study of these enlightening books, can you gain adequate experience in fields of radio, air conditioning and refrigeration. Each book is uniform. The volumes measure 6 x 9 inches—contain 64 pages, and have stiff, flexible covers. PRICE 50¢ PER BOOK. All books are sent to you postpaid.

Here Are The Titles:

**Book No. 2 MODERN VACUUM TUBES**

**Book No. 18 POINT-TO-POINT RESISTANCE ANALYSIS**

**Book No. 5 BRINGING ELECTRIC SETS UP-TO-DATE**

**Book No. 19 PRACTICAL RADIO KINKS AND SHORT CUTS**

**Book No. 13 ABC OF AIR CONDITIONING**

**Book No. 16 POCKET RADIO GUIDE**

**Book No. 4 THE CATHODE-RAY OSCILLOSCOPE**

**Book No. 20 BREAKING INTO RADIO SERVICING**

**Book No. 11 NEW RADIO QUESTIONS AND ANSWERS**

**Book No. 21 SERVICING WITH SET ANALYZERS**

**Book No. 22 PRACTICAL PUBLIC ADDRESS**

**Book No. 23**

—

EACH BOOK IN THIS SERIES—50¢

RADCRAFT PUBLICATIONS, Inc., 99 HUDSON ST. NEW YORK, N. Y.

**Concise: Enclosed find remittance of $... for which send me, POSTPAID, the Manuals or Books indicated below by a cross (x) in the Panel.

( ) Volume 7 @ $1.00
( ) 1936 Manual @ $3.00
( ) 1937 Manual @ $3.00
( ) 1938 Manual @ $3.00
( ) 1939 Manual @ $3.00
( ) 1940 Manual @ $3.00
( ) 1941 Manual @ $3.00
( ) 1942 Manual @ $3.00

( ) Refrigeration Manual (Vol. 2) @ $5.00
( ) Air Conditioning Manual @ $5.00

RADIO-CRAFT LIBRARY SERIES—$2 EACH

Circle book numbers wanted: 2 6 12 14 18 16 18 20 21 22 23

Name
Address

City
State

(Send remittance in form of check or money order) register your letter
if you send cash or unused U. S. Postage Stamps.)

RC-340

Please remember to enclose 50¢ for each book sent.
WAY back in 1926 in the writer's former publication Radio News, for May, 1926, was a number of prophesies were made by him. Remember, that in 1925 the radio set as we know it today had not appeared, and this in those times were table models with anywhere from 4 to 10 controls. In order to tune such a set you had to be almost a juggler. The really big fan. Our radio sets had no loudspeakers built into them, but we were using separate speakers. The sets were still operated by batteries at that time. The modern set which plays into the house-lighting current supply was still in the future.

A few selections at random from the aforementioned article appearing in 1925, therefore make interesting reading in today's retrospect.

"Suppose one of our popular broadcast stations were to suddenly jump to 25 meters. No broadcast receiver made today could receive at such a low wavelength, because modern receivers are made to operate on a wavelength between 200 and 600 meters or thereabout.

"The writer makes the prediction that within the next 10 years the popular broadcast receivers will be those which will be able to tune down lower and lower."

"At the same time the sensitivity of our sets will keep on increasing as it has during the past 10 years."

"While the writer believes in the present cycle of super power, he does not believe that it will prevail in 1935."

"(It is interesting to note that in 1938 the Federal Communications Commission refused to license a number of stations for super power.)"

"In 1935 we shall have radio television. It will be possible to see as well as to hear by radio."

"What tubes shall we use in 1935? At the present time all tubes are used by batteries. Within the next few years we shall have a 110-volt tube which will operate directly from the electric lighting main, without any resistances whatever."

"The control of the radio receiving outfit of 1935 will be simplified by a one-way switch, knobs and other handles, which long before 1935 will be obsolete."

"The loud-speaker of 1935 will not have a diaphragm at all... you may rest assured that in 1935 you will not be able to tell the difference between the singer's voice when singing over the radio and actually hearing her on the stage."

"It is all but certain that in the near future the ultimate sensitivity of radio will be approached. By that time anywhere from 25 to 35 million radio receiving outfits will be in operation in the United States."

"Rather than decreasing, the number of radio broadcast stations will probably keep on increasing during the next few years. At that time we shall also have moving broadcast stations, as, for instance, stations on board ships, stations on board airships and airplanes, the most ambitious and semi-commercial purposes."

"Every rich man's automobile will have its radio transmission and receiving station to enable him to keep in direct touch with his office."

"In 1925 all of the above predictions sounded wild and many people thought that the writer overstated the bounds of probability. That remains that most of the predictions were realized long before 1935."

"What about radio in 1950, 10 years hence? Basing the present upon the past, the writer believes that by 1950 the following radio improvements will surely have come about.

"Television now seemingly an accomplished fact is held back mostly on account of the high cost of the present receivers. By 1950, we will have radio receivers incorporating television which will sell at popular prices down to $25 and less, for the complete set which includes sound and television as well. The present television receiver will bear no resemblance to those of 1935. The future receiver will be both compact and indeed radio-television sets similar to our present midget radio sets will have been evolved. The television set of 1950 will show an image on the ceiling or the opposite wall of the room with such brilliance and power that you will be able to see the program even in broad daylight, a thing which you cannot do today."

"The idea of viewing the image at the end of a cathode-ray tube to my way of thinking is all wrong. It will not prevail in the future. The special screens for 5- and 6-millimeter tubes which by electronic bombardment will light up brilliantly so that the eye does not have to be strained when viewing the most elaborate presentation."

"Commercial sponsorship in television will be an accomplished fact in 1950 and the advertising, I am sure, will not be as blatant as it is today. Aided by sight the sales points will be driven home more by suggestion than by raw, unvarnished sales talk, which, unfortunately, we have to put up with today. An entirely new sales technique will be developed in the form of propaganda rather than direct sales assault upon our reluctant senses. Instead of irritation the listener will experience the most soothing fluff and he will take the "show" for granted and with good grace, and incidentally the sponsors' sales will improve in direct ratio."

"The next decade will be one triumphant in staticless and noiseless. Thanks to Major Armstrong's invention of wide-band Frequency Modulation the entire radio industry will be revolutionized so much that, by 1950, when we listen to a 1940 radio set it will arouse our incredible laughter."

"It is interesting here to note how the tinny and blarey loud-speaker of 1925 has made way for the softer-sounding radio which we are accustomed to today; but as the years roll our jangled nerves, already saturated with noise, will demand still less volume and still softer, quieter radio sets will be the order of the day. But we will not stop there because even a medium-low radio set if softened down by all the requirements of available technique, will still disturb people in the same house or in the same apartment. For this reason I believe that the personalized radio set will be preferred by many in 1950. People will wish to listen to their radios as and enjoy listening to people who are not too far away or disturbing people in the same room or adjoining room. The solution of the problem is to equip the future radio receivers with a 2-way system so the sound will issue as usual if wanted. Then if necessary, the set can be silenced for everyone in the room, apart from or house by house by means of a switch that plugs into the set can be strapped to your wrist, with the astonishing result that you and you alone will hear all of the sounds without disturbing anyone else."

"In 1926 when I invented the instrument known as the "Oonphone" (the forerunner of all present-day bone-conduction hearing-aids) I noticed that it was possible for the oonphone when pressing it against any bone of the human body, to transmit sounds clearly to the auditory system. It was interesting to note that while a loud volume could thus be transmitted to the ear a person standing alongside of you could hardly hear anything at all. Therefore, by attaching a powerful resonator to the wrist you will be enabled to hear your favorite program in a personalized manner not possible today. Incidentally, the vibration thus imparted to the bone structure gives a delightful sensation, similar to mechanical vibrationators which have been in vogue for many years. The personalized wrist-listening device will be a great boon to hospitals, where patients can listen to radio programs to their heart's content without disturbing others who wish quiet."

"Our present, highly complex radio sets will probably be simple, from the manufacturing and servicing point of view, by 1950. The trend of future sets is toward less and less tubes. Ten years ago the average set had 8 tubes. Today the average set has probably 5. By 1950 the average set will probably have not more than 3 multiple-duty tubes. This not only cuts the cost of production greatly but makes the receiver less complex and easier to service, while the greater sensitivity and power of the tubes will give even better results in point of output, selectivity and sensitivity than our present 5- and 6-tube receivers. The trend toward simplification of all radio components will continue during the next 10 years. Simplification and ease of replacement will have made tremendous progress by 1950."

"How many receivers will we have by 1950? Probably between 50 and 50 million. This figure is conservative as it also includes mobile sets such as automobile radios, pocket radios, portable radios, etc."
THE RADIO MONTH

"F.M."

W2XOR are the letters the F.C.C. assigned last month to supplant the original designation, W2XW1, of WOR Mutual's frequency-modulated transmitter which is slated to take the air early in January. The new call letters are a special dispensation so that they may be associated more readily with WOR. Nice goin'.

Parallel with the "network" frequency modulation experiments of General Electric Co. between Schenectady and New York City is the development of a network program, incorporating 3 stations, by the Yankee Broadcasting System. Net will include smitters at Mt. Washington, N. H.; Paxton, Mass.; and, Alpine, N. J., to afford improved reception to a potential 20,000,000 listeners (virtually 1/6 of the entire population of the U.S.), proxy John Shepard pointed out last month.

W2XQR, John V. L. Hogan's F.M. station (operated by Interstate Broadcasting Company), on 43.2 mc., is scheduled to air programs 42 hrs. per week. Major source of material will be programs from W2XQR (Eastern-most of the only 4 special hi-fi broadcasters in the U.S.), it was announced last month.

TELEVISION

The new RCA/N.B.C. portable telly equipment demonstrated to the F.C.C. last month incorporated such features as a 1-meter telly relay unit—shortest wavelength yet employed in practical telly work (on this wavelength neither electrical disturbances—notably elevator contacts, diathermy equipment and automobile ignition systems—nor lightning are a serious factor); a "delay" component for keeping cameras locked in absolute synchronism; and, a new wedge-type antenna which focuses the broadcast energy into practically a searchlight beam. Units operate on 115 V., A.C.; cost is about 1/6; power consumption is about 1/5; and, weight about 1/10, of the present "mobile" equipment carried in 2 large vans.

The fairly general idea that television images and sound cannot be sent between New York and Philadelphia was knocked into a cocked hat, last month, with the lodging of an official complaint by Philco with the Federal Communications Commission that its telly programs from a station in Philly were being interfered-with by programs from the Columbia Broadcasting System's station in N.Y.C.

As this department has repeatedly pointed out, long-distance telly transmissions on the channels in the 6- to 7-meter region are not at all improbabilities; in fact, N.Y.C. telly programs have been picked-up in London, and vice-versa. And for that matter, 5-meter ham-radio stations have established coast-to-coast 2-way contact.

In this connection, we must not lose sight of the fact that a direct line drawn from the top of the Empire State Building to the tops of the tallest buildings in the Quaker City would not drop below the horizon; points at this distance of about 85 miles, however, would be just about at the "fringe distance."

The inquisitive eye of television is giving boxing an unprecedented boost—and at the same time doing a bang-up job of selling telly to Mr. and Mrs. Doakess family. Telecast boxing cards from Ridgewood Grove, Madison Square Garden, and other hotbeds of fistic encounters, last month, have started to do the trick. Wrestling, too, is garnering air-laurels.
IN REVIEW

ABROAD

RADIO helped create a French town, which perhaps may replace one possibly eventually destroyed during the World War, Second Edition, commented the press dept. of Bambergner Broadcasting Service, last month. According to Victor Lusinchi, WOR-Mutual observer, at a report, who speaks from French General Headquarters, the location of the GHQ has so often been referred-to in dispatches as "Somewhere in France" that the appellation has been officially adopted as the name of the town!!

SOUND

THE Novachord, 168-tube pipeless electronic organ (described in April 1939 Radio-Craft) is now one of the props at WMCA on which Ted Steele daily solos 5 station reissues stated last month.

Do you want to hear a recording of an electronic piano selection? Bob Zurke's RCA Victor recording, "Somebody Told Me" contains "The Old Tom Cat of the Keys," a selection played on the Storytone electronic piano (See Radio-Craft, February, 1940). This disc was released last month.

F.C.C.

That engineering and business interest in television, frequency modulation and facsimile is continuing to expand, is indicated by the following excerpts, from Federal Communications Commission reports released last month, on projects in these fields!

Television.—W2XAL, First National Television, Inc., Kansas City, Mo.; requested renewal of license for television station...Henry Joseph Walcak, Springfield, Mass.; the request for a telly station on 1,550 kc., 250 W. at 360 Worthington St., Springfield, Mass., reported in this department of Radio-Craft last month as having been returned, was re-submitted as amended to read 1,550 kc. Walcak is still out of luck. New application was again returned as "Frequency requested not allowable for television."...Columbia Broadcasting System, New York City; applied for permission to build a portable-mobile unit for operation in metropolitan area on 356-348 mc. (roundly 1 meter!), 25 watts for visual and 6 watts for aural. Special and telly emission. Unlimited time. Application amended to request 10 W. aural instead of 5 W....

Applications for renewal of telly licenses were received from W2XVF (Allen B. Du Mont), W2XAB (C.B.S.), and W2XBPT and W2XBS (both N.B.C.)...Don Lee Broadcasting System; license requested for new special portable-mobile relay broadcasting station for use with telly station W6XAO, Los Angeles, and telly relay station W6XDU. Frequencies, kc.: 1,646, 2,090, 2,190, 2,830, 100 W., unlimited time, A3 emission, equipment of station KABB. Ditto except equipment of KABD. Ditto except equipment KAOG and 8 W. Ditto except on frequencies 31.62, 35.26, 37.34, 39.62 mc., 10 W. and equipment of KEGQ. And, ditto, except 2 W. and equipment of KEGO.

W2XAB, RCA Mfg. Co., Inc., New York City; granted temporary OK to trolleycast on 336-342 mc. and 342-348 mc. (roundly 1 meter!) for the month of December...W2XR, Radio Pictures, Inc., Long Island City, N. Y.; granted OK to experimentally use aural transmitter of television station W2XAB and to reduce operating power to 500 W.

Frequency Modulation.—Zenith Radio Corp., Chicago, Ill.; Co. put in its bid for a new high-frequency station, "special emission" (presumably F.M.), on 42.8 mc., on 5 kilowatts, at 6001 Dickens Ave., Chicago, Ill. ...Boston Edison Co., Boston, Mass.; requested OK to construct high-frequency broadcasting station at 1165 Massachusetts Ave., Boston, Mass. Channel at 42.8 mc. (the F.M. range) was requested (Continued on page 576)
BUILDING AN AMPLIFIER
To Test Amplifiers!

"While remodeling our service shop we bought some new testing instruments and found that it would be advisable to have an amplifier to supplement some of the features of these new instruments. We built such an amplifier and have had it in use for several months, and find that it is a big help. In this article we have described this amplifier and the ways in which it can be used."

LOUIS K. SANDOR, W8QNU

The only testing instruments found in the average service shop up until a year or so ago were the voltmeter, ohmmeter and current meter. Radio sets however had advanced considerably in features, design and quality of reproduction.

There were a few men in the service industry who woke up to the fact that means of adequately testing the performance of radio receivers were sadly lacking. As a result, just in the last 2 years we have begun to see something really new in testing instruments. The amplifier to be described has been designed with the idea in mind of supplementing some of the features of these new-type testing instruments. For the fellows who like perfection in what they build this amplifier really and truly represents the last word in audio reproduction.

A lot of experimenters in the last few years have built "hi-fi" amplifiers, only to experience disappointment. They built these amplifiers with the best of parts and they probably had good frequency response. What these fellows didn’t take into consideration was the response of the speaker attached, which could ruin the quality of the best of amplifiers. Also the input to the amplifier was frequently far from high-fidelity.

The amount of harmonic distortion at rated output is probably the first consideration in the design of any quality amplifier. Since the amplifier here described was to be used as a testing instrument, and therefore could not have any distortion if true tests were to be made, it was designed throughout for minimum harmonic distortion; and a flat response from 30 to 10,000 cycles. Three separate tone controls were built into the amplifier, so if it was desired, the frequency response could be changed to suit any situation.

THE EXPANDER - COMPRESSOR

Besides being a testing instrument the amplifier was designed to show the customer the quality of reproduction possible with the right equipment. To achieve this in the Nth degree a separate expander - compressor channel was used.

The expander is to be used in the reproduction of classical music and also pipe organ music. The uses of expansion on organ music adds something that makes it very realistic.

The compressor is used to illustrate to the customer the effect of compressed broadcasts. It also makes a very good audio A.V.O. which prevents overloading of the amplifier when using it to test audio circuits, when the level of the signal is unknown.

THE "EYES"

The action of the expansion and compression can be noted visually as well as audibly. A 6E5 tuning eye is connected to this circuit and is biased with resistor R15, Fig. 4, so that with no action it remains halfway between open and close. As the voltage for expansion builds up, the eye opens more, indicating expansion. Also, as the voltage for compression builds up, the eye begins to close. The entire action of the expander - compressor circuit and the eye indication is switched from one to the other by a double-throw triple-pole switch located just under the meter in the center of the amplifier panel.

Another 6E5 tube is used as output indicator. It not only indicates the volume level but is also very valuable in using the amplifier to check the frequency response of other audio units.

CHECKING RESPONSE

To check response, the first step is to set the amplifier tone controls so the

---

Fig. 4. Schematic circuit of the Amplifier-Testing Amplifier.
response is flat. The input of the amplifier is then connected to the output of the instrument to be tested. An audio oscillator with a flat response (such as the RCA type 104) is connected to the input of the instrument to be tested. Then, by merely turning the audio oscillator over its full range, the response of any audio unit can fairly accurately be determined.

This method makes it practical for the Serviceman to test the response of any unit. With the usual voltage plotting method, it takes so long that the Serviceman is reluctant to make the test; and, the cost is prohibitive.

This amplifier was to be used on a service testing panel and, therefore, 4 of the inputs were wired to plugs that plug into 4 input jacks located on the rear of the chassis. The 5th input circuit is wired to a jack located in the lower-right-hand corner of the front panel. This input is used with a shielded lead and probe to check through audio amplifiers. All 5 of these input circuits are wired to a selector switch located on the extreme right in the middle of the panel. The connecting arm of the selector switch is wired to the 2 gain controls, R1 and R2, which operate in parallel.

**FIGURES 1, 2, 3**

The diagrams in Figs. 1, 2 and 3 will more fully explain the uses of the various input circuits.

Figure 1 shows how the amplifier is set up to test the approximate audio response of other amplifiers and audio units. If a more accurate check is desired, an A.C. voltmeter may be connected to an output tap of the amplifier terminated with the proper load resistance.

Figure 2 illustrates the permanent wiring of the audio oscillator into the test panel. This arrangement is used to test speakers, cones and cabinets for resonance effect.

Figure 3 is also wired permanently into the test board. When the input selector switch is set at No. 3 and No. 4 the amplifier supplements channel-testing instruments by taking the place of headphones ordinarily used to listen to the signal on the channel tester.

A good 12-in. speaker with plenty of baffle is connected to the amplifier. This makes a much better “listen check” of a signal than you get even with crystal phones.

The input of the amplifier (see schematic diagram, Fig. 4) is divided into 2 channels. One is a 6C5. The other is a 6C5 into a 6L7. The output of both channels is wired to a single-pole double-throw switch. For average use the single 6C5 triode stage is used. For special uses (such as expansion or compression) the 6C5 - 6L7 stage is used.

**TONE CONTROLS**

The output of this switch is wired to another 6C5 stage which operates normally with a gain of 1. This stage makes up a special tone control circuit recently developed by the Thordarson Co. The 2 tone controls used in this stage are located 2nd and 3rd from the lower-left of the panel. Note the scale reads from 0 either to the left or right. This 6C5 tone stage has a flat response with the control set at 0. By rotating the controls to the left the high or the bass frequencies may be independently boosted as desired. By rotating the controls to the right the highs and bass may also be independently attenuated.

A third tone control located in the lower center of the amplifier panel is a resonant circuit control. It is used to lower the hiss frequencies, such as record hiss, without completely attenuating the hiss. With the values given it resonates at about 2500 cycles.

The 6C5 tone stage is capacity coupled to a 6C5 driver stage. The plate of this tube is fed through resistor R-31. The signal is capacity coupled to the special push-pull input transformer.

Probably the most popular output tube today is the 6L6 or some of its variations in the beam tube line. There are many (Continued on page 573)
Build Your Own Experimental

ELECTRONIC ORGAN

We believe that Radio-Craft readers will be exceptionally interested in the following concise description of a practical and experimental "Type 1" electronic organ. The author's instructions include information as to the sources of various component units which the constructor may not wish to make.

W. K. ALLAN

MANY Radio-Craft readers would enjoy playing an electronic organ, but cannot afford such an instrument. If you would, why not build one? You will then have the pleasure that an organ of your own can bring. Moreover you will gain experience which will probably be of profit if the present development of electronic music continues. Here's how to make an electronic organ of your own that incorporates as many of the features so far developed in this field as you may wish to include.

BIBLIOGRAPHY

From audion oscillator organs suggested in The Electrical Experimenter over a score of years ago, Gernsback publications have given many excellent descriptions of electronic organs; for example, Science and Invention, Feb. '28; and, Radio-Craft issues of Jan. '31, Apr. '35, Apr. '37, Apr. '38, Apr. '39, and May '39. The fact that relatively few constructional articles have appeared is the excuse for this one, which will use as a guiding theme the fundamental principle that most amateur constructors have little cash and must use second-hand parts frequently perverted from their original functions.

Electronic musical instruments might be classified according to their method of generating and picking up tone:

1. Vibration and Acoustic pick-up, e.g., Magnetone, contact mikes.
2. Photoelectric pick-up, e.g., Photona, Trillion Tone.
3. Electrostatic pick-up, e.g., Orgatron, Eletone.
4. Electromagnetic pick-up, e.g., Hammond, Robb Wave, Story & Clark.

The merits of the Reed Vibration or Acoustical Pickup type of electronic organ here described are as follows:

ADVANTAGES
1. Separate reeds produce a true ensemble effect not found in electric (not electronic) organs of the mechanical type.
2. Cheapest type to build.
3. Easiest type to build.

DISADVANTAGES
1. Slow attack.
2. Absence of flute tones.
3. Slight action unless magnetic reeds are used.
4. When the swell pedal is open and no notes are sounding, the suction may produce a slight sound in the loudspeaker.

Various elements in the experimental electronic organ suggested by Mr. W. K. Allan.

Fig. 11. Console, speakers and piano. The depression of 51 central keys in the solo or top manual is due to the wind reservoir touching them when the organ is not operating. See illustration of reservoir, Fig. 2.
With the possible exception of Type 4, organs using these methods may be built by the home constructor. As an example, here is a description of Type 1, or . . .

**VIBRATION AND ACOUSTIC PICK-UP**

Reed Organ; Windchest.—A search of attics, cellars, 2nd-hand furniture shops, and music stores generally yields an old reed organ. Since the commercially-available electronic organ compass is 5 octaves from C₂ to C₇, or 61 notes, plus a lower octave for pedals (and constituting the pedal clavier), making 73 notes, be sure to get a 6-octave C to C organ which comes in a piano case and not the common 5-octave F to F harmonium.

Replace the bottom of the windchest (where the bellows are attached) with a sheet of tempered presdwood or ma-sonite ¾-in. thick, Fig. 1. You will need a wind reservoir (with spring side) but not the bellows. Retain the swell shutters to deaden the sound.

Rest a contact mike (the $6 Amperite high-impedance unit was used) on the presdwood near the highest notes. Do not fasten with adhesive as suggested in the instructions with the mike, but apply weight to the rubber portions of the mike until the required inertia is obtained to make the bass response sound like a pipe organ. This weight must touch only the mike; Fig 2 shows the presdwood sounding board, mike with weight removed (visible beside it), and smaller reservoir bellows replacing original reservoir. (If the reed organ were not included in a console but kept in its original state, the presdwood would be on the bottom with the mike resting on it inside the windchest.)

Four or 5 stages of resistance-coupled amplification are used. A 2-stage pre-amplifier starting with a 6JT feeding into the audio system of a good broadcast receiver is fine, or into a Wurlitzer amplifier (see July '39 Radio-Craft) as is used by the writer.

**Suction Source.**—Suction source is the silent, motor-driven bellows, with relief or spill valve, requisitioned from a discarded reproducing piano. Figure 3 is a view with the side removed. In searching for one, include amusement concessions.

A centrifugal turbine, Fig. 5, is easily built but must be placed some distance from the console, unless the motor is suspended on springs with shaft vertical and the whole is well enclosed. The turbine wheel, Fig. 6, may be made of wood, about 8 ins. in diameter for a 3,500- r.p.m. motor and 16 ins. for a 1,750 r.p.m. with radial vanes like a vacuum cleaner separated ¾-in. from a plane surface in the center of which is the hole for suction. A vacuum cleaner is a poor choice—too noisy. A ½-in. radiator hose, or cardboard mailing tubes split with friction tape, will carry suction.

**Swell Pedal.**—A foot-operated volume control or swell pedal is needed. The one made for use with the contact mike would doubtless do.

However, the writer revamped an old projection machine fader by rearranging all resistors in order and adding 1½ gears from a telephone magneto, as shown in Fig. 7. An external series resistor prevents the sound from the speaker falling below the level of the sound escaping from the console.

A contactless, stepless, inductive swell pedal used on the Robb Wave Organ consists of a 60-cycle transformer with a stationary air-core primary and movable secondary attached to the swell pedal, so that varying the position of the pedal, varies the induced voltage in the center-tapped secondary. This voltage is rectified by a A.V.C. tube (6H6, 80 or 75), and after smoothing by a resistance-capacity filter, is fed to the injector grid of a 6L7 in the preamplifier.

**Pedal Clavier.**—A pedal clavier could be made by a woodworker for dimensions given in "The Contemporary American Organ" by Dr. Wm. Barnes; but first consult the nearest organ builders.

You may be able to get a pedal-board that is not quite standard, e.g., not 32-note compass or non-radiating or not resonant, for about $5. Contacts can be made from bronze weatherstrip and contact wire, obtained from the organ builder. See Figs. 8 and 9. Addresses of organ manufacturers may be obtained from the advertisements in The American Organist or Diapason magazines.

**OBTAINING USED PARTS**

With so many theatres having allowed their organs to fall into hopeless disrepair, and churches enlarging or rebuilding their organs, it is rather easy to pick up used parts.

**Manuals.**—The writer has obtained used 58-note C to A manuals for $5; and 61-note C to C manuals, for $7.50, from (Continued on page 550)

---

![Fig. 4. Front view of console showing suction supply and rods from extensions on rear of key to more closely-paced reed pallets.](image-url)
The practical information which the radio Serviceman needs to enable him to sell, install and service marine radio telephone equipment is contained in this article. Note that the station must be licensed, and that preliminary transmitter adjustments and tuning must be made by a 1st Class or 2nd Class commercial operator.

A PREVIOUS article in Radio-Craft entitled "Marine Radio Telephone, Latest Field for Servicemen," which was published in September of 1939, gave Servicemen an introduction to the subject of low-powered radio telephony in what the Federal Communications Commission refers to as the "ship harbor" service.*

Briefly to reiterate, there are now low-powered, compact transmitter-receiver combinations on the market which can be installed in boats even as small as 18 feet, making possible telephonic communication between ships, with the Coast Guard, and from ship-to-shore for distances of hundreds of miles. Contact with the shore is established through "coastal harbor" stations of the Bell Telephone System and of independent companies at strategic points along the Atlantic and Pacific Coasts and along the shores of the Great Lakes. Connection is made with the land lines and 2-way conversations may be carried on between boats and telephone subscribers anywhere in the world.

PROSPECTS
The chief use of coastal harbor radio is in the control of harbor and coastwise craft by direct telephonic contact with their dispatchers. Tug boats, tankers, and trawlers which were not compelled under the Government regulations to carry a radio telegraph set usually did not do so because of the cost of the equipment and the expense of hiring an operator. Now for an expenditure of only a few hundred dollars per vessel, the owners of these boats can obtain not radio telegraph but radio telephone equipment by which they can keep in constant direct contact with the captain; and the Government has made it easy for the captain himself or any member of the crew to obtain a license to use the equipment. This license, formerly known as the 3rd Class license, is now known as the Restricted Operator's license and can be studied-for from multigraphed notes prepared and issued by the Federal Communications Commission.

Since the cost of running a tug boat or tanker may be of the order of $35 to $50 an hour it is evident that every commercial fleet owner should be a prospective customer. One single timely phone call to a boat by the dispatcher may save enough of the boat's running time to pay for the set—and leave plenty over!

In the fishing field the radio telephone offers contact between agents and their trawlers, so that the boats can be called in when prices are highest; and told to remain out when prices are low. A smart independent owner-captain of a radio-
equipped trawler will telephone the fish markets in several harbors and take his catch where the prices are highest.

In the realm of sport fishing, many owners of individual charter boats and open party boats sailing out of sport fishing localities have come to realize that by cooperating with their competitors in locating schools of fish, more fish are caught by all, which means a larger crowd of fishing enthusiasts drawn to the locality as a whole. Then there are those in a fleet who, wary of their competitors, locate the fish and summon other fleet members by secret code.

Then there is the private yachtsman who uses the radio telephone as a convenience, communicating with home or office while on a vacation.

Lastly, there is the all-important feature of safety for all boat owners. In the event of an emergency the Coast Guard can be summoned. Last Summer an injured sailor was removed from a trawler by a plane summoned by radio telephone. In less dramatic cases Coast Guard boats have willingly lent their assistance in pulling yachts off shoals upon which they had become fast. In another instance a tanker’s engine broke down and repairs were made at sea under instructions from the home shipyard.

MR. SERVICEMAN

Returning to the Serviceman’s prime interest, after the sale has been made, we have the equipment itself and then the installation. Installation of marine radio telephones may be taken up under 7 different classifications, namely:

(A) Wiring to the Ship’s Voltage Supply
(B) The Aerial
(C) Placement of the Set
(D) The Ground
(E) Noise Suppression
(F) Tuning the Set
(G) Planning the Job

Stock equipment offered by various manufacturers runs in power output ratings of from 5 to 600 watts. There are relatively few sets over 100 watts sold, mainly because of cost and necessary available input power. The trend of popularity this year seems to be toward a 25-watt set, since this size seems to offer the most in range for low cost, small dimensions, ease in operation and low input power.

A number of different methods are commonly employed, in conjunction with different makes of sets and different models, to convert the ship’s direct current supply to the proper voltages for operation.

Dynamotors have often been used to supply the high voltage for the transmitter and even the receiver. However, sets of this type are costly to build since heater and control circuits must be different for every type of ship’s voltage encountered.

Rotary converters are in wide use on sets of 15 watts and over. The advantage is that the sets then are made for 110 volts A.C. regardless of ship’s voltage, cutting production costs and making service easy. The disadvantage is poor power efficiency, particularly in the “Receive” position, and the necessity of selling an elaborate installation.

Vibrapacks (vibrator, step-up transformer, and filter system) have been in use for some time on very small sets and have since become available in sizes large enough for sets of 25 watt output. They have the advantage of low power consumption, silent operation, saving of space, and a minimum of installation necessary. Many are equipped with 110-volt A.C. windings, so that the sets can be serviced on the bench without the need of storage batteries. The one disadvantage of vibrapacks—sudden failure as against the gradual failure of a generator or converter—has been minimized by the fact that vibrators are now built with a life of from 2,000 to 5,000 hours; and also by the fact that the heaters and pilot lights in the most modern sets are also built through the pack so that failure of the vibrator may be discerned at once through failure of the heaters and pilot lights to come on.

(A) WIRING TO THE SHIP’S VOLTAGE SUPPLY

The first problem to come up in connection with any installation is that of the ship’s power supply. The ship’s supply is always D.C. except in a few instances where gasoline-driven alternators are used for the radio equipment.

Voltages are 110 or 32 on fairly large passenger and commercial craft, with a preponderance of 32 V. on Diesel-powered tug boats and trawlers. Private yachts have 6- and 12-volt supplies when gasoline-driven but larger gasoline boats have a separate 32-volt lighting system. Certain foreign Die-

Fig. 4. A 25-watt Marinephone installed aboard the yacht Vesta. It serves to emphasize the importance of neatness in marine radio telephone installations.

Fig. 1. Alameda, a bridge deck type of cruiser has a Marconi-type antenna roughly of the inverted-L type. Wires (arrow, 1) run forward from each corner of the canopy at the stern and join at mast-top, whence a lead-in (arrow, 2) drops to the cabin. (Generally the lead-in is not doubled-back.)

(Continued on page 566)
In Part I of this series, which started in the January, 1940 issue of Radio-Craft, an elementary description of Microphones, and their capabilities, was given. In Part II (February Radio-Craft) the general characteristics of Loudspeakers, and their housings (Baffles, Horns, etc.), were described in elementary fashion for the beginner in public-address work. This month instead of discussing Amplifiers as originally planned, the placing of sound equipment will be described; it is planned to present the concluding article on Amplifiers in the April issue of Radio-Craft.

The article which follows will describe the general installation problems in connection with sound equipment in Churches, Mortuaries, Ballrooms, Auditoriums and Stadiums.

SOUND IN CHURCHES

It's easy for you to choose the best sound system for your church. Simply decide which of the 5 diagrams (Figs. 1 to 5, incl.) most nearly conforms to the shape of your church. Then turn to the listing of "Recommended Equipment" and you'll find the proper size amplifier and correct number of speakers specified.

For instance, if your church is about square, use the diagram No. 1. Then if your church seats approximately 1200 people, you'll find that one 30- or 40-watt amplifier with 4 speakers in Wall Baffles is recommended for churches seating from 800 to 1,800 people. You can always use a larger, but seldom a smaller amplifier than recommended.

Mikes, speakers, phono attachments plug into the amplifier like an electric table lamp plugs into a light socket.

If your church has a balcony, or if you want Chimes for your church, see the data below.

If you want extra loudspeakers in Sunday School, social or overflow rooms accommodating less than 250 people, use 1 speaker in each room, and 1 speaker for each group of 250 people in larger rooms. Use volume controls for individually adjusting the volume of speakers in separate rooms.

Churches located where extreme noise conditions have to be contended with, or churches with unusually high ceilings, may require the next larger size amplifier than recommended. This is not likely, however, except in rare cases, if the amplifiers are conservatively rated.

Your sound system can be used for beautiful Chime music by installing one or more speakers in the belfry and connecting a Record Player to your amplifier. Use speakers mounted in Projectors or Trumpets, and point in any direction or directions. A 60- to 75-watt amplifier with 4 Trumpets covers a 1- to 2-mile radius around your church. A 30- to 40-watt amplifier with 4 Projectors covers a ½- to 1-mile radius (depending on street noises). For shorter distances use a 25-, 24-, 22- or even a 20-watt amplifier.

If you use the amplifier for both Chimes and indoor sound, order the larger amplifier, either the one specified for Chimes, or the one recommended for church interior. Example: If the recommended amplifier for church interior is 25 watts, and the proper amplifier for your Chimes is 40 watts, then the 40-watt job is ample for both. Also amplify organ music, services or play any records.

The seating capacity of a balcony should be included in choosing the power of your amplifier. If you require only 2 speakers, no special provision for the space under the balcony is usually necessary.

If, however, the seating capacity including the balcony requires 4 or more speakers, we suggest that half the number of speakers recommended be mounted in horns (Projectors or Trumpets). This permits directing the sound more effectively towards the audience under the balcony.

In long narrow churches without balconies use horns; but if your church is of this shape and also has a balcony it will not be necessary to add additional horns except in unusual cases.

The value of sound equipment proves itself when appropriate organ or chime music is played as the funeral cortège enters and leaves the grounds. Then too, sacred twilight and Sunday concerts are becoming increasingly popular in many communities.

Equipment needed is the same as for Chime Systems. The amplifier and Record Player can be located in the office or any convenient room, with the Projectors or Trumpets mounted on the roof, preferably in a grilled enclosure of some kind to protect them from the weather.

A sound installation for a cemetery is just as simple as any other sound system. If your cemetery is not wired for electricity, use convertible amplifiers.

(Continued on page 563)
DEDICATION ceremonies were held last month at the new Allison Park, Pa., home of KDKA, 19 years and 2 days after it broadcast the world's first scheduled radio program, with only 0.1-kw. power, on what was destined to be the inauguration of the Radio Broadcast Industry as we know it today. Radio-Craft extends its very best wishes, and hopes that the eventful and illustrious pioneer past of "old KDKA" foreshadows an equivalent frontier future success for "new KDKA," here illustrated.

(Continued on page 552)
Converting a 5-inch Telly Kit

FOR RECEIVING A 9-INCH IMAGE

Here's a plan for building a "5-inch" television receiver from a standard kit, becoming familiar with its operation, and then making the necessary changes so that this basic kit may operate a 9- or 12-inch Kinescope! Viewing is thereby greatly improved. It's probably the least expensive way so far suggested for obtaining a virtual 9- or 12-inch teleceiver.

4 NEW SECTIONS

The photos above show that 4 new sections have been fastened to the main chassis.

Looking at the set from the front we see on top a wooden box which holds the 9-inch tube and deflecting yoke.

On the right side there is a 2-stage image (pix) I.F. amplifier, and on the left side are the sweep output transformers to match the deflecting yoke; we see also, the horizontal damping tube, and a row of sweep controls.

At the extreme rear we have enclosed a high-voltage power supply which delivers 7,000 volts at 1 milliamper to the 9-inch tube.

We wish to point out here that the 12-inch RCA Kinescope may be substituted for the 9-inch tube with absolutely no electrical changes required!

Some readers may not care for the given arrangement of these 4 sections. It is possible, too, that some readers may want to use a 12-inch tube with mirror viewing, which would alter the layout. For high-definition television reception it is imperative that the wiring and stray capacities be held down to an absolute minimum; all unavoidable capacities then should be accurately known, and counterbalanced if possible. This important factor should be kept in mind when any alterations in layout are attempted.

CONSTRUCTION—UNIT NO. 1

Prepare the small image I.F. chassis from the drawing (Fig. 2). Drill all holes exactly as shown and have your local tinsmith "fold" the bends indicated on the sketch. The 2 sockets, the 2 image I.F. transformers, and the sound-trap, are now assembled. The blue dot on each I.F. transformer should point toward the loudspeaker at the front panel.

The signal sequence is given in Fig. 3; and the schematic circuit of the complete image I.F. channel is shown in Fig. 4. It will be necessary to drill a 1/4-in. hole for each of the 4 grid leads in the side of the main chassis. Next, proceed to wire-up the small chassis, leaving the grid wires off until the small chassis is fastened to the main chassis. Run a twisted pair of filament leads from the Sync. Separator socket to the 2 sockets in the small chassis. Run a "B-plus" lead from the main chassis to the terminal strip in the small chassis and also solder a ground lead from the main chassis to the small one. Now solder the grid leads in proper order, and as short and direct as possible. The plate leads, the grid-return leads, and the grounded connections should be checked against the schematic of Fig. 4 and the signal sequence of Fig. 3. The values of all resistors must be as shown, otherwise the combination of sensitivity, stability and band-width will be upset.

REALIGNMENT—WITH 5-IN. TUBE IN PLACE

Having completed this stage of the conversion the next
step is to realign the image I.F. channel while still using the 5-inch tube. Alignment of wide-band television I.F. amplifiers is a difficult and tedious task even when all necessary equipment is available, as fortunately it was in the writer's case.

For example, the development of the present circuit required the use of a $500 Standard Signal Generator, an Impedance Bridge, a sensitive Vacuum-Tube Voltmeter, a 10,000-volt Electrostatic Voltmeter, a Television Alignment Wobbler, and an Oscilloscope.

However, the only equipment actually required in the realignment process is a fairly good shop oscillator, and a V-T.V.m. with low input capacity and range from 1 to 10 volts. A few sheets of square graph paper should be prepared as shown in Fig. 5. The ideal response curve is shown in Fig. 6. Five important items should be kept in mind during the alignment process:

1. Always start aligning at the last I.F. stage feeding into the image-detector cathode circuit. The V-T.V.m. is connected between ground and the junction of the 2 chokes in the image-detector cathode circuit.

2. Be sure to disconnect the grid lead of the preceding I.F. transformer as otherwise resonant effects of the grid winding will upset results.

3. Measure and maintain a constant bias of 2 volts on the stage being aligned.

4. Maintain the signal generator output constant, at say 50,000 microvolts, through the range of 7 to 15 mc. on the stage under alignment. Reduce the signal generator output, from stage to stage, but leave the bias setting of the I.F. amplifier at 2 volts throughout.

5. When through aligning a stage reconnect the grid lead and disconnect the preceding one. The mixer-tube grid must be disconnected and a 10,000-ohm resistor connected in series, as described in the Meissner instruction sheet.

ALIGNMENT—WITH 5-IN. TUBE REMOVED

Since the addition of 2 stages to the image amplifier modifies the bandwidth to 4 megacycles the following details must be strictly adhered to.

1. Disconnect the high-voltage primary and remove the 5-inch tube. Place the set upside-down on the work-bench. Do not align the set on a metal surface such as a kitchen table.

2. Connect the V-T.V.m. across your shop oscillator (previously warmed up) set at 11.5 mc., and adjust the attenuator to 100,000 microvolts (equal to 0.1 volt) as indicated on the V-T.V.m. Now, shift the frequency of the oscillator from 8.25 mc. up to 14.25 mc., and note where the oscillator output varies, and how much. It will then be necessary to check, and set, the oscillator output each time the frequency is shifted.

Having re-set the oscillator to 11.5 mc. and 100,000 microvolts, shift the (Continued on following page)
(Continued from preceding page)

V-T.Vm. to the junction of the 2 chokes (No. 15-7501) and chassis. The oscillator is fed to the grid (No. 4 pin on each socket) of the 4th image-amplifier tube, connect a 5,000-ohm resistor from grid to chassis, temporarily. The ceramic trimmer is loosened all the way on the 5th image I.F. transformer, and the plunger screws are turned all the way out, until a single peak is obtained at 11.5 mc. Note the V-T.Vm. reading, and mark the graph paper at 11.5 mc. and 100 per cent. Now, shift the oscillator frequency to 9 mc., set the attenuator at 100,000 microvolts, and slowly screw-in the ceramic trimmer until the V-T.Vm. reads as before. We now have 2 peaks in the resonance curve; the valley between peaks is found by shifting frequency from 9 to 10 mc., noting the reading on the graph, shifting from 10 to 11 mc., and marking the graph, and finally, shifting to 11.5 mc. When the 2 peaks have been made equal the alignment of this stage is completed.

Disconnect the oscillator and 5,000-ohm resistor, reconnect the grid lead, and disconnect the grid lead on the 3rd image-tube. Connect the 5,000-ohm resistor from grid to chassis as before. Reset the oscillator output to 50,000 microvolts and the frequency to 11 mc. Loosen the ceramic trimmer on the 4th image I.F. transformer and turn the plunger screws about half-way in until one peak shows at 11 mc. Shift frequency to 9.5 mc. then slowly screw-in the ceramic trimmer until the same reading appears at 9.5 mc. The overall graph will show about 15 per cent dip in the valley between peaks. The alignment of this stage is now done.

We shift now to the 3rd image I.F. transformer and 2nd image-amplifier tube. Proceed as before, but reduce the oscillator output to 25,000 microvolts. Turn the ceramic trimmer out all the way and the plungers nearly all the way in. Set the oscillator to 10.5 mc. and obtain maximum reading on this peak. Screw-in the ceramic trimmer and obtain the same reading at 9.5 mc. The valley between peaks now wiped-out and the response should be flat, or nearly flat, between 9 and 11.5 mc.

We proceed now to the 2nd image transformer and 1st image-amplifier tube. Set the oscillator to 12. mc. and 10,000 microvolts.

Incidentally, in order to reduce attenuator output and still get fair accuracy, use a voltage divider consisting of a 900-ohm and 100-ohm carbon resistor across the output posts. This will reduce the input voltage to the set to a value 1/10 that across the attenuator posts at the generator. Thus when the V-T.Vm. reads 0.1 volt across the total resistance, the voltage at the junction of the 2 resistors will be 0.01-volt.

Unscrew the ceramic trimmer all the way, and unscrew the plungers ¾-out, until one peak shows at 12 mc. Screw-in the ceramic trimmer until the 2nd peak appears at 8.76 mc.

Now take an overall response curve from 8 mc. to 14 mc., in 1-mc. steps, on the graph paper.

The curve should show 50 per cent response at the carrier frequency of 12.75 mc., 100 per cent response at 11.5 mc. straight across up to 8.75 mc., and drop abruptly to zero at 8.25 mc. The sound-trap should be set for maximum attenuation at 8.25 mc. and the adjacent channel-trap set for maximum attenuation at 14.25 mc. Slight retouching of the plunger screws may be necessary to get the best response curve. In this respect a graph record of each stage's response would be helpful in locating the weak point on the curve and the proper plunger to adjust. The alignment of the image I.F. channel is now complete. Where do we go from here? Next is the comparatively simple job of aligning the sound I.F. channel.

(Continued on page 554)
The Question . . .

I have an amplifier which I wish to rebuild to one of higher gain and with more inputs, without adding too many transformers.

Will you kindly send me a sketch concerning this? I wish three microphone inputs and one phono and would like to use 3-6SJ7 tubes in the input stage, followed by 6N7's or 6Y7's, and in the final, 6L6's.

What would be the best inexpensive output meter for above, for use across a 500-ohm line?

M. H. CANDEE
Candee Radio Shop
Pasco, Wash.

The Answer . . .

Figure 1 gives a circuit diagram of a 9-tube, 25-watt, high-fidelity amplifier, which fulfills your requirements. Three 6SJ7's are used for microphone preamplifiers. Two 6SC7's are used for electronic mixers for the 3 microphones, as well as for 1 phonograph input. A 6N7 balanced inverter provides a push-pull signal for a pair of 6L6 output tubes.

It will be noted, that a no-bias circuit is employed in the input stage. This circuit eliminates the necessity of using cathode resistors and bypass condensers. It also eliminates all sources of hum associated with the use of these components.

The 4-position electronic mixer provides for independent control for each one of the 4 inputs without affecting any of the others.

It will be noted that a master volume control is incorporated ahead of the grid of the 6N7 inverter. The self-balancing inverter employs feedback by using a common grid-return resistor in the amplifier is increased. Similarly, when the control is set at the opposite end, the 0.003-mf. condenser bypasses the 1.5-megohm feedback resistor to increase the amount of high-frequency feedback, which, in turn, cuts the high-frequency response of the amplifier.

A separate 6-volt 1½-amp. filament winding is employed to heat the three 6SJ7's and two 6SC7's. It will be noted that one side is grounded, as this arrangement produces less hum than the conventional center-tap-to-ground circuit.

Complete information on how to make a calibrated volume indicator, will be found in the December, 1939, issue of Radio-Craft, pg. 343, "How to Add 1 to 14 Modern Features to the All-Push-Pull Direct-Coupled 30-watt P.A. Amplifier."

The Question . . .

As per your announcement in November Radio-Craft, I am submitting my P.A. headache.

I own a United Sound Engineering amplifier, rated at approximately 30 watts. I am unable to give you a circuit diagram of this model, as the original manufacturers are no longer in business.

The main kick on this amplifier is lack of gain. I understand this job never had sufficient gain and I would like to know if there is some more or less simple method for increasing its gain.

I can get pretty good results if the gain controls are on full, but this, also, increases hum, so that it is very

(Continued on page 569)
NEW CIRCUITS
IN MODERN RADIO RECEIVERS

The details of the modern radio receiver circuits that make them “different” from previous designs are illustrated and described each month by a well-known technician.

F. L. SPRAYBERRY
NUMBER 30

(1) TUNING INDICATOR FOR FREQUENCY MODULATION RECEIVER

Stromberg-Carlson Model 480—(Fig. 1). For an R.F. or I.F. signal of constant intensity such as we are dealing with here, obviously we cannot use the usual type of resonance indicator. An entirely new and novel approach to this problem has been used in this receiver. The circuit is shown in Fig. 1.

In accordance with the operation of the usual frequency discriminator circuit, the ungrounded cathode, U, of the 6H6 discriminator will remain at ground potential at exact resonance, will become positive as the I.F. signal falls below resonance with the circuit and will become negative as the I.F. signal rises above resonance of the circuit. Although in a frequency modulation receiver the frequency is rapidly shifting through wide values, the average voltage at U will be zero only when the tuning is correctly centered with respect to the signal.

While the A.F. is taken from this point, there is also added a filter for the resonance indicator circuit. This filter consists of R and C. Point V is therefore at the average potential of U, the A.F. being filtered out.

When the signal is above resonance of the I.F. amplifier point V becomes negative with respect to ground causing conduction in diode D1 and R1 resulting in point W becoming negative by the drop across R1. Grid W of the 6F8G becomes negative likewise and point Z of the 6F8G loaded plate becomes more positive. The ray control electrode in one side of the 6AF6G ray control tube is connected at Z and the shadow angle in one side of it decreases.

With the signal below resonance of the I.F., point V will have a positive D.C. value causing conduction through D2 and R2, making point X positive, by the drop across R2 and the X grid of the 6F8G likewise positive. Being in the 6F8G triode having no plate load, an increasing current will be drawn through R3 making point Y more positive; and with the W grid of the 6F8G unchanged here, the plate current of the loaded 6F8G triode will reduce as before with the potential of Z increasing, and the same shadow angle reducing.

At resonance, V will be at zero, causing zero voltages at W and X and a minimum voltage at Z with a corresponding maximum shadow angle. The other ray control electrode is used for indicating resonance in the amplitude modulation receiver.

(2) EFFECTIVE HUM CONTROL IN A.C.-D.C. SETS

Emerson Models CU-265, CULW-261-262-265 and 274.—(Fig. 2). An effective means of diminishing hum in these receivers is employed through introducing the hum component into the detector grid so that the amplified component will appear in reverse phase at the output.

The circuit as in Fig. 2 consists of a capacity-resistance divider C-R which introduces approximately 1/7 of 1% (about 1/600th of the total hum component from the rectifier cathode into the detector grid. This hum component is amplified approximately 600 times by the 12S5GT and 50L6GT and its phase is reversed twice (once by each tube), so that at the output plate it is again in the same phase as at the rectifier cathode. Since we have a hum component at the 50L6GT plate of the same

(Continued on page 549)
Servicing Puzzlers
Solved by the Use of Test Equipment

No. 3

In the recent Weston Contest, in celebration of the 50th Anniversary of Weston Electrical Instrument Corp., on "How Modern Test Equipment Helped Me Solve a Difficult Servicing Problem," many letters were submitted which have general interest as typical of today's servicing requirements. A third group of letters is presented here in the form of servicing notes which may prove of value in enabling the Serviceman to obtain the greatest possible usefulness from his test equipment.

Walter A. Cobb

- Poor Tone Quality. A Westinghouse WR 116 was brought in with poor quality of tone, with all voices raspy and guttural. After tubes and voltages were checked, all bypass, grid and coupling condensers were disconnected and checked. Since this set is A.C.-D.C. the chassis is isolated from the "live" circuit, yet a careful measurement with a Weston Model 772 Analyzer showed approximately 0.5-volt D.C. from chassis to "B-" leg. The D.C. resistance was 600,000 ohms and careful tracing showed the leakage to be caused by a cardboard filter condenser covering having absorbed moisture, allowing a leakage path to chassis. This trouble would not have been located with an old-type volt-ohmmeter.

- Intermittent Drop in Volume. A GE M-81 receiver used in a sick-room was received for test, to be returned the same day. Intermittently, the radio set would drop in volume. On the slightest provocation, such as a static impulse or the contact of the test leads, the set would snap on and play perfectly for a long time. This condition made ordinary test methods impractical. The only solution was to let the set operate with an oscillator feeding the input and a V.T.-VM. progressively connected to the various circuits to determine if the signal voltage at any point would drop simultaneously with the drop in volume when the set acted-up.

The first time the set dropped in volume, the V.T.-VM. was connected across the volume control and no deflection was noted when the receiver dropped in volume. This localized the trouble to the A.F. end. The only time I would devote to this set was when the audio signal in the speaker would drop. The following was the result of the readings taken at the intervals of volume decrease: Volume control—no change; grid of 75 tube—no change; plate of 75—change. The test also showed no A.C. voltage across the cathode resistor until a drop in volume would occur, indicating an intermittently-open 10-mf. cathode bypass condenser.

A. R. Davidson

- Intermittent Fading. A Majestic 290 receiver was brought in for fading, operating for days at a time, and then fading for a like period. All tubes, coupling and screen condensers were checked and found OK. No voltage changes on the fade. Finally a high-resistance voltmeter showed an intermittently-open A.V.C. condenser located on top of one of the shielded coils.

D. Harrington

- Intermittent Fading. A Majestic 290 receiver was brought in for fading, operating for days at a time, and then fading for a like period. All tubes, coupling and screen condensers were checked and found OK. No voltage changes on the fade. Finally a high-resistance voltmeter showed an intermittently-open A.V.C. condenser located on top of one of the shielded coils.

- Insensitive on Sections of Shortwave Band. A Philco 116 X receiver was found to be very insensitive on sections of the shortwave band. All the voltages and resistances were checked with the factory wiring diagram and found within normal limits. Adjustment of the set was tried, but still it would not function properly. Condensers were checked and found OK. A sensitive ohmmeter was used to locate a high-resistance leak, caused by humidity, in the tuning condenser from the stator of the oscillator plates through the insulators to the ground.

Robert H. Douglas

- Fading After Short Operation. The radio set under consideration was a Fada 42. Fading persisted after checking of usual parts causing such trouble. A Weston Model 772 Analyzer was used for checking of all tube voltages and currents. (The set uses a 27-type diode detector with a detector amplifier, for A.V.C. action on the R.F."

Readings showed that the A.V.C. tube current increased gradually after the set was turned on, and the controlled R.F. bias increased with this A.V.C. action. Also, the filament voltage on all tubes was slightly high. After rechecking resistors for change in value, the filament voltage was considered.

In this section, line voltage runs about 130 V., A.C. The transformer voltage switch was in the High position so there should have been no trouble from that source, but the low scale of the 772 ohmmeter showed less than 54-ohm across the switch terminals. The low voltage tap was disconnected from the switch and the fading ceased. The switch was shorted internally.

My theory is that the high filament voltages increased the signal through the R.F. tubes to the A.V.C. tube and also caused the A.V.C. tube to abnormally bias the controlled tubes because of the greater rectified current as the cathodes heated.

Howell B. Axtell

- No Volume and Distortion. This complaint was made on an older radio set, a Model 290 Majestic having A.V.C. and interstation noise suppression. A quick check with a 1000 ohms/volt meter revealed that the coupling condenser between the 57 1st audio and the type 47 output tubes was leaking. After replacing the condenser, the set played just about the same as before.

Further voltage measurements indicated very little due to the high-resistance circuits employed in detector and A.V.C. One clue to the trouble was apparent when the volume control was advanced from minimum to maximum. At or near minimum the set played weakly, but as the control was advanced, the signal disappeared entirely. In circuits of this type, where the average meter renders any reading useless because of the comparatively large current necessary to operate the meter, the use of a supersensitive voltmeter is imperative.

The sensitive meter immediately showed that the type 57 1st audio grid voltage assumed a higher negative bias as the volume control was advanced. Finally this voltage reached a value sufficient to bias the tube to cutoff. Actually the faulty part was the coupling condenser between the 2d-detector diode load resistor and the 57 tube's grid. The condenser was leaking enough to impress a negative potential from the A.V.C. buss on the 1st audio grid.

John W. Nicholls

- Occasional Popping Noises. An RCA 9715L was brought in with an unusual complaint of occasional popping noises at infrequent intervals sounding like static discharges from metal structures to ground.

After isolating to A.F., I applied A.F. surges (400 cycles) stage by stage, noting output on a db. meter. It proved to be the driver transformer which operates with no D.C. in primary. The A.F. is fed through coupling transfer condensers from preceding stages. Putting D.C. through the primary, an ammeter gave another check showing intermittent jumps in current.

Omar A. Bean

- Weakening Volume Until Signal Inaudible. After about 5 minutes of normal operation, a Philco 37-116 receiver would begin to weaken in volume until the signal became inaudible. Retuning would bring in the signal, though several kilocycles off calibration. This peculiarity would develop only on the Broadcast band with the Magnetic Tuning switch in the "off" position. All

(Continued on page 575)

RADIO-CRAFT for MARCH, 1940
THREE especially notable advances in oscillator design will be described with the thought that they will be of service whenever a source of radio or audio frequency voltage having improved stability from frequency drift is required, such as in superheter receivers, service oscillators, beat-frequency oscillators, electronic musical instruments, amateur radio stations, etc.

**LAMPKIN “RELATIVE IMPEDANCE” OSCILLATOR**

Circuit No. 1.—The 1st development to be considered is generally attributed to G. P. Lampkin, though his work is supplementary to that of F. B. Llewellyn who is responsible for much of the basic research in stabilized oscillators. Mr. Lampkin’s development is dependent upon well-known principles of the relative magnitudes of impedances in tube circuits. In the Proceedings of the I.R.E. for March 1939 he explains—“A useful concept in regard to stability of oscillators is that of relative impedances. An oscillator in general consists of a tube exciting a tuned circuit. The frequency of oscillations depends upon the net impedances of the tube and circuit in combination. The impedance of the tuned circuit itself very nearly can be fixed, since it depends chiefly on physical dimensions. Then any method which will minimize the impedance of the tube relative to that of the circuit will result in greater stability. This will be true for variations from tube to tube, for variations in a given tube due to changes in temperature, operating voltages, physical dimensions, and aging, and for variations in load applied throughout the tube.”

The above concept can be applied directly to most crystal-controlled oscillators in which the crystal functions at series resonance. The tube capacity lies in series with, and is several hundred times larger than the equivalent resonant capacity of the crystal. Any change of capacity in the tube appears, in the combination, reduced by the ratio of crystal-to-tube capacity and thus can vary the oscillation frequency only slightly. In the well-known hi-C oscillator, the tube capacity is effectively in parallel with a much larger lumped capacity so that changes in the tube are a relatively small part of the whole.

In Figs. 1A and 1B are shown methods whereby the tube impedance may be reduced relative to the circuit impedance. In 1A is shown a Hartley-type oscillator, with one side of the circuit grounded and the tube connected across the entire circuit in the usual way. In 1B the tube is tapped down into the coil and includes only a portion of the circuit. For the circuit of Fig. 1A the factor \( \frac{N2}{N1} \) is equal to unity (1). In Fig. 1B the same quantity can become as small as 0.05. The reduction applies not only to temperature effects but in general to all influences of the tube on the oscillator frequency.

As the tube is tapped down into the coil a point is reached where it tends to take off into parasitic oscillation at a frequency determined by the inter-element capacities and the included turns (only a part of the coil). Such oscillations can effectively be suppressed if a non-inductive resistance having a lower distributed capacity is connected in the grid or plate circuit of the oscillator.

It should be located close to the tube. The best value ranges from 50 to 25,000 ohms depending upon the frequency and circuit conditions.

**BRUNETTI “TRANSITRON” OSCILLATOR**

Circuit No. 2.—The 2nd development to be described is a new circuit known as the “transitron” oscillator. This oscillator is similar in many respects to the dynatron or secondary-emission oscillator which found favor a few years ago in radio receivers and testing equipment.

The trouble with dynatron oscillators was that they varied with aging of tubes. The result, of course, was variation in calibration over a period of time and eventually complete failure of the oscillator when the secondary emission from the plate dropped below a certain critical value.

In describing the “transitron” oscillator in the Proceedings of the I.R.E. for February 1939, C. Brunetti explained the following facts—“The solution of the difficulty with dynatron oscillators was supplied with the introduction of the triple-grid tube employing negative transconductance but it appears that not all are aware of this. It is not the logical tube to replace the dynatron since it has all the advantages of the latter without the disadvantages. It possesses essentially the same type of reactance characteristic of the dynatron but has the advantage in that its characteristic is independent of secondary emission and remains practically constant throughout the life of the tube. To this similarity is added the convenience that with only a slight modification of the circuit any triple-grid tube if originally employed as a dynatron may be converted to one displaying negative transconductance.”

A type 58 variable-mu pentode connected as a transitron is shown in Fig. 2. The voltage \( V_g \) is chosen so as to make grid No. 3 negative with respect to the cathode. Electrons repelled by the high positive potential of grid No. 2 (virtual anode) are repelled by the negative potential of grid No. 3. Thus grid No. 3 with its retarding field acts as a virtual cathode. A slight negative increase in voltage across terminals A and B is transmitted simultaneously to both the virtual anode and grid No. 3 causing the latter to repel more electrons and the net current to the virtual anode to increase. The transconductance between grid No. 3 and the virtual anode is therefore negative.

A current-voltage curve for the circuit of Fig. 2 is shown in Fig. 3. If the voltage \( V_2 \) is set at 86 volts a direct current of 5 milliamperes will flow. This
OSCILLATOR CIRCUITS

one of radio's bases—have been made in research laboratories results—piezocrystal setups, combined with compensating networks far be—especially notable advances in such oscillators are here described.

is illustrated by point 0 which is called the "operating point." At this point the slope of the characteristic curve is fairly constant. A small alternating voltage applied across A and B will cause an alternating current to flow 180 degrees out of phase with the voltage. This indicates that the voltage is working into a negative resistance.

By applying a small negative bias to grid No. 1 the total current flow to the anode may be controlled and the negative slope of the current—voltage characteristic may vary. A small negative bias will cause a decrease in the slope. A more practical circuit than that shown in Fig. 2 may be had by replacing the bias between grids Nos. 2 and 3 with a large condenser as in Fig. 3. The bias for grid No. 3 is then supplied directly from the cathode through the high resistance (1 megohm) in the circuit.

If a condenser in parallel with an inductance and its associated resistance is connected across terminals A-B of Fig. 2 the circuit will oscillate. Oscillations in the parallel "tank" circuit will begin when the quantity L/RC is just equal to the reciprocal of the slope of the current—voltage characteristic at the operating point. The quantity L/RC is approximately the parallel impedance of the "tank" or tuned circuit at the frequency of oscillation.

Under normal conditions the transitron oscillator will not experience changes in frequency of more than a few hundredths of 1 per cent for relatively large variations in the "B" voltage if the change in the tube capacity is negligible.

"A typical set of experimental data showing the operation of the transitron oscillator is given in Table I. These data are obtained using a type 68 tube with Vp=11 volts, V2=100 volts, Vg =-10 volts; C1=0.1 mf. and R1=1 meg. Voltage V2 is chosen so that the operating point falls near the center of the characteristic. The No. 1 grid is tied to the cathode. The anode and plate direct currents do not exceed 3 milliamperes. The minimum value of negative resistance is -2800 ohms."

"The upper frequency limit shown in Table I does not represent, by far, the highest frequency obtainable. It represents only the highest frequency at which a good waveform still obtains as shown by inspection on an oscilloscope. In all cases the ratio D=L/C is less than 30,000,000. If a good waveform were not a prerequisite the upper frequency limit could be extended considerably into the R.F. region, with the coils of Table I by additional reduction of C. If a good waveform is desired at still higher frequencies it is necessary only to decrease both L and C to keep the ratio L/C from becoming too large. With ordinary tubes the transitron oscillator will produce oscillations from the lowest audio frequency to about 20 megacycles! With the type 954 acorn combination this range may be extended at least 2 or 3 times."

Transitron action may be obtained with any ordinary 3-grid tube. Some other suitable types are: 57, 58, 59, 89, 6C6, 6J7 and 6K7. The magnitude of condenser C1 is governed only by the requirement that its reactance at the lowest frequency be small in comparison with R1. The value of R1 may be any value larger than 1 meg., though very good results may be had if its value is kept less than 10 meg. Condenser C1 may also have any value from 1 mf. to 100 mmf., depending upon the desired frequency range.

MEACHAM "WHEATSTONE BRIDGE" OSCILLATOR

Circuit No. 3.—The 3rd constant-frequency oscillator is attributed to L. A. Meacham of Bell Telephone Labs., and was described in the Bell System Technical Journal for Oct. 1938. It consists of an amplifier combined with a Wheatstone bridge as shown in Fig. 5.

The amplifier output is impressed across one of the diagonals of the bridge and the unbalance potential, appearing across the opposite diagonal is applied to the amplifier input terminals. One of the 4 bridge arms R1 is a thermally-controlled resistance; 2 others, R2 and R3, are fixed resistances; and the 4th is a quartz crystal suitable for operation at its low impedance or series resonance. A coil and condenser in series could be substituted, and even a parallel resonance circuit (coil and condenser in parallel) might be used by exchanging its position in the bridge with R2 or R3.

In order that the circuit may oscillate, a slight unbalance is required. Accordingly R1 must be given some value slightly smaller than R2/R3 so that the attenuation through the bridge is just equal to the gain of the amplifier. It is evident that if all the bridge arms had fixed values of resistance the attenuation of the bridge would be very critical with slight changes in any arm. The thermally-controlled resistance R1 eliminated this difficulty. This arm has a large positive temperature coefficient of

(Continued on page 569)

| TABLE I |
|---|---|---|---|---|---|
| Coil | L | R (Heinies) | Range of C (in mmf.) | Frequency Range (In kc.) | L | L (X10') |
| | | (Ohms at low freq.) | C Max. | C Min. | Low | High | Max. | C Min. |
| 1 | 5.00 | 200 | 9.00 | 0.200 | 23 | 150 | 2,780 | 25.0 |
| 2 | 0.506 | 30 | 6.00 | 0.020 | 91 | 1,580 | 2,810 | 25.3 |
| 3 | 0.301 | 120 | 0.90 | 0.016 | 300 | 2,292 | 2,790 | 18.8 |
| 4 | 0.0285 | 18 | 0.56 | 0.001 | 1,270 | 29,800 | 2,830 | 28.5 |

RADIO-CRAFT for MARCH, 1940 515

www.americanradiohistory.com
SERVICING "ORPHANS" and

Even experienced Servicemen occasionally are stumped by the problem of servicing a products of companies now out of business; "private-brands"—radio sets for which the marking on the set; or perhaps "loft" receivers—sets manufactured by small com-
or even "custom-built" or "special" sets. It is the problems that may arise in connection

CHARLES R. LEUTZ

PRESENT-DAY radio receiver service practice calls for the use of service manuals to locate the exact wiring diagram of the set involved. Provided with a wiring diagram and a reasonable amount of service equipment, the average radio technician has little difficulty restoring a standard receiver to its original operating condition. In following this practice day in and day out the Serviceman finds that the inevita-
ble schematic becomes a necessity and unless it is available the proper service procedure is not instantly apparent.

For example there are receivers manufactured by major companies but mar-
teted under private brands; also so-called "loft" receivers manufactured by smaller companies on contract; also numerous custom-built or special receivers, any one of which may be brought in for service and the service manual or wiring diagram not immediately available.

To service such receivers, the Service-
man needs a fair knowledge of the funda-
mentals common to all radio receivers regardless of type or manufacture. Standard service practice calls for re-

o service and eliminate frequent disability. With few exceptions broadcast receivers are manufactured to a certain minimum cost and that calls for low safety factors of critical parts and sacrifice of desirable features in many instances. The Serviceman coming in close contact with his customers can of-
f ten point out the advisability of changes or improvements versus simple repair of one defective part, a procedure that will add profits to the till.

The purpose of this article is two-

o service or as a matter of fact any receiver, without the use of a dia-
go service manual. Secondly, the same information will be found useful in improving radio receivers during the servicing operations.

EQUIPMENT

The following minimum service equip-
ment should be available:

(1) Tube-Tester.

(2) Combination A.C.-D.C. Voltme-
ter, D.C. Milliammeter and Ohmmeter (the latter feature is also available for continuity tests).

(3) Pair of Headphones.

The following additional equipment is desirable, and given in the order of importance:

(1) Signal Generator.

(2) Condenser Tester.

(3) Vacuum-Tube Voltmeter.

BASIC CIRCUITS

Basically, all radio broadcast receiv-
ers and their circuits are essentially the same in that they employ (1) radio-

o power supply. Factors 1, 2, 3, and 4 are common to both tuned-radio-frequency and super-
heterodyne receivers, and the latter also calls for additional radio-frequency am-
ification at an intermediate frequency in conjunction with 1 of 3 oscillator-mixer methods, viz:

- A Mixermultiplier, either a triode, tetrode or pentode, and an Oscillator tube; the oscillator and signal voltages are applied to the same grid. The 2 circuits may be coupled by a condenser (capacity-coupled, through C4) as shown in Fig. 1A; or they may be inductively-coupled by suitable mechanical relation of the inductances L1 and L2, L3. This method was very common prior to the introduction of special tubes for this application.

- (2) A Pentagrid Converter Tube may be used, wherein the oscillator tube and mixer tube are combined in 1 shell and the 2 circuits electron-coupled, as shown in Fig. 1B.

- (3) A Pentagrid Mixer (especially designed for shortwave or all-wave circuits), having 2 separate control-grids, 1 for the R.F. signal and 1 grid for the oscillator voltage, and used with a separate oscillator tube, as shown in Fig. 1C.

While on the subject of oscillators, it is well to point out there are prac-
tically only 2 types of oscillator-coils used, one without a tickler winding and the other with a tickler winding, these are shown in Figs. 1D and 1E. The cir-
cuit in Fig. 1D, without the tickler, oscillates due to capacity feedback across the padding condenser C1, and is used principally for the broadcast band or lower frequencies. For the shortwave bands, the tickler method (Fig. 1E) gives more stable operation, especially on the higher frequencies and is pre-
ferred and used for that reason. Tests and adjustment to mixer-oscillator cir-
cuits will be described further on in this article.

CIRCUIT FEATURES

Aside from the fundamental circuit divi-
sions previously mentioned, various receivers include one or more features developed in recent years including automatic volume control; automatic fre-

o signal

www.americanradiohistory.com
PRIVATE-BRAND SETS

receiver for which they can find no diagram. Such receivers may be so-called "orphans"—dealer has no diagram, and the manufacturer of which cannot be determined by any panies on contract and having circuits that may vary during the run of the contract; with receivers of these types which Mr. Leutz analyzes in detail in this useful article.

PART I

POWER SUPPLIES

A large majority of all transformer power supplies use a full-wave rectifier tube. Occasionally a power pack will have a single half-wave rectifier, and for practical purposes, it can be considered either half of a full-wave circuit. In some high-voltage power supplies, we find 2 half-wave rectifiers used to make a full-wave circuit; for example, two 281 tubes as shown in diagram 2A.

The principal difference between transformer rectifier circuits is the matter of either choke or condenser input to the filter. The choke input has the advantage of better regulation, tending to keep plate current constant and preventing distortion in R.F. or A.F. tubes due to current fluctuations. It also has the advantage of less voltage strain on the 1st filter condenser, C1, as shown in the Choke Input circuit.

The condenser, C, in the condenser input type of circuit must be capable of withstanding the instantaneous peak A.C. input voltages (1.4 times the r.m.s. value indicated on an A.C. voltmeter), and consequently, this is a common point of failure due to insufficient rating. To correct this condition when a sufficiently high-rating condenser is not available, 2 lower-voltage condensers may be connected in series to get the desired result, viz., two 15-mf., 475-working-volts condensers in series in place of one 8-mf., 475-working-volts condenser. When using series condensers for this purpose, they should be shunted by equal, high resistances to equally divide the total strain across the 2 condensers; this is shown by dotted lines in Fig. 2A. For the above case, equal resistors of about 50,000 to 100,000 ohms would be satisfactory.

To properly check a power supply, the "B plus" lead to the receiver should be disconnected and a dummy load substituted in the form of a resistor having a value which will duplicate the receiver plate load. The proper resistor can be calculated from Ohm's law, estimating the receiver's total plate load in milli-ampere and the estimated plate voltage.

\[ R = \frac{E_p}{I_p} \]

This is resistor R in Fig. 2A. Under this condition, tests on the power supply are independent of any influence from possible defects in the other parts of the receiver circuit. The power supply tests then consist of the following (under load): (1) Line voltage across primary of transformer (2) Rectifier filament voltage. (3) Filament voltage to receiver tubes. (4) A.C. voltage input to rectifier plates (Y to ground). (5) Unfiltered D.C. (X-1 to ground). (6) Voltage drop across filter choke or chokes. Knowing the total (Continued on page 571)
A.F. AMPLIFIER

A concise discussion of a number of interesting aspects of applications. No progressive P.A. technician

A. C. SHANEY

reflection from an insulated primary to a magnetically-coupled secondary.

This basic phenomenon is the cornerstone in our foundation for correct matching techniques.

THE FIRST TRANSFORMATION

The selection of the best load resistance into which a power tube works is based upon a load which produces the highest output with the least distortion. Figure 2 gives characteristic power output and distortion curves, of a single 6L6 tube, plotted against varying loads.

Although a 3,500-ohm load provides for highest power output with minimum total distortion, a 2,500-ohm is actually recommended because the 3rd-harmonic (which is very objectionable to the ear) is less than 50% of its value at the 3,500-ohm load. This decreased load condition causes a drop in power output from 7.3 to 6.5 watts; and an increase in total distortion from 0.8% to 9.4%. Actual laboratory tests show the advantage of losing some power and increasing the total distortion as long as the 3rd-harmonic is kept low. (In actual practice, distortion is considerably reduced by push-pull operation and inverse feedback.)

Assuming we desire to match an 8-ohm speaker to the output of the amplifier, the turns ratio of our output transformer would be

$$ T_e = \sqrt{Z_e} = \sqrt{2500} = 50 ohms $$

$$ T_s = \frac{Z_s}{Z_e} = \frac{8}{1} $$

$$ T_r = \frac{Primary}{Secondary} $$

$$ Z_e = 2500 ohms $$

$$ Z_s = Secondary Load Resistance $$

$$ Z_r = \text{Load Resistance} $$

Although the turns ratio would be

$$ T_r = \frac{2500}{312.5} $$

$$ Z_e = 8 ohms $$

If an 8-ohm resistor is connected to the primary of our ideal transformer, the secondary would present an impedance of 2,500 ohms to the tube at all frequencies. See Fig. 3A.

THE FIRST RESULTS

When we connect an 8-ohm speaker, however, the picture becomes entirely

---

FROM the type of questions generally asked about Speaker Matching Practice, the writer believes that some basic knowledge about this sadly overlooked interconnecting link, between amplifier and load, will prove helpful to many readers.

For the sake of brevity, this discussion will be confined to fundamental output transformer considerations, aside from their general academic treatment, i.e., relationship of impedance, turns, current and voltages, except where these characteristics are of an unusual nature.

For the sake of simplicity, the effects of leakage reactance, core losses, inductance, copper losses, capacitative reactance, and the coefficient of coupling will not be considered unless they affect the basic problems involved.

THE SIMPLE OUTPUT TRANSFORMER

AND ITS IMPLICATIONS

The first important point to remember about output transformers is that the primary and secondary windings are not completely isolated from each other. While they may be electrically insulated, they are closely coupled magnetically. In fact, this close magnetic coupling accounts for the reason that any circuit connected to one winding, will produce an equivalent reflected circuit in the other. The relative magnitude of these circuits will be proportional to the square of the turns ratio between both windings. As is well known, a transformer will transform (step-up or step-down) voltages and currents (proportionately to turns ratio). It will similarly transform capacity, inductance and impedance (proportionately to the square of the turns ratio).

If a 1-mf. condenser is connected to the primary of an ideal transformer having a primary-to-secondary turns ratio of 1:2, the secondary will behave like a 4-mf. condenser! See Fig. 1A. In other words, if the primary of the transformer "looks into" (connects to) a 1-mf. condenser, the secondary will be looking out of (appear to be connected to a reflected) 4-mf. condenser. (If the turns ratio was 1 to 1, then the secondary would be looking out of a 1-mf. condenser.)

This means that the secondary will no longer exhibit ideal characteristics, but will definitely become frequency discriminating, i.e., present a low impedance at high frequencies; and a high impedance at low frequencies.

Likewise, if an inductance of 1 henry is connected to the primary of this same transformer, the secondary will exhibit an inductive reactance equivalent to 4 henries. See Fig. 1B. Assuming that the transformer itself is ideal (has an infinite inductive reactance), its secondary will become decidedly frequency-discriminating inductively, and present a high impedance at high frequencies; and a low impedance at low frequencies.

Similarly, if a resistance (having a constant impedance at all frequencies) of 10 ohms, is connected to the primary of the same transformer, it will cause a reflected impedance of 40 ohms to appear in the secondary. See Fig. 1C. Inasmuch as the impedance of the primary resistor will not vary with frequency, the secondary will likewise present a constant impedance at all frequencies.

These examples show how the secondary of the same transformer can be made to behave 3 different ways though nothing is actually connected to it! They furthermore stress the effect of varying primary-to-secondary turns ratio.
LOAD-MATCHING TECHNIQUE

of matching the output of an amplifier to a wide variety of loads under varying or amplifier enthusiast should miss this expert and authoritative discussion.

different. In the first place, the speaker is partly inductive, because of the iron pole-piece inside the voice coil. Therefore it cannot be 8 ohms at all frequencies. See Fig. 3B.

Assuming it was rated 8 ohms at 400 cycles, it is quite feasible that its impedance would drop to 5 ohms at 60 cycles and gradually rise to 11.2 ohms at 3,000 cycles. Knowing that the impedance ratio of our transformer is 312.5 to 1, it follows that the reflected load impedance "facing the tube" will vary from 1,560 ohms at 60 cycles to 3,500 ohms at 3,000 cycles. Figure 2 tells us that at 60 cycles (1,560-ohm reflected load) our tube will deliver 4.8 watts instead of 6.5 watts (at 400 cycles). This accounts for the apparent poor low-frequency response of many speakers. Similarly, at 3,000 cycles (3,500-ohm reflected load), the power output increases to 7.5 watts at 1.3% 3rd-harmonic instead of 0.5% at 400 cycles. This accounts for the increased distortion at the high frequencies and its associated irritating quality.

An analysis of these observations crystallizes 2 interesting and annoying facts. Under supposedly ideal speaker matching conditions, we have:

1. Amplitude Distortion—Varying power output with frequency—and it varies in a very unfavorable way. The low frequencies to which we are normally insensitive, drop out.

2. Frequency Distortion—Varying distortion with frequency—and this, too, varies unfavorably. The high harmonics, to which we are normally very sensitive, build up.

The disconcerting part of these disclosures is that few laboratories check for these conditions of varying reflected impedance during routine amplifier performance measurements.

THE SPEAKER LINE

—AND ITS COMPLICATIONS

For the sake of studying the effect of speaker lines on performance, let us assume our installation requires that our speaker be placed 100 feet from the amplifier. (Here, again, for the sake of simplicity, line losses of negligible effect, such as change of resistance with temperature, etc., will not be considered.)

If a No. 20 wire cable is installed, this line will have a resistance of 0.0164-ohm per foot, or a total of 200 x 0.0164 = 3.288 ohms (200 ft. of single-conductor wire is required, or 100 feet up and 100 feet back). This series resistance adds to the impedance of the speaker to make a total of 11.28 ohms, at 400 cycles. See Fig. 3C. This means that our reflected load, at 400 cycles will now be 11.28 x 312.5 = 3,560 ohms, which is very similar to our original set-up (without the line) at 3,000 cycles.

Naturally, the increased reflected load increases the 3rd-harmonic, and strangely enough, actually puts more power into the line (7.3 watts at 400 cycles, compared to 6.5 watts without the line)! This unusual condition, is characteristic of most output circuits, wherein the operating plate load is less than load indicated for optimum power output. Charts showing the loss of power due to mismatch do not take this into consideration and may therefore be misleading.

Although more power may be fed into the line, it may not reach the speaker because of the effective series resistance of the line. The loss of watts power across the line is

\[ W_t = \frac{(Z_s + Z_L) W_o}{(Z_s + Z_L)} \]

\[ W_t = \text{Watts loss in line} \]

\[ Z_s = \text{Resistance of line} \]

\[ Z_L = \text{Total Impedance of Load} \]

\[ W_o = \text{Total Power put into line} \]

The actual power delivered to the speaker equals

\[ W_s = \frac{Z_s}{Z_s + Z_L} W_o = \frac{8}{11.288} \cdot 7.3 = 5.1 \text{ watts} \]

Loss of power = \frac{2.2}{7.3} \approx 30.5\% \]

CORRECTING THE FAULTS

If a 500-ohm line is run, of the same wire, the loss of power would be considerably less. It would also be easier to reflect the optimum load to the output tube. To offset this, however, the efficiency of the line-to-speaker transform-

Can You Answer?

1. How long can an 8-ohm speaker line be run?
2. How do you calculate power loss in speaker lines?
3. What is the disadvantage of running long, high-impedance output lines?
4. What detrimental effects are produced by long, low-impedance speaker lines?
5. How do you calculate the impedance of in-between taps of an output transformer?
6. How would you automatically compensate for variations in impedance of cutting heads and speakers?
7. What is the basic formula for design of speaker power distribution networks?

All these, and many other questions are answered by Mr. A. C. Shaney in this article.
SERVICING QUESTIONS & ANSWERS

HIS IN AUTO-RADIO SET

(149) John W. McArthur, Alley, Ga. (Q.) I have a Philco 806 auto-radio set which has been completely baffled. It is being used with a J. F. D. cowl-type antenna (100-inch) which should certainly give plenty of volume. It has been tested and was found to be all right; and aligned, which helped not at all. The complaints are:

(1) All stations during the day, come in with a hiss which varies in pitch. When the station is in exact tune the hiss is low in frequency but quite annoying. On weak stations the hiss almost drowns out the speech or music. Turning the tone control down reduces it a little but the program more.

(2) Vibrator harsh and hiss (no station tuned-in) which is helped little by different vibrator, buffer condenser, etc. Shorting the 1st R.F. grid cap to ground stops it completely. In fact it is not very bad when the antenna is disconnected, but increases enormously when it is connected and extended for playing. I might add this is a rather unsatisfactory location for daytime reception, being over 100 miles from a station (a 5 kw. outfit). But other auto-radio receivers, some less expensive and of poorer quality, perform almost like a house set.

Would it be worthwhile, from the standpoint of improvement of performance, to replace the I.F. transformers with new high-grain iron-core coils? If you think the above mentioned antenna doesn't match the set kindly advise me how I may change it to do so, as I don't want to get another antenna.

(A.) To overcome the condition you described, realign the I.F. transformers and R.F. circuits completely. Then short-circuit the choke coil in the antenna circuit and realign the R.F. trimmer with "rod" antenna connected.

"IGNITION" NOISE

(150) B. D. Cooke, Sidney, N. Y. (Q.) I have in for service, a Delco, Chevrolet car-radio set, model 958258; complaint, motor noise. The set was installed in a 1938 Chevrolet coach.

All the usual procedures were taken to overcome the noise—such as suppressors, bonding, etc.—and this seemed to help temporarily, but the interference returned whenever passing under a high-tension wire and would continue for a few minutes after the car was stopped and the ignition turned off.

We then suggested the use of a microphone in the Music Room and another at the Portable Pulpit for the Minister. When this met with their approval we suggested they install hearing-aids to make the service outstanding in completeness. Our customers left the entire job up to us. We itemized equipment and stated the price which met with their approval and we were given the order.

In the main auditorium (40 by 20 ft.) we used two 10-inch speakers in angle wall baffles and 3 hearing-aid outlets. In the family room we used one 10-inch speaker with wall baffle and T-pad, and one hearing-aid outlet.

All 4 hearing-aids have individual volume controls and have dummy load in each aid so that any number of them may be used without affecting the operation of the others. Two styles of earphones were used, 2 of the headband type and 2 of lorgnette type.

The portable has a crystal pickup and is for 33 1/3 r.p.m. long-playing records. Microphones are crystal with frequency response of 40 to 10,000 cycles.

All this is powered with an 8-tube, 20-watt amplifier with remote mixer, dual tone and 4 mixing circuits. Gain is ~190 db. on microphone, and ~80 db. on phone.

All wiring is concealed, with outlets in the walls for microphones, speakers and hearing-aids. Both the transformers are installed in the speaker baffle.

While this is installed as a permanent job, it can be made portable in a minimum amount of time with extra speaker and microphone cables. The diagram is here shown in block form. Webster-Chicago amplifier, speakers and microphones, and

(Continued on page 55)

HUMS ONLY IN CUSTOMER'S HOME

151) C. J. Swan, Buffalo, N. Y. (Q.) We are in trouble in a Bush and Lane No. 12, a T.R.F. job, using 24's in the R.F., 27's as detector and 1st audio, and 45's in the push-pull output stage.

At the customer's house this set has a modulated hum on stations between 550 and 900 kc., stations above this range are not affected. Brought into the shop, the set plays OK; there is no noticeable hum present on any station. Tubes test OK, by-pass condensers were installed across the power transformer primary; all other condensers test OK. The tuning condenser is encased and it would necessitate the dismantling of the entire R.F. section to get at them, a piece of braided copper wire was soldered to the protruding condenser shaft and ground so as to insure good connection. Despite all the precautions the hum was present when the set was returned to the customer's house. There is but a slight variation in line voltages between the shop and the customer's home. A preliminary survey of the house wiring gave no clue.

(A.) The trouble is caused by 1 of 2 conditions both of which are external to the receiver.

One condition is a pick-up from an A.C. line. That is, the antenna or lead-in absorbs the radio energy directly from an A.C. line in the vicinity. We suggest changing the direction of the antenna; and, the use of a good ground. Perhaps the pick-up may be from wiring in the walls, the only cure for which is to change the location of the receiver.

The other condition which is similar is a type of cross-modulation, and generally exists in the vicinity of powerful stations. Some external rectifying element causes rectification of the strong signals and new or modulated frequencies are produced; in your case, with hum. The only cure is locating the rectifier element and its elimination. Generally it is caused by poor grounds on the A.C. feeder system. Check the condition location with a battery portable.

(Continued on page 575)

CASE HISTORIES OF P.A. SALES

NO. 6

COMPETITION today requires that the modern funeral home offer its community every service and convenience available. We learned that an old-established funeral director contemplated building a new Funeral Home and contacted him as a prospect for a Public Address system. We first suggested a musical reproduction system with turntable and amplifier in the Service Room, and speakers in the Auditorium and the private Family Room. Such a system offers organ music, vibratone and chimes or vocal music without the expense of installing an organ or paying musicians.
THE BEGINNERS’ ALL-WAVER
Build This 2-Tube Plug-in-Coil Breadboard Receiver

Experimental radio sets incorporating new ideas, for receiving programs on wavelengths below 545 meters, have been described in radio publications from time to time. The newest design, is a swell, all-around job which utilizes 2 of the new 1.4 V. low-drain battery tubes.

M. N. BEITMAN

This 2-Tube All-Waver is a dependable, battery-operated all-wave receiver which can be built quickly and easily. The tuning range is 15 to 500 meters when used with proper coils, covering the important foreign and domestic ‘phone and code Amateur bands, as well as regular standard broadcast programs.

You will find this circuit very interesting and educational. The beginner can learn the essentials of radio building and operation. The finished receiver is very neat in appearance and will bring in plenty of real DX on all bands.

Before you begin to wire, you should mount all the parts as indicated on the pictorial diagram. This is extremely important for effective results. You can then start the wiring, following the schematic diagram and checking your work from time to time with the pictorial diagram. As you proceed, trace the completed connections with a colored pencil. This will help you to remember exactly which connections have already been made.

TESTING

After the set has been wired, and one of the coils and the two 1.4-volt tubes are in place, connect the “A” cell and notice the filament glow in the tubes. This will serve as a safety check to see if the filaments are wired correctly. No glow indicates that an error has been made in the filament circuit. When the filament glows, connect the “B” battery and insert the headphones into the proper Fahnestock clips.

Now test the set to see if it will regenerate. Advance the regeneration control to the right, and a whistle will be heard. If you do not hear this whistle, check the connections to the coil socket and the “B” batteries to see that they are wired correctly.

Next, connect the antenna and ground. With these in place and the regeneration control just below oscillation (whistling point), turn the tuning control and you will receive several stations. You will find that adjusting the antenna trimmer will help a great deal. The antenna condenser should be adjusted, so that the detector tube will oscillate at all points on the tuning dial. The point of adjustment depends entirely upon the degree of absorption of the antenna circuit from the tuning circuit. Once the trimmer is adjusted for any one of the coils, no other changes need be made until a different coil is used. This adjustment is not critical except when you actually want some real DX. It is worth mentioning here that a good aerial is essential for efficient shortwave reception, particularly for a set of the “DX” (long-distance) type. Both the aerial and lead-in should be well insulated and kept as far away from walls, roofs, etc., as possible.

You will soon learn in using the All-Waver that broadcast (Continued on page 553)
To align the I.F. stages, feed a 455-kc. signal through a 0.1-mf. dummy antenna to the front lug of the grid condenser and adjust trimmers 1-2 and 3-4 for maximum response in the order given. To adjust the wave trap, use a 455-kc. signal through a 200-mf. dummy antenna applied to terminal A and adjust trimmer 5 for minimum response. Next, feed a 1,000-kc. signal to terminal A through the same dummy antenna, turn dial to 1,000 kc. and adjust the broadcast oscillator shunt, trimmer 6, for maximum response. Under these same conditions adjust the broadcast antenna trimmer No. 7 for maximum response. Then turn the dial to 600 kc. and with a 600-kc. signal adjust the broadcast oscillator shunt pad for maximum response.

To adjust the foreign band use a 14-mega cycle signal through a 400-ohm dummy antenna applied to terminal A. Turn the dial to 14 mc. and adjust the foreign oscillator shunt trimmer No. 9 for maximum output. Check to see if proper peak was obtained by tuning-in image at approximately 13.1 megacycles. If image does not appear, realign at 14 megacycles with trimmer screw further out. Re-check image. Under these same conditions adjust the foreign-band antenna trimmer No. 10 for maximum output.

Connect the output meter across the voice coil or between the plate of the 6F6G output tube and ground in series with a 0.1-mf. condenser, depending on the type of meter. (The more sensitive type should be connected across the voice coil.) Connect the ground lead of the signal generator to the G terminal of the chassis. NOTE: Remove the connector from between the A and X terminals. Turn the volume control to the maximum volume position and keep it in this position throughout the entire alignment procedure. With the gang condenser in full-mesh, set the pointer at a point 1% ins. from the left flange of the brown dial plate. This point corresponds to the last mark on the low-frequency end of the dial scale. If the pointer is incorrectly set, it is only necessary to loosen the set screws on the dial drive drum and push the gang condenser in full-mesh, with the pointer properly set, then tighten the set screws. The volume control is a 1-meg. unit.

Please let us know whether there are any particular types of radio receivers, or any particular features of servicing procedure, not described in past Radio Service Data Sheets that you would like to see in forthcoming issues. Address your notes to:

Editor, Radio Service Data Sheets
RADIO-CRAFT Magazine
99 Hudson St.
New York, N. Y.
This receiver is equipped with a "fixed-variable" sensitivity control located on the side of the chassis as shown in Fig. 3. The control is set at the factory to a position which gives a sensitivity of 7 microvolts at 1 W. output. It is found advisable to hold the receiver at this level as any higher sensitivity may result in motor noise or excessive background noise and unless laboratory equipment is available for measuring sensitivity, it is not advisable to change this setting.

ALIGNMENT

The signal for the entire alignment procedure, both I.F. and R.F., is fed through a special Zenith dummy (Part number 37832). The capacities in the Zenith dummy antenna as shown in Fig. 1 are identical with the standard Ford antenna. If the Zenith dummy is not available, you can substitute the values shown in Fig. 1.

Caution: Care should be taken while making all adjustments on the receiver to have the volume control turned full-on. The intensity of the signal should be reduced only at the signal generator.

I.F.: The tuning condenser is fully meshed (540 kC). The word "dial" must appear in the Roto-Matic window. The signal generator is set at 455 kc. and fed through the antenna dummy to the receiver. The wavetrap adjustment screw A, see Figs. 2 and 3, is adjusted for maximum response. The adjusting screws B, C, D and E are then adjusted, in order, to maximum response on the output meter. (See Figs. 2 and 3.) Wavetrap A is then adjusted for minimum response.

B.F.: The tuning control is rotated until the condenser plates are completely out of mesh (1,420 kc.). Set the signal generator to 1,520 kc. and adjust the I.F. trimmer shown in Fig. 4, for maximum response. Reset the signal generator to 600 kc., and rotate the tuning control until a signal is heard. The condenser ganz is then turned slowly while adjusting the 600 kc. band (see Fig. 1) to maximum response on the output meter.

An element below the speaker on the front of the receiver is provided so that the output meter may be connected to the voice coil.

If you have the type of output meter which is usually connected to the plate of the output tube, it may be adjusted for this type of connection by using an output transformer with the output meter leads connected to the primaries. The secondaries leads are then connected across the voice coil.

1940 Zenith-Ford auto-radio with Roto-Matic tuning (1 button for 5 stations).

Use 1,000 ohms/volt meter; measure across chassis ground. Ant. disconnected; vol. at min.; battery, 6v.
3 NEW TUBES

A series of 3 new "GT" or "glass-midget" tubes was introduced by Arcturus Radio Tube Co. last month. The feature of these tubes is not alone that they are new additions to the line of glass midgets but also that 2 of these tubes introduce the use of 117-V. filaments which connect directly across the light-line. This general idea is not new to Radio-Craft readers,* but the fact is new that the 117-V-filament power output tube (plus a rectifier section), which Radio-Craft forecast, is included in the group. These tubes are described individually as follows:

3A8GT Midget Diode-Triode-Pentode Detector-Amplifier

This triple-purpose tube is designed for use in receivers operating from a low-voltage battery filament supply.

It consists of a pentode section and a diode-triode section with a common filament in 1 envelope. The pentode section can be used as a high-frequency amplifier, and the diode-triode section as a combined diode detector and resistance-coupled audio-frequency amplifier.

Filaments may be operated in series at 2.8 volts or in parallel at 1.4 volts. In parallel, the filaments may be operated directly from a 1.5-volt dry cell; and in series, from a 3-volt dry battery. (The older, type 1D8GT operates only from a 1.5-V. "A" supply.)

The pentode filament is connected between pins 1 and 2 and the diode-triode filament between pins 1 and 7. The diode plate is located at the negative end of the filament.

This tube may be mounted in any position. The cap connection is what is known as a "skirted miniature." Maximum dimensions follow:

Overall length, 3 7/16 ins.; seated height, 2 1/2 ins.; dia. 1 5/16 ins. Characteristics data on this tube are given at the end of this article. This tube uses an 8-pin octal base.

117L7GT Midget Rectifier - Beam Power Amplifier

This tube like the 117Z6GT is of the uni-potential cathode type and has been designed primarily for use as a combined output tube and half-wave rectifier in A.C.-D.C. battery receiver combinations as a source of filament current and plate supply for light-line operation.

The output of the amplifier section at 90 V. is 1 watt. The rectifier D.C. output is 70 ma. Base is 8-pin octal. Maximum dimensions: overall length, 3 7/16 ins.; seated height, 2 1/2 ins.; dia. 1 3/8 ins. May be mounted in any position. Characteristics data at end of article.

117Z6GT Midget High-Vacuum Full-Wave Rectifier

In addition to its feature of having a 117-V. filament this tube introduces a new small-space size for this type of construction. This midget rectifier is of the uni-potential or indirect-heater type, designed for operation, like the 117L7GT, directly across a 117-V. line. By bringing the center-tap of the heaters out to No. 1 pin, it is possible to operate the heaters in parallel on 58.5 V. with a heater current of 160 milliamperes. This tube utilizes a 7-pin octal base. It may be mounted in any position. Maximum dimensions are as follows: Overall length, 3 5/16 ins.; seated height, 2 1/2 ins.; dia. 1 3/4 ins. Characteristics data are given in the tabulations which follow.

R. D. WASHBURN


CHARACTERISTICS

3A8GT Series Parallel Connection

<table>
<thead>
<tr>
<th>Filament voltage*</th>
<th>2.8 D.C.</th>
<th>1.4 D.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament current</td>
<td>0.05</td>
<td>0.1</td>
</tr>
<tr>
<td>Maximum plate voltage</td>
<td>90 volts</td>
<td></td>
</tr>
</tbody>
</table>

Typical Amplifier Operation—Class A Triode Pentode Section

| Plate voltage | 90 | 90 |
| Screen-grid voltage | 90 | 90 |
| Grid bias | 0 | 0 |
| Amplification factor | 65 | 65 |
| Plate resistance (approx.) | 0.24 | 0.6 |
| Transconductance | 750 | 750 |
| Plate current | 0.15 | 1.2 |
| Screen-grid current | 0.3 | 0.3 |
| With standard tube shield connected to cathode. |

* The filaments in parallel may be operated directly from a 1.5-volt dry cell; and in series, from a 3-volt dry battery.

** Grid bias measured from the negative filament of each section. With the parallel filament connection, pin No. 7 is the negative filament for both sections. With the series filament connection, pin No. 7 is the negative filament for the triode section and pin No. 1 is the negative for the pentode section.

Direct Interelectrode Capacities

| Pentode grid to plate | 0.015 | max. m.mf. |
| Pentode input | 2.6 | m.mf. |
| Pentode output | 10 | m.mf. |
| Triode grid to plate | 2.2 | m.mf. |
| Triode grid to plate | 2.6 | m.mf. |
| Triode output | 4.6 | m.mf. |

117L7GT

| Heater voltage | 117 volts |
| Heater current | 0.090 ampere |

Ratings and Characteristics

Amplifier Section

| Plate voltage | 90 volts |
| Screen-grid voltage | 90 volts |
| Control-grid voltage | 3.2 volts |
| Plate current | 45 ma. |
| Screen-grid current | 4 ma. |
| Mutual conductance | 5,000 micromhos |
| Plate resistance | 20,000 ohms (approx.) |
| Load resistance | 2,000 ohms |
| Power output | 1 watt |
| Total distortion | 8% |

Rectifier Section

| A.C. plate voltage | 117 volts |
| D.C. output current | 70 ma. |
| Voltage drop at 140 ma. | 20 volts (avg.) |

117Z6GT

| Heater voltage | 117 volts |
| Heater current | 0.150 0.075 ampere |
| Max. D.C. heater to cathode voltage | 350 350 volts |
| Max. peak inverse voltage | 700 700 volts |
| Tube voltage drop at 120 ma. per plate | 15.5 15.5 volts |

Operating Conditions and Characteristics

Voltage Doubler

| Heater voltage | 117 volts |
| A.C. voltage per plate (r.m.s.) | 117 volts |
| D.C. output current | 60 ma. max. |
| Plate supply impedance per plate (min.) | 350 m.mf. |

(Continued on page 551)

RADIO-CRAFT for MARCH, 1940
TELLY GOES TO TOWN
IN NEW 1940 MARKET
Better Biz for New Season Seen as Mfrs. Get Down to Earth
on Price Schedule

Long-heralded television reached the market in 1939 but should really go to town in 1940. The new art had its U.S. début with the opening of the N.Y. World's Fair and a splashy impact point of advertising in the metropolitan area. Estimates on set sales at prices ranging from $125 for complete 5-in. kit to $600 for 12-in. telly-radio combination ran from 500 to 1,000 units. This was disappointing to mfrs. & dealers who had envisioned a boom equal to that which radio experienced in the early 1920's.

Many reasons for the non-appearance of said boom were given; most logical seems to be that kid with $5 could assemble simple radio set, while man with bankroll was needed to make telly customer.

Evidence toward this end was adduced when a pre-Christmas sales drive took upstate New York city offered $600 sets at $395; $400 sets for $295, with the result that 100 units were sold in a single week.

Similar probable price reduction for 1940, coupled with fact that NBC plans additional stations while G.E., CBS, Philco, et al., are scheduled to open soon & Tom Lee plans expansion, should do much to give telly a big boost for '40.

Only possible factor to retard telly sales (CTR) is a feeling of programs. NBC now provides 2 to 3 excellent hrs. per wk. out of 20 on the air, with balance ranging from good to awful. Program competition as other nets take markets are bound to result in greater audience interest & therefore greater sales.

Another move to this end would be better servicing of receivers now installed as dealer demonstrators & in purchasers' homes. Almost every home set is now acting as demonstrator, as friends of family wander in to see show, now a novelty. The reaction of visitors varies from "Is it snowing there?" to "Isn't this a marvelous age we're living in?" with former (and similar) comments predominating. Wise policy on part of dealers & mfrs. would be to make sure that every installation would give demonstrations of the sort that really sells sets.

BIZ OP - - In War Area

There may be a war in China, but his goes on as usual, according to a report by the Chinese Radio Laboratory, Kowloon Factoyy, Ma Tau Wei Road, Kowloon. They want complete catalogues, literature, price sheets and discount schedules on any and all lines intimately or remotely connected with radio and the electric specialties. This includes tools and machinery for producing radio and electrical products.

F. C. COMMISSIONERS ASSEMBLE AT TELLY SET

RADIO INDUSTRY NEEDS "CZAR" SAY DEALERS AS PRICE CUTTERS SLASH

Self-Regulation, Like That in Baseball & Movies, Will Stabilize Sales & Insure Profits, According to Merchandisers' Group

RECORDS SAVE HERO DOG

"Duke," 2nd from left, chased armed bandits who tried to hold up his master, Gustave A. Schwoeri, left. He was awarded gold medal by governor of N.J. & was to bark thanks over WCAM. Mike thy, although gunshots, "Duke" lost his voice in stud. He refused to bark! RCA came to rescue with record. Big day was saved. Picture above shows "Duke" & Schwoeri meeting rescue "Nipper," RCA's trademark fylke.

BEG PARDON

On p. 492 in the RTD section of Feb., 1940, a statement ascribed to Commissioner E. F. McDonald, Jr., should read that he suggested television transmitters be licensed for commercial operation only in the New York area. The word commercial was omitted and is here emphasized.

A "price armistice"—but not of the sort you might think—is being recommended by Sayre M. Ramadell, x-p. of Philco. Mr. Ramadell in a statement to the press expresses the fear that prices will rise too rapidly & too soon, now that markets are expanding.

While Mr. Ramadell's ideas are sound, in the opinions of radio dealers surveyed by RTD, their replies indicate that the trade is seeking a different sort of price armistice—an armistice on price cutting. Despite the legislative protection of mfrs.' list prices, dealers of a certain sort find means to cut & get away with it. The public, always bargain conscious, rushes for cut-rate mdse. without thought of fact that something must be sacrificed—e.g., service—in order to get lower rate. This leaves dealer who stands back of mdse, holding large & heavy bag.

Some dealers covered in survey suggest retail trade needs its own Judge Landis or Will Hays in order that industry can police itself & protect the majority against the price-cutting minority.

Group of several—and not the largest—dealers have met in secret session to discuss plans for forming national body whereby industry can regulate itself.

RTD would be glad to hear from Service men & dealers interested in joining such an organization. Those who feel that cooperation within the industry to avoid price cutting would insure better business at a reasonable profit should address their letters to Robert Eichberg, editor, Radio Trade Digest, Radio-Craft, 99 Hudson St., N.Y.C.
Personal

FLOYD D. MASTERS, after 17 yrs. in the radio & appliance field, has been appointed special factory rep. for Stewart-Warner Corp.'s radio div.

EDWARD J. REH Feldt, for 6 yrs. a marketing exec. with Thornden Econ. Mfr. Co., has recently been appointed dir. of foreign sales.

HARRY L. SOMMER, formerly asst. to the exec. v.p. of RCA Mfr. Co., has been appointed mgr. of mfr. for all the co.'s plants.

B. G. KRICK, pres. of Hygrade Sylvinite Corp., was written-up on the front pg. of the Cameron County Press. Factory is located in Emporium, Pa., & the article features the growth of the town during the yrs. in which Hygrade Sylvinite has been operating there.

BENSON E. FRATT, former pres. agent for NBC's Blue network, resigned to become press agent for Thomas E. Dewey's campaign for the presidential Republican nomination. Ben handled the radio campaign for G.O.P. in 1932. He is succeeded by ART DONEGAN who has been handling NBC trade news.

DAVE KUBRICK, sales rep. for Ampertite Co. in the N.Y. Metropolitan area, is busy handling the "Kentak" mike to the radio & music trades, for amplifying orchestral instruments.

W. C. NOLL is now mgr. of product services for G.E.'s appliance & merchandise dept., Bridgeport, Conn.

PHIL GILLIG, for 15 yrs. an exec. v.p. of the Ludwig Battery Co., manager of the Steatite (insulator) div. of General Ceramics Co.

There are 5 new faces on the staff of American Steel Expert Co., expert dist. of Philco products. They're worn by TIMOTHY WILLIAMS, HORACIO LIMA, HANK STAUDER, CAMRON S. HERBERT & ALBERT A. BOMBE. Williams will handle all export sales on the co.'s refrigerator & air-conditioner line; Lima is resident mgr. for Brazil; while Stauder and Herbert fill the same positions in Mexico and Colombia, respectively; Bombe will handle radio & refrigerator sales in South & Central America.


EMPLOYEES GET $2,400 of General Electric Co.'s earnings this year under General Profit Sharing Plan authorized by stockholders in 1934. Last year they received only $557,000. Eligible employees with 5 or more yrs. of service received 3.75% of their earnings as payment for last half of 1939. First half received in August, 1939. Company now has 67,000 employees, 10,000 more than a year ago.

DIVIDENDS OF $25 per share were announced last month by directors of Stewart-Warner Corp. Increased business and better outlook for 1940 made it possible, said Pres. HERBERT A. BAUMANN.

RCA DIVIDENDS for period from October 1, 1939 to December 31, 1939 were announced as follows: $3.50 1st Preferred stock; $2.50 per share. Outstanding shares of common stock, $25 per share.

PHILCO-R.M.S. PLANS EXTENSIVE RADIO SERVICE CAMPAIGN

In a nationwide plan of cooperation between Philco & its distributors, the co. plans to make available radio receiver parts in all sections of the U.S. for Philco home & auto radios at nominal prices. A comprehensive educational program will be instituted, consisting of numerous intimate service meetings to disseminate important servicing and blue-printing info., and encourage greater Serviceeman cooperation. Philco plans to keep the ball spinning all-year round.

N.R.P.D.A. Reports Increased Membership

Arthur Moss, pres. of National Radio Parts Distributors' Assoc., returning from a recent tour covering Eastern Pennsylvania and New England, reports the organization as being represented now in these territories by almost 100% of the eligible parts wholesalers. Latest members in these territories to be added to N.R.P.D.A. roll are:

Eastern Pennsylvania
J. R. S. Distributors, York.


Herbach & Remader, Erie.

Kraft Bros., Norristown.

New England

Ware Radio Supply, Brockton, Mass.


Providence, R. I.

A. A. Co., Boston, Mass.


A tie-up with the new technicolor cartoon, "Gulliver's Travels," has been arranged by STEWART-WARNER CORP., which will introduce 2 sets each bearing a full-color reproduction of Gulliver & other characters. Local theatre mgrs. and Stewart-Warner dealers will be supplied with lobby & window displays, cooperative advertising for local papers & other merchandising aids.

A special demonstration record album with everything from swing to classics is being supplied to PHILCO salesmen. The idea is that the customer can hear a swell recording of whatever type of music he likes best in order to sell him on a phone.

MIDWEST RADIO CORP. is offering a free midget set with every console sold at $49.95.

A sales-help package containing 300 letters & costing the dealer only $1.20 is being used by PHILCO to boost the sales of its Greek-letter radio sets to members of fraternities & sororities.

RCA is using educational films "Television" and "Air Waves" to get biz and goodwill. 244,707 persons saw films in one month alone.
AN EDITORIAL
By Artie Dee

One of the easiest things to do is to fall out of step with the parade—to remain on the sidelines while progress speeds past. While this is easy, the trouble is that profits pass you by at the same time. It’s up to you to put on your running shoes if you want to keep up with all the advances that are being made in radio and—still more important—make them put cash into your till.

Millions of dollars worth of publicity are being given to developments which have taken place, at least as far as sales are concerned, within the past year. Three such developments are Television, Frequency Modulation and Facsimile.

This column has said so much about television during the past few months that no more will be written concerning it today, although the editor believes it to be the most fruitful source of immediate profits if it’s handled right.

Instead, turn to F.M.—this as your only real music lover on the desirability of having such equipment in his home. But are you equipped to demonstrate F.M.? If you’re not, you are missing chances to make some worthwhile sales.

Facsimile is also on the market and you should be equipped to demonstrate and sell these units. While they do not represent as big sales as television and F.M., receivers, they have even more novelty appeal. The man who wants the latest in everything is an almost certain customer of such apparatus.

Don’t fall behind the parade. Be equipped to make those extra dollars!

BROADCAST SERIES PEPS SALES FOR SERVICEMEN

As announced in “Snoops & Scoops” last month, a new series of weekly programs called “Radio Masters of the Air” and devoted to the welfare of radio Servicemen is now being aired by WCNW (N.Y.C., 1,500 kw.) every Wed. from 10:00 to 10:30 P.M. Announcements of new merchandise—why necessary & used, service hints, troubles & solutions and business-building suggestions will be the bill of fare. Jack Grand, dir. of the program, says that a free monthly bulletin, containing a digest of the broadcasts and other sales-promotion features, will be sent to all Servicemen and radio dealers. The early broadcasts will be of an experimental nature which, if successful, may be put on big. If you get an invitation to cooperate—do. Give the Serviceman a helping hand!

Watch for Finch Labs. to open their own factory somewhere in Jersey. Early reports are that they’re taking 15,000 sq. ft. in Jersey City to turn out facsy sets for airmen & cops. . . . G.E.’s new 7-tube, 2-band console H-736 with 6 pushbuttons will sell complete with record player for about what you should expect to get for the set itself, plus the customer’s old set . . . Importers, Ltd., South India, is interested in getting hold of new lines. As the address is more important—make them put cash into your till.

WXZY has moved its transmitter from downtown Detroit to a point 6 miles out of town. . . . G.E. has a new line of transmitter tubes; also a new 3-way portable.

Sidney L. Capell, Toronto, managing dir. of Philco Prds., Ltd., Canada, credits radio as a “foremost factor in uniting the British Empire for War” (And you remember the days when they were talking about radio as “the greatest force for peace”) . . . Maybe this isn’t such a bad War—reports are that public is buying costlier sets to be assured of picking-up European stations direct. . . . Floyd Faussett, former v-p & chief eng. of Supreme, now heads his own Radio Instruments Mfg. Co., which makes the Rimeo Dynalyzer, being pushed by Nat’l Union.

NEWEST SIDELINE

RCA, G.E. & WESTINGHOUSE IN NEW PATENT COMBINE

New patent arrangements supplementing those made in 1932 have just been announced. RCA reserves right to sell, and grant licenses to others for the sale of most types of radio tubes for many uses. G.E. & Westinghouse get right to sell radio equipment, including tubes, for broadcasting transmitters, television and facsimile apparatus, airport equipment, etc. The agreement enables anyone using the patents of the 3 co. to give to each a broader market for its products & services.

Changes & New Addresses

Where to Reach Old and New Companies

ATLAS SOUND CORP. has appointed P. D. Terwilliger sales rep. for N.Y. State. His address is 505 University Ave., Rochester, N.Y.

NON-OX CO. of 3533 S. Losau Ave., Maywood, Calif., has just been organized to make & market chemicals for use by the trade, such as speaker cement, solder paste, cabinet polish, etc. The co. is now producing a light mineral oil, Non-Ox, which is said to reduce oxidation.

SPEAK-O-PHONE RECORDING & EQUIPMENT CO. has appointed several new sales representatives as follows: Paul Cornell, 3292 Cedarbrook Rd., Cleveland Heights, Ohio; Mel Foster, 601 Cedar Lake Rd., Minneapolis, Minn.; Henry Segel, 235 Pine St., Gardner, Mass.; Royal Stem, 211 E. Van Buren St., Chicago, Ill.; Royal Smith, 912 Commerce St., Dallas, Tex.; Byron Moore, 111 St. Frank Ave., Buffalo, N.Y.; and Donald Wallace, 2414 Country Club Dr., Long Beach, Calif.

A new company has just been formed, known as TRAN BERN EQUIPMENT CO., INC., 135 Liberty St., N. Y. C., headed by Duncan Taylor and Joseph T. Bernley. They are manufacturing ground support aviation and marine-radio equipment, as well as electronic instruments and hearing-aid devices. “Joe” is well-known to Radio-Craft readers for his articles on many different technical-radio topics.

TRANSCRIPTION IMPORTS BARRED BY AUSTRALIA

Australian war emergency legislation now prohibits entry of transcriptions, pressings and stamper’s from the dollar countries. Australia however will permit importation of Mother Matrices in proportion to transcription purchases during year ended June, 1939. Importers must apply for licenses from Canberra. Free sample discs are still allowed until Feb. 29, 1940. Australian producers can still ship discs ordered and paid for, but arrival in Australian ports must be before Feb. date. This info, according to cubed advice from Macquarie Network of Sydney to Dina Amer, rep. Dr. Ralph L. Power, Los Angeles.
CO. OFFERS ITS LOWEST PRICE PHONO-RADIO CONSOLE

As a new phono-radio seasonal price break, G.E. has produced high-quality model HLA-629 to sell at the lowest retail prices in the G.E. line. Sat has full-length lid over dial sections, "FeatherTouch" tuning keys, tunable, pickup & controls; cabinet contains 14-in. speaker, beamscop antenna, & 6-tube chassis, tuning from 550 to 1,800 kc. Cost is $318,873.

$alesman $am $ays:

Data issued by U.S. Govt. Far more detailed information is available from the Bureau of Foreign & Domestic Commerce, Washington, D.C. Publications to request are: World Radio Markets covering countries wanted & The Electrical & Radio World Trade News.

NIGERIA—Largest British West African dependency. Population 21,000,000, of which only 7,000 are Whites. Total number of sets in use is 1,037. Demand small—about 760 new sets being sold annually. Americans not sold; cheaper ones do not stand up and tropic-proofed ones are too expensive. Netherlands sets enjoy greatest sales.

GIBRALTAR—2,500 sets in use by 21,000 population. This is war zone. Need we say more?

BURMA—3,700 sets in use by nearly 15,000,000 population, mostly not prospects. Poor market.

BOLIVIA—Supplementary report just issued deals with internal regulations on radio. Order as Bolivia Supplement 113-117.

FRENCH OCEANIA—425 sets in use by 45,000 population. 95% not prospects. Less than 50 sets sold last y.

NEW SERVICING MANUAL

Cornell-Dubilier’s new “Capacitor Manual for Radio Servicing” is a “prip” for the servicing profession. In its 256 pages there is a complete listing of all the radio receivers to date and the corresponding Cornell-Dubilier replacement capacitor numbers. Included also is the page in Rider’s Manuals on which each of the circuits may be found. In the rear of the book there are pages of diagrams on filter and bypass circuits as well as electrolytic capacitor diagrams, Book is gratis to all Servicemen.

OFF THE PRESS

CIRCULAR, Form GEA-2021B, General Electric Co. 6 pp. Complete list of transmitting condensers, specifications and prices.

CATALOG, No. 79 (Gift Edition). Radio Wire & Cable (formerly Wholesale Radio Service Co., Inc.) 8 pp. Radio, toys, home appliances, etc.

CATALOG-PREVIEW CIRCULAR. Presto Recording Corp. 4 pp. Recording and transcription equipment, accessories, heads, blank discs, etc.

COUNTRY REPORTS:
   CUBA—175,000 sets in use by 3,200,000 population. Competition is keen—40 different brands on market. American-made sets most popular. Deferred-payment plan used almost exclusively. Period of heavy demands is during cooler months. Medium- and short-wave sets of 5 to 7 tubes best sellers. These retail from 55 to 90 pesos (peso-$1). Electric service mostly 110-volt—60 cycles, A.C. Only 19% of autos in use have radio sets. All sets should be proofed against humidity. Very limited demand for A.C.-D.C., straight D.C. or battery sets. Set imports during last 10 mos. of 1939 numbered 16,894 units amounting to $118,578.

“F.M.” BROADCASTING DEMONSTRATIONS AND LECTURES HELD BY BOSTON RSA CHAPTER

Boston Chapter RSA, one of the pioneer chapters of the RSA, has just completed a series of lectures and demonstrations on frequency modulation. From reports received, this demonstration participated by outstanding engineers and organizers interested people in the industry was given before a capacity audience in Boston.

The talk was led by *Mr. Glenn Brownie who gave a very interesting discourse on the history of Frequency Modulation, followed by a very thorough chat-talk on the F.M. Circuit and Diagram Analysis of the receiver he is putting out. This was followed by a demonstration of the receiver itself. As the demonstration was loaned to the Boston Chapter by Mr. Harold Sampson of the General Electric Company, the Demambro Radio Company and the Lansing Manufacturing Company.

A very prominent participant in the evening’s meeting was Mr. Irving Robinson, Manager of the Yankee Network which has pioneered in the New England area the operation of Frequency-Modulated Stations.

Boston Chapter RSA is proud to have been able to bring to its members and guests this exceptional development, and desires to take this means of thankings all of the men and manufacturers who cooperated to make the program such an outstanding success.


www.americanradiohistory.com
NEW CIRCUITS IN MODERN RADIO RECEIVERS

(Continued from page 592)

magnitude and phase as at the rectifier cathode, there is no drop across the output transformer primary due to the hum component and hence the hum is reduced to the vanishing point, without an elaborate filter in the power supply.

[3] SEPARATE OSCILLATOR FOR PUSHBUTTON TUNING

Garod Models 1649 and 4159—(Fig. 3). By using a separate oscillator circuit for pushbutton tuning it is not necessary to change the wave-band setting in order to use the pushbutton tuning system, a minimum number of switch contacts need be used in high-frequency circuits and separate control of the oscillator component is provided. Mixer efficiency is greatly improved.

A transfer from manual to pushbutton tuning is made by the manual-pushbutton switch as, as in Fig. 3, the important section of which is shown. It removes the plate voltage from the regular oscillator (6SK triode section) and places it on the pushbutton tuning tube screen-grid and oscillator anode support. The pushbutton oscillator circuit is of the Colpitts type, modified by auxiliary magnetic coupling between the signal and oscillator control-grids. To the former is applied the A.C. voltage so that the oscillator and signal components are more nearly uniform.

[4] FEEDBACK IMPROVES BOTH SENSITIVITY AND SELECTIVITY OF INPUT CIRCUIT

Gamble Skogmo Inc. Model 15C—(Fig. 4). Finding a single tuned input circuit inadequate for this automobile receiver, feedback for controlled regeneration has been added which improves both selectivity and sensitivity. In this way the single tuned input circuit may be made to have the performance of a double tuned filter.

As shown in Fig. 4, the 1st I.F. primary tuning trimmer is not connected to "B"-in as usually done to a small feedback coil, L1, coupled to the 6AG signal grid input coil. Through adjustment of C1 alone, the closed circuit C1-L1-C2-L2 is tuned to the I.F. peak value, but radio frequencies may readily pass through C1-L1, thus feeding energy back to the signal grid. By this means much of the R.F. resistance of L3 is compensated or neutralized, and the Q of the circuit L3-C3 is of course materially raised. Regeneration need not increase the R.F. gain of the 6AG tube.

[5] DEGENERATION ACHIEVED BY CONDUCTIVE PLATE COUPLING

Sentinel Model 1431—(Fig. 5). Without any other circuit revisions degeneration is achieved in this receiver, simply by connecting the 2 A.F. plates with the proper value of resistance.

The signal gain from 1 plate to the other is about 10 and of course the signals at the 2 plates are in reverse phase. In effect, the signal voltage is fed back from the 6Q7G plate to ground, to the sum of this and the 0.5-meg. resistor. Something less than 10% of the signal is fed back to the 6Q7G plate so that the reverse phase signal is less than the original signal. The 2 signals approach equality at some low limiting frequency, and the circuit tends to greatly equalize the frequency response characteristics of the circuit, as for any other degenerative circuit.

PERFORMANCE
You've never seen before!
Yours with the new Meissner "TRAFFIC-MASTER"

The complete answer to the Ham's prayer — especially if he doesn't have a small fortune to spend. The Meissner "Traffic-Master" will stand up under the severest reception conditions and drag the QSO's out of the mud when other receivers fail.

Check this receiver — feature by feature — against much more expensive sets. Check it in your shack — side by side with any ham set on the market — compare results first — then take a look at the difference in cost.

High-gain "television" type tubes used in the RF section — ceramic sockets — two-stage IF channel with crystal filter — air-tuned transformers throughout. A perfected noise silencer circuit — operating ahead of the crystal filter — eliminates a large percentage of interference. Controlled pitch BFO for CW reception. Audio and phase-inverter with push-pull 6V6's provide 8.5 watts undistorted output. Last but far from least — of the important features of this receiver — the Voltage Regulated power supply to maintain perfect frequency stability!

Years of experience and development have gone into making of this receiver the finest that can be built for the dyed-in-the-wool Ham. Although it is furnished in kit form — the important components are factory-wired and tested — complete assurance of ultimate satisfaction. The entire RF-Mixer-Oscillator section is ready built — sockets for the three tubes, ceramic-insulated band-spread tuning condenser, dual-control fly-wheel dial and all associated small parts, assembled, wired and aligned — on a special sub-chassis ready to be connected to the IF channel.

The Crystal Filter and Beat Frequency Oscillator are also supplied as separate complete units. Every part is furnished (except tubes and speaker) — down to the smallest detail. All guess-work has been eliminated — the chassis and panel are completely punched — full printed instructions together with Schematic and Pictorial Wiring Diagrams make this superior receiver really easy to build!

Use the easy Meissner Time Payment Plan

The "Traffic-Master" and many other Meissner products may be painlessly purchased on a simple monthly payment basis. See your Jobber for details of this plan.

Write for Free Catalog

For further information on this remarkable receiver, as well as complete descriptions and prices on all Meissner products, write today for your free copy of the big 48-page complete catalog. Just cut out the lower portion of this ad, write your name and address on the page margin and mail to the address below.

DEPT. C-3

Meissner
MT. CARMEL
ILLINOIS

"A FAMOUS NAME FOR TWO DECADES"

Only $88.80 Net Complete Kit

530 KC to 32.4 MC

Please Say That You Saw It in RADIO-CRAFT

HOT OFF THE PRESS!

A brand new 168-page book, fully illustrated, up-to-the-minute radio constructional data and information. Contains complete diagrams and instructions for all the Meissner Kit Receivers as well as complete data on ready-wired units. A 16-page book, fully of late Television data covering theory and practical application in plain language. See your Jobber at once or order your copy direct from factory. Only 50c net.

www.americanradiohistory.com
BEST BUY in Wireless
INTERCOMMUNICATING
Systems

$24.50 per pair, consisting of TWO
COMPLETE MASTER STATIONS.

Complete two-way wireless loud speaking system. Perfect performance. Plug into any 110 volt socket, AC or DC. Equipped with CALL-TALK switch and volume control. Write for information or catalogue.

Sold on 10-day trial with Money-Back Guarantee.

Jobbers, Dealers and Distributors write for special quantity discount.

AMPLIFIERS - DISTRIBUTORS CORP.
DEPT. R.C., CHRYSLER BLDG., NEW YORK
Address Orders to
CROSLEY CHATTOBAX

Are You The Man For This Job?

ARE YOU prepared to take advantage of the opportunities that the new TELEVISION industry is creating? Train yourself now, while Television is young, for a better job. Write for FREE ILLUSTRATED BOOKLET, "A Test Plan for a Future in Radio & Television." CAPITOL RADIO ENGINEERING INSTITUTE, Dept. RC-3, 3224-16th St., N.W., Washington, D. C.

SERVICE MANUAL

DIAGRAMS YOU NEED

In our handy manual you have all the diagrams of the most-current communications and intercommunication equipment you will ever need. Complete, trouble-shooting circuits make your job easier, permit faster and better repairs.

HOW TO SAVE TIME

Circuit data, hints, information are time-savers and money-makers for you. Let this diagnosis manual be your guide to faster troubles and easier service work. Why work hard and at times be stumped again and again when hints you will ever need are included in this one bound manual. Compiled by M. Beltsman, R.F. radio serviceman, veteran instructor of radio in 5 radio schools.

LIMITED EDITION

Get your copy of this radio-man's lifetime tool. No need to scrimp money for bulky, space-wasting manuals. Only $1.95 to-day brings your copy of the handy, pocket-size tool for the job. Send to:

CROSLEY CHATTOBAX

FREE EXAMINATION COUPON

Guaranteed Publications 1212 West 13th Street
Chicago, Illinois

White-compressed Service Manual. I may return the manual for a full cash refund if I am not satisfied.

I am enclosing $1.95, send me CROSLEY CHATTOBAX Service Manual.

Send C.O.D. I will pay postman $1.95 and a few cents postage.

NAME ________________________________

ADDRESS ________________________________

Send to:
CROSLEY CHATTOBAX

Build Your Own Experimental Electronic Organ

(Continued from page 529)

Sassavant Freres who acquires them in rebuilding jobs. Two 88-note manuals with Sectional bookcases of the same width formed the author's first "console," as pictured in Fig. 11 shows.

Pneumatic Console.—A church had its roof and entire organ loft destroyed by fire after which the lead tubing leading from the pneumatic console to the organ was sold. Since pneumatic actions are obsolete, the console was of no value for rebuilding, and after gathering dust over 10 years in a store-room they were glad to sell it very cheaply.

The bulky pneumatic console is ideal for experiments since there is room to place the apparatus inside, as Fig. 11 shows.

Pallets.—Having secured your pedals, your piano-case organ is almost sure to contain an 8-foot (unison) stop and a 4-foot (one octave above normal) set of reeds. Since the bottom octave of each set is not used on the 5-octave manuals, the bottom 12 valves or pallets, if removed and replaced by magnetically-operated ones opening the 4-ft. and 8-ft. reeds separately, will provide 2 octaves of pedal notes. Magnets like those shown in Fig. 12 are made by August Klann or Wicks Co.

If your reed organ with vibration pickup is to be included in the pipe-organ console along with other types of organs don't forget that the key widths of reed-organisms and pipe-organ manuals are not the same, the reeds being slightly closer together. To overcome this, the regular rods connecting keys to pallets were replaced by longer brass welding rods (threaded for adjustment) which were fastened to extensions on the back of the manual keys. This enabled the reed action to be placed upside-down, and far enough away that the difference of spacing did not matter. See Figs. 1 and 4.

If you can afford magnetic valves to replace all the pallets, the reeds may be unified, i.e., made available in sub, unison, super, or 2-octaves-higher on any manual, but you may be troubled with key clicks if you use a wide-range audio amplifier. This means a condenser on each contact; or, plenty of shielding and grounding.

STOP EFFECTS

New stop effects can be produced in electronic organs by various circuit changes.

Intensity; Harmonics; Reenforcement.

—A straight change in intensity can make a Dulciana into a Salicional; and, with still more amplification, into a Tremulant. Higher harmonics can be accentuated by a series condenser; or, removed by a shunting condenser. A car ignition coil with secondary shunted by a condenser of 0.15-mf. can shift the resonant point to the bottom of the keyboard for bass reenforcement.

Tremolo. —Power tremolo can be produced by a rotating fibre shudder in front of the loudspeaker. An aluminum-disk-type phonograph motor with governor removed will do for the drive; Fig. 13. Adjust the speed to about 5 revolutions per second by altering the size of the shutter.

Little will be said of straight sound or acoustic pickup, type of electronic organ except to remark that it is much more susceptible to feedback. Since the Voz Humana is the hardest common stop to imitate and because it uses small pipes often bent in, on a pipe organ, a rank of these pipes enclosed with a microphone is probably the most promising application. You might try imitating the RCA chimes with a mike, and spiral chimes from striking clocks.

Fig. 14. Schematic circuit of swell pedal as employed by W. S. Pollock in the Robb Wave Organ.
Fig. 8.—Construction of the contact assembly.

Fig. 9.—Pedal contacts; it is the construction of these which is shown in Fig. 8. Also view of manual contacts, 1 feed and 3 contacts per note.

Fig. 12.—Specially-shaped pole and armature to open pallets at 15 volts and a few milliamperes.

Fig. 13.—Tremolo. Adjust frequency by altering size of shutter.

CASE HISTORIES OF P.A. SALES

(Continued from page 540)

Trimm hearing-aid devices were put in. This system was installed by Keesman Advertising Service, last Fall, at a total cost to the customer of $997.50, and a profit of 40%.

H. H. KEESMAN.

Mr. Keesman’s description of this Public Address Installation won him a Transducer Microphone as his prize in the 4th Section of the recent Radio-Craft P.A. Contest.—Editor

3 NEW TUBES

(Continued from page 544)

Half-Wave Rectifier

Heater voltage 117 117 117 volts
A.C. voltage per plate 117 150 225 max. volts
D.C. output current per plate 60 60 60 ma. max.
Plate input impedance per plate (min.) 0 40 100 ohms min.
* Sufficient impedance to limit maximum peak plate current to value shown.

C. LEE ANSON

CLEARER, Quieter RECEPTION

The Result of 6 NOISE REDUCING SYSTEMS

Many kinds of disturbing “noise” in radio and recorded music have been greatly reduced in the Custom Built Scott. Distant American and Foreign programs can now be thoroughly enjoyed. Surface noises have been removed from record reproduction without affecting tone at normal volumes.

THE WORLD’S FINEST RADIO

The precision built Scott is generally acknowledged “the world’s finest radio.” Because sold direct from our Laboratories only, it costs little more than many receivers made in factories by mass production methods and sold through jobbers and dealers. Noise reduction is only one of many amazing Scott features. Get all the facts. Mail the coupon, today!

MAIL THE COUPON...GET SPECIAL OFFER!

E. H. SCOTT RADIO LABORATORIES, INC.
4404 Ravenna Wood Ave., Dept. 244C40, Chicago, Ill.

Send all facts, special offer, order blank, and Scott Record Review. No obligation.

Name ________________________________

Street ________________________________

City __________________________ State _________________

STUDIOS: NEW YORK, CHICAGO, BUFFALO, DETROIT, LOS ANGELES

GET A REAL ELECTROPLATING KIT ABSOLUTELY FREE!

Complete details as to how it is possible to get a Real Electroplating Kit FREE, appear on Page 566 of this issue. TURN TO IT NOW!
THE "NEW" KDKA
(Continued from page 527)

As these photos show, the new 50-kw. transmitter is a great improvement over the old Westinghouse transmitter at Saxonburg, Pa. Descriptions of the photos are as follows.

1.—Against a backdrop of the 718-ft. broadcast antenna at KDKA's new transmitter station near Pittsburgh, listeners connect the radio-frequency transmission line through which program signals travel on their way into the ether.

2.—The high-voltage rectifier installed in the new transmitting station obviates manual changing of tubes during broadcast periods. In the foreground are the rectifier tubes which change alternating current to direct current. In the background are automatic relays for changing tubes without interrupting broadcasts.

3.—George Saviers, installation engineer of the Westinghouse Electric & Mfg. Co.'s radio division, connecting new air-cooled tube in the modulator unit of "new" station KDKA broadcasting the signal to his left are the high-frequency exciter and radio-frequency exciter units of the transmitter.

4.—Final connections are shown being made to 1 of the 2 radio-frequency power amplifier units in the new transmitter. The 2 tubes produce 4% of the 50-kilowatt carrier and 1/8 of the 200-kilowatt peak power of the station.

Cover Photo.—A "spare tube changer" is here shown being connected for service in the new transmitter. 2 of these 4 air-cooled modular tubes are "spares." By means of a pushbutton relay device, the "spares" can be put into service, without removal of the defective tube, during the station's transmission period. Each tube has a maximum output of 50,000 watts!

SELF-AIRCONDITIONING RADIO SYSTEM
Characteristic of the technical advances incorporated in the new station is a "radio air conditioning" system developed by Westinghouse engineers and used for the first time both to cool the giant transmitting tubes and to heat the building. Supplanting the conventional practice of circulating streams of water around the tubes and carrying off the heat generated by them, air ducts and fans circulate cool air about the mass of radiating tubes and then recirculate the heated air through the building. As the station will be on the air approximately 18 hours a day, electrical heating units housed inside the ventilating ducts of the building will be able to provide sufficient heat for the remaining 6 hours.

S.W. AND ULTRA-S.W. BROADCASTING
Although for the present the new transmitter station will send out only the standard broadcast programs, the engineers designed it ultimately to assume the broadcasting of short-wave programs over the Westinghouse international station WPTF (formerly W8XK), which is now operating at Saxonburg, and to inaugurate noise-free experimental short-wave programs over a "pick-a-back" (cross- arm) aerial which may replace the 718-foot standard broadcast tower.

Standard-wavelength broadcasting facilities of the station have been transferred from Saxonburg to the new site in order to provide more powerful radio reception for Pittsburgh's metropolitan area. Reception surveys made by this station from the new site indicate that the altered broadcast signal will be from 5 to 10 times stronger.

In addition to bringing the transmitter within 8 1/2 miles of downtown Pittsburgh, the move also enables it to broadcast its radio signals from one of the highest points in Allegheny County. At the top of the broadcasting tower, 1,000 ft. above the surrounding country, the station has been equipped with a 36-inch rotating aviation beacon mounted on a 60-foot tower. The ceramic tower has been protected by a 12-inch flashing beacon.

Eventually a cross-arm aerial will be superimposed on the main tower for the transmission of programs on high frequencies free from the usual interfering atmospheric noise. These signals will be limited, in the main, to a radius of 35 miles power to 3 independent towers. Equipment for handling this power will ultimately include 2-dozen transformers.

TRANSMITTER NO. 1
First of the 3 transmitters to be placed in operation, the standard broadcast transmitter consists of 3 principal units: a power amplifying unit, exciter modulator, and a radio-frequency power amplifier unit. The exciter modulator unit starts and shuts off the transmitter, and includes protective devices for all the electrical units.

A speech amplifier, part of the exciter modulator unit, amplifies the sixty-millionth watt program signal to a power of 250 watts, which is powerful enough to control the two 15-kilowatt modulator tubes.

In the radio-frequency exciter section of the exciter modulator unit, a quartz-crystal detector demodulates the signal frequency of the transmitter. The output of this quartz-crystal oscillator, oscillating at 980,000 cycles per second, is amplified to a power of 1,000 watts, which is strong enough to drive the 4 radio-frequency power amplifier output tubes. Each of these 4 output tubes is capable of 250 watts, giving a combined output of 200,000 watts when the transmitter is fully modulated and broadcasting; however, no program is being driven by the power output from these tubes. The 2 modulator tubes driven by the 250-watt program signal control 50-kilowatt power output from the radio-frequency power tubes, by means of a 10-ton modulation transformer, in direct unison with the program signal.

The radio-frequency power output is car-

www.americanradiohistory.com
ried over an R.F. transmission line to the broadcast antenna and radiated into the ether.

A duplicate set of controls for each of the 3 transmitters will enable an operator in the glass-enclosed master control room to supervise the programs being carried by all 3 transmitters when they are in service simultaneously. He will be able to "tune-in" on them and regulate their quality and volume.

AUTOMATIC SWITCHING OF TUBES

In addition to the master control, the air-cooled tubes and streamlined apparatus, the transmitting station boasts another "first" in radio in a pushbutton relay device which banishes interruptions of broadcasts due to rectifier tube failure.

Until now radio engineers have had to take stations off the air while they replaced rectifier tubes. The new device eliminates this interruption as it is equipped with a spare tube and a relay which automatically brings it into service when one of the regular tubes becomes inoperable. At the press of a button the inoperative tube is selected and cut out of the circuit, and a reserve tube takes up its work immediately with no loss of station time or hazard to the operators.

THE BEGINNERS' ALL-WAVER

(Continued from page 541)

and amateur phone stations come in best when the regeneration control is below the point where oscillation starts. Code signals, however, come in best above this point. In working on the shortwave bands, keep the circuit just oscillating, and tune very slowly. The incoming "dit-dit-dah" will tell you that you have a code station. A whistle, on the other hand, should serve as a warning to reduce the regeneration control setting, and then to listen to a phone station at this dial setting.

While there is nothing tricky about the operation of the All-Waver, it is well to spend some time in learning how to tune it so that you may derive maximum reception.

This article has been prepared from data supplied by courtesy of Allied Radio Corp.

LIST OF PARTS

One R.F. choke;
One variable condenser, 140 mmf.;
One antenna trimmer condenser;
One mica condenser, 100 mmf.;
One mica condenser, 0.001 mf.;
One condenser, 0.05 mf., 400 V.;
One resistor, 0.3 meg., ¥1/2 W.;
One resistor, 3 meg.; ¥1/4 W.;
One resistor, 1.5 meg.; ¥3/4 W.;
One resistor, 0.26 meg., ¥1/2 W.;
One regeneration control, 50,000 ohms;
Eight Fahnestock single clips;
Two R.F. chokes, vernier dial;
One rotary "on-off" switch;
One masonic panel 7 x 9 ins.;
One Eby 4-prong socket;
Two Eby octal sockets;
Hardware (grid clips, screws, knobs baseboard, etc.).

ACCESSORIES

One coil kit for 16 to 217 meters;
One coil kit for 190 to 560 meters;
One Raytheon type 1HSG tube;
One Raytheon type 1NSG tube;
One 1¥1/2-V. dry cell;
Two "B" batteries;
One pair Brandes 2,400-ohm headphones.

NATIONAL UNION GIVES
DYNALYZER signal tracer
on special LIMITED OFFER

$3700 DEPOSIT!
(Regularly $85.30 Dealer Price)

1600 points...
and this complete
3 channel tester
is yours!

*Points are easy to make when you sell National Union Tubes and Condensers.

OFFER EXPIRES MARCH 15th . . . ACT NOW

Look at these great features. Read why you should own a DYNALYZER for better work!

1. Accurately measures signals from 95 K to 15 M.C. in ANY LF or R.F. Channel—Only 1 tuning control required.

2. Meter enables visual tests of Osc. or Control Channels, voltage measurements up to 2,000,000 ohms per volt, and resistances up to 10 megohms.

3. Built-in Speaker enables "Listening-in" on (1) any other channel while (2) meter is being used for Osc. Tests and while (3) speaker of radio is used to listen to audio channel of radio.

It Pays to Sell National Union Tubes and Condensers!
National Union Equipment Offers Build Better Business! Ask Your Parts Wholesaler
Get COMPLETE information on the
DYNALYZER and SPECIAL LIMITED
OFFER now!

National Union Radio Corporation
Newark, New Jersey

A NEW BOOK ON PUBLIC ADDRESS

An important announcement about the greatest book on the subject of sound and allied subjects appears on Page 570 of this issue. TURN TO THE ANNOUNCEMENT NOW!

Please Say That You Saw It in Radio-Craft
ALIGNMENT—SOUND CHANNEL

It is a good plan at this point to check the alignment of the sound I.F. channel.

Shifts the oscillator frequency to 8.25 mc. and 1,000 microvolts with modulation, remove the V-T.V.m. from the junction of the 2 chokes in the image detector, and connect the V-T.V.m. from grid to chassis of the 6V6G sound output tube.

Trim the sound grid coil, and the primary and secondary plungers of the sound I.F. transformer, to a single maximum peak at 8.25 mc. If resonance occurs off-side of 8.25 mc. then slightly adjust the V-T.V.m. on the sound I.F. transformer should be spread apart or brought closer together until resonance does occur at 8.25 mc.

Proper alignment of the sound channel enables one to tune-in the image carrier of 12.75 mc. (which would be hard to find) coincidentally with the sound carrier, at its maximum peak, at 8.25 mc.

Remove the 10,000-ohm resistor and align the R.F. and oscillator trimmers by means of the station signal,—preferably, the test pattern.

In the New York metropolitan area, Station W2XBS (N.B.C.) at the present time is operating on a regular schedule and transmits the test pattern referred-to. To the trained eye this pattern tells the whole story of receiver performance at a glance.

We shall say more on the subject later on. For the present, while still using a 5-inch tube, note closely how far in towards the "bull's eye" extend the black lines forming the vertical wedges. These lines, black and white, should be clearly defined to about 1/4 in. from the outer circle of the "bull's eye" and will merge into a uniform gray in this 1/4-in. region. This represents the best that a 5-inch tube can give, and so, we will now take up the construction of the sweep chassis for electromagnetic deflection.

CONSTRUCTION—UNIT NO. 2

Prepare the small sweep chassis from the drilling layout of Fig. 7 in the same manner as the small I.F. chassis. After assembling the 2 output transformers, the 2 sockets, and the centering and linearity controls, it will be necessary to dismantle the sweep circuits on the main chassis. The 4 sweep controls are removed and reassembled on the small chassis as shown in Fig. 8. Note that the entire layout has been altered to conform with Fig. 9.

The circuit changes required in the horizontal sweep are shown in the schematic of Fig. 10 while the revised vertical sweep is shown in Fig. 11. In both cases, the main centering control requires a rearrangement of the "B" supply wiring as shown in Fig. 12. Study these diagrams very carefully as a small mistake here may do a lot of damage.

When all components have been completely assembled on the small chassis, check against Fig. 8 for correct placement of parts. Wiring of this unit should be done before fastening to the main chassis. All the leads which run from the controls on the small chassis to terminating points on the main chassis may be passed through the 4 holes which previously were occupied by the electrostatic sweep controls. These 4 holes should be enlarged to at least 3/4-in. size to prevent interaction between leads.

One of these leads, namely the Horizontal Amplitude pot.'s moving arm must be shielded up to within 1/4-in. of the 50,000-ohm limiting resistor which terminates at the plate of the G67 Horizontal oscillator, V1. All other leads are not critical providing that a little space is left between them. A 1/8-in. slip of copper foil is used for the shielding, to the yoke, with pin No. 3 grounded. Four separate wires should be connected to the yoke, the shield lug on the yoke need not be grounded.

Do not attempt to substitute this yoke or the Horizontal and Vertical output transformer with that of some other make, as the result will be an unsatisfactory image. In fact, you cannot substitute any 1 of the 3 connection units, unless you also change the other 2 parts to match.

THE DAMPING TUBE

The filament power of the damping tube is supplied by the winding which formerly was used on the 5-inch cathode ray tube. Note that the 4.5-ohm metal-sheathed resistor is discarded and that two 1-ohm wire-wound resistors are connected, 1 in each green filament lead, before reaching the damping tube socket. These resistors control to some extent the horizontal linearity and their value may have to be changed up or down in some special cases.

The bias resistor for the 6L6 Horizontal Amplifier should be of the variable-slider type, adjusted to the full amount of resistance at the start. Later on, when the set is working properly, the slider may be adjusted to about the half-way mark, or until the inner and outer large circles of the

Please Say That You Saw It in RADIO-CRAFT
test pattern are an equal distance apart. We will describe the purpose and operation of the 7 sweep controls under "Test and Operation." In the meantime let us build Unit No. 3, the High-Voltage Power Supply.

CONSTRUCTION—UNIT NO. 3

The Safety Box. Preparation of the steel box and cover of this unit represents a considerable amount of hard work. It is designed first for maximum safety and next for maximum ease of accessibility and servicing. Only 1 dangerous wire emerges from this box, that is, the wire (insulated for 10,000 volts) coming out of the top of the box and terminated in a bakelite cup which fits over the Anode 2 metal cap on the side of the Kinescope. Thus the safety box may be removed from the main chassis and placed at a distance if alterations in layout are desirable.

It is advisable to center-punch the sheet metal while still flat, on each indicated hole, after which the folding may be done, and finally, each hole drilled to size. Drilling layouts for the safety box and cover are given in Figs. 13 and 14.

The arrangement of the parts within the box is given in Fig. 16, while the upper portion of Fig. 16 gives the schematic wiring of the unit.

The drilling layout of the bakelite strip which holds the two 0.05-mf. condensers and the 2 X 2 rectifier is given in Fig. 17.

The bakelite strip which holds the voltage divider resistors and fuse is shown in Fig. 18. The position of these resistors is shown in Fig. 19.

Wiring of these 2 panels should be done first, to the partial assembly in the box and final assembly and wiring when the unit is fastened to the main chassis. The photo shows the completely assembled unit with cover removed.

SAFETY FIRST!

The set should never be operated with this cover removed. If at any time it is necessary to service the unit, first shut off all power and next discharge each high-voltage condenser to ground by touching an insulated screwdriver between ground and the condenser terminal lugs.

In order to keep the box size within reason the spacing of components with respect to the metal box is already at a minimum. Under certain conditions of excessive moisture it is possible that arcs may leap from the rectifier socket prongs to the shell of the power transformer 5%-inch below. Do not be alarmed, as a piece of oiled cambric or a thin sheet of bakelite inserted between socket and transformer will prevent any further arcs.

Testing the maximum high-voltage should not be done with the usual 1000 ohms/volt meter. Instead use either a 25,000 ohms/volt tester or an electrostatic voltmeter with 10,000-volt range. For safety's sake test only from within the bakelite cup lead of Anode 2 (which is fused), to ground, or frame of box. The voltage should be between 5,000 and 7,200 V. depending on the line source.

CONSTRUCTION—UNIT NO. 4

There remains only one more item to be done—the construction of Unit No. 4, the wooden box which holds the 9-inch tube. The box is made of 1/8-inch plywood reinforced at the inside corners with 1/4-inch-square runners. The exact dimensions of the box and mask are given in Figs. 20 and 21. Small metal tabs are used for fastening the box to the front and rear chassis partitions.

The tube support at the rear of the Kinescope is made according to Fig. 22. The mounting holes must be drilled so that they fall in between the perforations on the slope

MATCHED commercial sound products are as important to your customer’s use and satisfaction as matched skiing equipment is to the fellow in the picture above. Because by offering “matched” equipment, you can easily present a more convincing sales story to prospects.

Co-ordination of design is one of the many reasons why it will pay you to recommend RCA Commercial Sound. Every unit—from the smallest microphone to the largest sound distribution system—is designed to operate perfectly with all other units. And that’s the sort of performance efficiency your customers will gladly pay for. The sort of efficiency that means increased sales and profits for you!
Radio noise elimination is one of the finest subjects in the trade today. It is a potential money-maker for the man who is in the business of selling circuits new. Jobs are springing up all over the country and in the smaller cities. It would be well for everyone to study this subject and become familiar with its possibilities.

Chapter I.

WE REQUIRE MATHEMATICS. The reader to overcome any apparent disadvantage, he must understand the principles of mathematics. He must grasp the meaning of numbers, be able to handle them, and study the subject thoroughly.

Chapter II.

Radio Noise Interference. This chapter tells the story of the interference that occurs in the radio tube itself. It also discusses the various types of interference and how to handle them.

Chapter III.

Easy Simplified Practical Elementary Mathematics. This chapter discusses the importance of understanding mathematics, and how it can help in the trade.

Chapter IV.

Elements of Radio Interference. This chapter covers the different types of interference that can occur in a radio circuit.

Chapter V.

CASH IN ON RADIO NOISE ELIMINATION PROFITS! The chapter will show you how to make money by overcoming radio noise interference.

Chapter VI.

Sockets. This chapter covers the different types of sockets that are used in radio circuits.

Chapter VII.

List of Parts. The chapter will list all the parts that are needed to build a radio circuit.

Chapter VIII.

Inoucadijin Units. This chapter discusses the different types of units that are used in radio circuits.

Chapter IX.

Thorodarson power transformer. This chapter will show you how to build a power transformer.

Chapter X.

Jefferson output transformer. This chapter will show you how to build an output transformer.

Chapter XI.

Jefferson Vertical output transformer, No. 467-549, T5.

Chapter XII.

Two Solar high-voltage, type XAT-1, 0.035-mf.

Chapter XIII.

Three-Dubler silver-mica, 2.5 mmf., C1.

Chapter XIV.

Dubler bakelite mica, 0.001 mf., C2, C3, C4.

Chapter XV.

Dubler bakelite mica, 500 mmf., C8.

Chapter XVI.

Dubler paper tube, 0.065-mf., 400V., C11.

Chapter XVII.

Dubler paper tube, 0.1-mf., 400V., C12, C13.

Chapter XVIII.

Dubler paper tube, 1.0 mf., 600V., C10.

Chapter XIX.


Chapter XX.


Chapter XXI.

Dubler electro-tubular, 40 mf., 50V., C9.

Chapter XXII.

Resistors. One I.R.C. 5,000-ohm potentiometer, R22.

Chapter XXIII.

One I.R.C. 20-ohm potentiometer, with fixed center-tap, R25.

Chapter XXIV.

One I.R.C. 50-ohm potentiometer with fixed center-tap, R16.

Chapter XXV.

Two I.R.C. 1-ohm wire-wound resistors, 10 watts AB, R17, R18.

Chapter XXVI.

One I.R.C. 200-ohm wire-wound resistor, 10 watts AB, R15.

Chapter XXVII.

Five I.R.C. 1.5-meg., 2 watts, R26 to R30.

Chapter XXVIII.

One I.R.C. 1-meg., 2 watts, R35.

Chapter XXIX.

One I.R.C. 3,000-ohms, 2 watts, R38.

Chapter XXX.

One I.R.C. 0.5-meg., R31.

Chapter XXXI.

Two I.R.C. 0.45-meg., R34, R35.

Chapter XXXII.

One I.R.C. 0.3-meg., R37.

Chapter XXXIII.

One I.R.C. 0.25-meg., R36.

Chapter XXXIV.

One I.R.C. 0.1-meg., R32.

Chapter XXXV.

One I.R.C. 50,000-ohm, R25.

Chapter XXXVI.

One I.R.C. 1,000-ohm, R24.

Chapter XXXVII.

One I.R.C. 510-ohm, R19.

Chapter XXXVIII.

One I.R.C. 10,000-ohm, R20.

Chapter XXXIX.

Two I.R.C. 0.1-meg., R6, R8.

Chapter XXXV.

Two I.R.C. 60,000-ohm, R3, R10.

Chapter XXXVII.

One I.R.C. 5,000-ohm, R39.

Chapter XXXVIII.

Three I.R.C. 5,000-ohm, R4, R12, R13.

Chapter XXXIX.

Two I.R.C. 2,000-ohm, R5, R11.

Chapter XXX.

Two I.R.C. 200-ohm, R7, R9.

Please Say That You Saw It in Radio-Craft
Three I.R.C. *100-ohm, R2, R13, R14;
One I.R.C. *70-ohm, R1.

**1-watt.
**½-watt.

MISCELLANEOUS
One Alden insulated cap for Kinescope, No.
92TIN;
One Alden insulated cap for 2X2, No.
91TIN;
One Littlefuse, 1 millampere, with mounting
clips;
One Amphenol plug, 5-prong;
One piece sheet steel, Image chassis, 6½ x 15
x 1/32-in.;
One piece sheet steel, Sweep chassis, 6½ x 15
x 1/32-in.;
One piece sheet steel, Power Box, 15 x 19 x
1/32-in.;
One piece sheet steel, cover, 9 x 13 x 1/32-in.;
One piece bakelite, voltage-divider panel,
2 x 3 x 1/8-in.;
One piece bakelite, condenser panel, 3 x 8 x
3/16-in.
One piece sheet brass, 1 x 8 x ½ x ¼-in.;
One piece sheet brass, ½ x 6 x 1/16-in.;
Wooden box (per specifications);
Hardware, etc.

PUBLIC ADDRESS IN
OCEANARIUM

(Continued from page 527)

Studios, Johnny Whitmore, chief announcer,
is shown at the controls. Over this system
are broadcast daily descriptive lectures of the
many specimens in the huge Ocean-
arium.

B.—Installation of headphones for diver.

C.—The diver goes below to feed a banana
to one of the large porpoises by hand. With
the installation of the helmet microphone
and headphones, he is able to converse with
the announcer in the Information Lounge,
discuss over the loudspeaking system activi-
ties in the bottoms of the tanks and at the
same time can receive instructions as to
how to proceed with the underwater feed-
ing, mechanical inspections, etc.

D.—There are 3 regular feeding programs
daily at Marine Studios, at 11:00 A.M., 2:00
P.M., and 4:30 P.M. Johnny Whitmore,
chief announcer, is shown describing in de-
tail to the large crowd the feeding activities
as they proceed.

SUB-SEA INTERPHONE!

A deep-sea diver, helmeted and encased in
his heavy rubber suit, tensely watches an
11-foot shark approaching him; he asks his
companion on the surface to keep a sharp
watch for other great fish which might ap-
proach him unawares from behind, and
receives an encouraging reply as hundreds of
spectators, who have heard the entire con-
versation, gasp with suspense.

THE P.A. SETUP

There are 34 loudspeakers located in the
corridors surrounding the 2 tanks for even
distribution of sound. There is also a bat-
tery of 20-watt directional speakers above
the tanks, while a powerful 60-watt direc-
tional speaker is concealed in a palm tree
in an adjoining park to provide entertain-
ment for the guests resting there.

The system is controlled from an opera-
tor's desk in the Lounge Room quarters of
the Studios. Equipment includes in addition
to control panel, microphone and monitors
in the operator's desk and the ticket booth complete's
the sound installation.

MODEL 561 OSCILLATOR in an en-
tirely new and better instrument. In
the 561 we have for the first time, at
moderate price, an oscillator capable of
producing 14 ultra-short wave R.F.
signal (2) linear audio modulation (3)
continuously variable percent ampli-
tude modulation at all audio frequen-
cies, etc.

A. F. OSCILLATOR, 15 to 15,000
cycles cover the audio spectrum. Push
button selection of 4 output imped-
ances: 50, 500, 5,000, 50,000 ohms to
match any input. Center-tapped for
use across push-pull inputs. Absolute
accuracy of frequency and waveform.
Frequency response flat ± 1 D.B.
from 30 cycles to 10,000 cycles—15
cycles down 3 D.B. and 15,000 cycles
down 2 D.B. Output perfectly con-
trollable to 0 maximum. Output: 125
milliwatts: 35 volts open circuit.

R. F. OSCILLATOR. 5 bands 65/205:
205/650: 650/2050: 2050/6500:
65/205/2050 M.C.’s harmonics above
60 M.C. Each range push-button selected
on only two scales, All scales illu-
minated. Shadow type, dual ratio
mechanism. Air-dielectric trimmers
and iron coils inductors allow factory
calibration at both ends of each band
and to within ½ of 1%—guaranteed accu-
racy. Push button attenuator with fine
control is continuously variable from
1/2 micro-volt to 100,000 micro-volts.

CARRIER AND MODULATION
MONITOR. A vacuum tube voltmeter
is used to control output level in actual
microvolts. The R. F. and A. F. Oscil-
lators can be used separately, or the
variable audio oscillator used to
modulate the R. F. Read percentage of
modulation, 0 to 80%, direct on meter.

FREQUENCY MODULATOR uses
the SUPREME patented electronic
‘lock-center-achronization’ circuit—the

GET A REAL ELECTRIC DRY SHAGER
ABSOLUTELY FREE!

Complete details as to how it is possible to get a Real Electric
Dry Shaver FREE, appear on Page 562 of this issue. TURN
TO IT NOW!

SUPREME MODEL 561

only system which proves correct,
both mathematically and in practice.
Positive automatic centering—no "im-
age wandering"—no distortion—all is
automatic. Ideal for aligning all R. F.,
I. F. and A. F. C. circuits.

SUPREME MODEL 561 gives you all this
for only $575.00. Installation Terms $35.00
dash and 12 monthly payments of $56.62.

STOP! LOOK! FIGURE! Look over
the specifications. Everything engi-
neered and built in one unit saves
you money. We repeat, the Model 561
SUPREME Combination, Metered A. F.
and R.F. Frequency Modulated Oscil-
lator is new and better. We believe it
is everything to be found in the finest
laboratory, brought within the service-
man’s reach. Never have we had more faith in an instrument finer, more
careful, thorough and dependable
job of circuit work has ever been done.

PERFORMANCE IS PROOF! We
want every good serviceman to care-
fully consider the Model 561 OSCIL-
lATOR, because we believe that every
good serviceman needs one. We want
qualified servicemen, who will appre-
ciate this new instrument, to try out
the new Model 561 OSCILLATOR in
their own shop—so much so that we’ll
ship it right now!—10 day free trial—
then you be the judge. See your job-
ter today or write for information.

8-TUBE, 2-BAND SUPER AC-DC

Please Say That You Saw It in Radio-Craft.

RADIOs SAVE UP TO 50%

GOLMONTONE RADIO CO. Dept. SC.
DEARBORN, MICH.

GOLMONTONE RADIO CO. DEPT. AC.
DEARBORN, MICH.
LATEST RADIO APPARATUS

NEW TUBE TESTER
Earl Wabber
1313 W. Randolph St., Chicago, Ill.

TO minimize obsolescence this model 200-5M tube tester has provisions for testing ½-V. filaments in addition to the regular line voltages. This direct-reading instrument is suitable for portable or counter service.

AUTOMATIC ROBOT TUBE TESTER
Dayco Radio Corp.
915 Valley St., Dayton, Ohio

EXACTLY as the name implies this instrument, the model 401, is entirely automatic. A card index covering all tubes is arranged for handy, quick reference. You place the proper card in the slot provided, insert the tube in the proper testing socket, and pull the lever. The robot tester gives all the answers. The instrument automatically adjusts itself to suit varying line voltages. It is claimed that obsolescence is entirely eliminated by the fact that when new tubes are announced, the user simply writes to the factory for an index card for such tubes, and the machine will record the new ones.

A total of 185 cards now provide for testing 580 receiving tubes now in use.

NEW PORTABLE SET
General Electric Co.
Bridgeport, Conn.

A NEW "A" and "B" battery eliminator for use with 4, 5, 6 or 7 tube, 2-V. filament radio receivers. It delivers 90 V. of "B" and consumes 14 W. of power. Five combinations of battery plug sockets permit the battery plugs to engage this unit without any modifications. This Model F instrument measures ¾ x 4½ x 2½ ins., and weighs but 4½ lbs.

POCKET MULTITESTER
Radio City Products Co.
88 Pearl St., New York, N. Y.

FOR various types of measurements, 23 ranges are available in this Pocket Multi-tester. Known as the model 415, the instrument offers a sensitivity of 2,500 ohms/volt for voltage measurements and the low D.C. current range of 0-400 microamperes. Measures, D.C., to 5,000 V., 400 microamperes, 1,000 ma., and 10 amperes; A.C., 5,000 V.; 0.1- and 1 meg.; -10 to +60 decibels. Measures only 6 ins. long, 3½ ins. wide by 2½ ins. deep.

Please Say That You Saw It in RADIO-CRAFT
NEW-CRYSTAL MIKE

The Turner Co.
Cedar Rapids, Iowa

Known as model 33X this new crystal mike has a 90-degree tilting head for semi- and non-directional operation. This response is 30 to 10,000 cycles, free from peaks; feedback is said to be remarkably low. It has a high level of .02 db, on a wide range of frequencies. Blast-proof crystal is impregnated against moisture. Finished in satin-chrome alloy modern lines.

(See page 500 for other articles)
(Continued from preceding page)

HOME RECORDING TURNTABLE
The General Industries Co.
Elyria, Ohio

AGI - DRIVEN, governed - controlled phonograph motor for heavy-duty work such as recording, etc. Pin which engages recording blanks retracts when regular records are played. Unit is furnished with a weighted turntable for 10- or 12-in. records for 110-V. A.C., 60-cycle use only. Priced low. Model RG, 78 r.p.m.; model RG 3, 33 1/3 r.p.m.

35-W. AMPLIFIER
Allied Radio Corp.
833 W. Jackson Blvd., Chicago, Ill.

According to the manufacturer, 101 new features are incorporated in this Knight Job. The circuit, for instance, features inverse feedback for fidelity, silencer jacks, fuses, illuminated volume meter, optional remote control, headphone jacks, etc. Interesting is the built-in phono top. Has 4 input channels; universal output impedance selector; xtal pickup.

3-WAY PORTABLE
Emerson Radio & Phonograph Corp.
111 Eighth Ave., New York, N. Y.

THIS compact portable the DF-302, is a 6-tube superhet, covering the standard broadcast band. Has a built-in loop antenna and 6¾-in. P.M. dynamic speaker. The instrument is "3-way"—plays on self-contained batteries, 110 V. A.C. and 110 V. D.C. Other portable models are available.

2-BAND MIDGET
Majestic Radio & Television Corp.
2600 W. 50 St., Chicago, Ill.

MODEL 2060 is a 110 V. A.C.-D.C. table-type 6-tube superhet, affording standard broadcast and foreign reception. Chassis

Mr. Serviceman: FOR BETTER BUSINESS
... FOR BIGGER PROFITS DURING 1940...

JOIN RSA! ←

★ You belong in this big, live servicemen's organization that is really doing things for its members!
★ RSA secured cooperation with broadcasters to sell servicing to the public over the air. ★ RSA helps you to solve many difficult technical problems. ★ RSA sends you technical bulletins. ★ RSA does many other beneficial things—for you. Send now for complete details.

Let's Grow Together in 1940!

RADIO SERVICEMEN OF AMERICA, Inc.
JOE MARTY, JR., EXECUTIVE SECRETARY
304 S. DEARBORN STREET, CHICAGO, U.S.A.

MAIL THIS COUPON NOW!

RADIO SERVICEMEN OF AMERICA, INC.
304 S. Dearborn St., Chicago, Ill.

Name ..............................................................
Address ................................................................
City .............................................................. State ................................

I am interested in RSA Membership. Tell me about it. ...... 
I am enclosing $4.00 for National dues and initiation. Covers dues up to Jan. 1, 1941, in accordance with special dues concession. ...... 
(Does not include Local Chapter dues where Local Chapters are)

Please Say That You Saw It in RADIO-CRAFT
is housed in ultra-modern plastic cabinet (walnut or ivory); has attractive gold and silver dial face.

HIGH-CAPACITY ELECTROLYTICS
Cornell-Dubilier Electric Corp.
South Plainfield, N. J.

CAPACITIES of 500, 1,000 and 2,000 mf., are available in compact form at working voltages of 12, 15, 18, 25 and 35 V., in this new type FA series of condensers designed for use in low-voltage circuits such as "A" elim. rectifiers, dynamic speaker installations, etc. Example of compactness is 2,000 mf., 12 V. unit which measures only 1 3/8 ins. in dia. by 4 3/4 ins. long.

LATEST HALLICRAFTER
The Hallicrafters
2611 S. Indiana, Chicago, Ill.

KNOWN as the model 220-B "Sky Champion," this 9-tube communications receiver is designed to appeal not only to the "ham" but to shortwave listeners and DX-ers, too. Tuning range is 540 kc. to 44 mc. in 4 bands. Features include high R.F. gain and signal-to-noise ratio; power line or battery operation with instant change-over; electrical band spreading in all ranges; A.V.C. for all R.F. and I.F. amplifiers; frequency stabilized oscillator; built-in speaker; automatic noise limiter circuit.

POWER LINE ANTENNA
Technical Appliance Corp.
17 E. 16 St., New York, N. Y.

CONSISTING of a step-up transformer, capacity-coupled to the power line, this unit makes possible the use of power lines as an antenna. Condenser breakdown will not endanger set or listener because of separate transformer windings. This Taco type 140 unit is said to exhibit "perfect signal-to-noise ratio."

(See page 562 for other items)
THIS new series of connectors is designed to radiate heat away from the grid and plate connections of transmitting tubes. Main feature is the protection of glass seals of the tube, eliminating the possibility of tube failure due to leakage. Available in 4 sizes to accommodate the common sizes of wire and cap leads.

**MULTI-CHANNEL RADIO TELEPHONE**

Western Electric Co.
195 Broadway, New York, N. Y.

DEIGNED especially for private and commercial aircraft use this multi-channel 2-way radio telephone transmitter-receiver provides for dial-switch selection of any one of 10 pre-tuned frequencies. The transmitter develops more than twice the power of conventional equipment and permits long-range operation of modern air liners. All remote control is accomplished electrically — no mechanical cables or rotating shafts.

Quick and convenient access for emergency servicing is one of the features of construction. Has forced draft pressure-type ventilation through spun glass filter. Model 27A transmitter weighs 60 lbs.; output, 125W. on 2,000 to 15,000 kc.; supply, 12, 24V., D.C. Model 29A receiver, 18 lbs.; range, same as transmitter; supply 12, 24 or 110 V., D.C.

**7-PIN SOCKETS FOR LILLIPUTIAN TUBES**

American Phenolic Corp.
1250 W. Van Buren St., Chicago, Ill.

**ULTRA-TINY 7-pin molded bakelite sockets for use with RCA series of Lilliputian tubes (see February, 1940, issue of Radio-Craft for story on these new tubes).** Metal sleeve in the center of the socket shields the tube pins from each other; hole in lower end permits grounding. Socket is no wider than the tube itself, permitting extreme compactness in set construction. Floating contacts eliminate danger of breaking seal between glass and prongs.

**FEATURES IN MARCH RADIO & TELEVISION**

Frequency Modulation Stations Multiply, Perry Ferrill Jr.
Simple 2½-meter Transmitter—details of "crack" New York Station, Arthur H. Lynch, WDKJ
S.W. & B.C. Beginners Receiver, Frederic Dillon
A 25-watt AC-DC Amplifier for use with Radio Tuner, Phonograph or Mike, F. J. Bauer, WsPO
Compact 2-band Receiver for A.C. or D.C.—Herman Yellin, W2AJL
Low-Cost Television Receiver, Howard Lawrence, W5UIP

Fotocraft Features:
The Amateur "News" Photographer—Mike Fish, Head of Photo Dept., C.B.S.

How to give your Girl! Photos Glamour—Murray Roman, Famous Portrait Photographer
MORTUARY P.A.

The solemnity of the occasion demands the most dignified and impressive services possible. Listings which follow at the end of this article give the best amplifier and speaker recommendations for the average acoustic conditions in a mortuary. All are listed according to the shape and seating capacity of the chapel. Remember, you can always use a larger, but seldom a smaller amplifier than recommended.

Recommendations are ample for extending the service to separate side rooms and overflow chambers simply by the use of extra speakers placed in each of the additional rooms. Individual volume controls permit services to be heard as softly as desired in any room.

Chime and organ music can be a part of your service too, by connecting a Record Player to your amplifier.

"Hear world-famous soloists, quartets, choirs and world-renowned organists through your church, mortuary or cemetery sound system. You'll find the cost is negligible . . . really much less than you'd expect to pay for the most mediocre talent," you may tell your prospect for sound equipment.

You need only a Record Player which plugs into your amplifier and brings your customer an unlimited choice of the world's finest recorded music. Or, you'll find special amplifiers with built-in Record Players, including one with a built-in Record Changer that plays up to 8 records automatically.

This combination assures you of exactly the right music for every occasion. It is one of the principal advantages of a high-quality sound system and adds immeasurably to the dignity and beauty of any services.

"The perfection of reproduction is as though an unseen organist were playing an invisible organ, or the blended tones of a hidden choir were wafting softly from a corner concealed loft. You'll marvel at the pleasing results and your visitors, too, will tell their friends of the very beautiful, appropriate musical atmosphere," is the way your sales patter may run.

BALLROOM AND AUDITORIUM SOUND

Now it's easy to select just the right sound system for your ballroom or dance hall. The listings which follow at the end of this article take away all the guesswork—requires but a few minutes of your time, and no previous knowledge or experience to make a quick, accurate choice. Simply choose the floor plan pictured that is nearest the shape of your ballroom. Then follow the listings down until you find the size that corresponds closest to your ballroom dimensions. The sound equipment best suited to your needs appears immediately below.

Microphone and speaker placement is pictured in each of the floor plans. Where 4 speakers are shown but only 2 are designated in the tables, use the 2 nearest the microphone. If your ballroom has a balcony, note the paragraphs on this item for additional information.

Thoughts of utmost importance and interest to the audience come from the mouths of prominent speakers. A word or phrase missed by any listener may cause him to misinterpret the idea entirely. The correct sound system in your auditorium leaves no thought misunderstood . . . everyone hears the entire lecture or speech clearly. The sound salesman, in talking-up auditorium P.A., should make this point stand out strongly.

Choose the floor plan nearest your own, and you'll find the correct auditorium amplifier and speaker combination listed under the figure number in "Recommended Equipment." Always use the size closest to the size of your own auditorium. If your auditorium has a balcony, see the additional information on this item.

If your auditorium or ballroom has a balcony at the sides, add the width of the balcony (at each side) to the width of your room; if it has a balcony at the back add the depth of the balcony (at the back) to the length of your room, to determine what size you need.

If your auditorium or ballroom requires only 2 speakers, no special provision is necessary. If, however, your auditorium or ballroom, including the balcony, requires 4 or more speakers, we recommend that half the speakers be mounted in horns (Projectors or Trumpets). The sound can then be directed more effectively toward the audience under the balcony which ordinary wall baffles will not take care of satisfactorily. Additional information on the correct speaker placement, and the right type of horn to use for the best results, is contained in the related paragraphs which follow.

Gymnasiums differ from other buildings because seats usually surround the point of interest. Loudspeakers should be suspended in a cluster as shown. Amplifier and mike can be placed to one side, or any place where
RADIO TECHNOLOGY

A big surprise in store for those who attend the RCA Institutes of New York and Chicago. This year we have added new 8-hour and 16-hour practical courses in modern equipment at New York and Chicago schools. We have also added new 24-hour courses and Radio Course under "No obligation" plan. Catalog 92-RC available.

RCA INSTITUTES, Inc.,
A Radio Corporation of America Service
75 Varick St., New York. 1114 Merchandise Mart, Chicago

RADIO Technologies

(Continued from preceding page)

the announcee can view the activities. It is important that a directional mike of the dynamic type be used in this type of installation. The following table suggests the correct amplifier and speaker equipment for different-size gymnasiums.

Up to 100 by 125 ft., with—

Seats on 2 sides—40-W. amplifier; 2 speakers in projectors.

Seats on 4 sides—50-W. amplifier with 4 speakers in projectors.

Up to 150 by 200 ft., with—

Seats on 2 sides—60-W. amplifier with 4 speakers in projectors.

Seats on 4 sides—60-W. amplifier with 6 speakers in projectors.

Figures D and E show the arrangement of sound equipment in, respectively, an Auditorium with a Balcony; and, a Gymnasium.

STADIUM PUBLIC ADDRESS

A Stadium is one of the few places where the speakers are not all grouped together. Instead, 2 projectors or trumpets, so placed as to direct the sound towards the stands (see illustration) are generally used. They should be mounted as high as possible, and about 25 ft. from the stands—pointed downward then slightly downward gives the best result. One of these speaker groups should be provided for each section of the stand as shown.

When 2 similar stadium grandstands are located on opposite sides of the field, use an amplifier of approximately twice the power (or 2 amplifiers), and twice the number of loudspeakers, as recommended for each stand.

In Fig. A is shown the preferred arrangement of sound equipment for stadium grandstands up to 100 ft. long and up to 50 ft. deep. For this service one 30- or 40-W. amplifier and 2 speakers and projectors are recommended.

Fig. B. For stadium grandstands from 200 to 250 ft. long and up to 100 ft. deep. Recommended: one 60- or 70-W. amplifier, and 4 speakers and projectors.

Fig. C. For stadium grandstands from 175 to 400 ft. long and up to 200 ft. deep. Recommended: one 100-W. amplifier, and 6 speakers in trumpets.

RECOMMENDED EQUIPMENT

Sound equipment may be installed as shown in Figs. 1 to 14 incl., and Fig. A to E, incl. The recommended ratings of equipment for use in the respective set-ups are given in the following listings:

FIG. 1 (CHRUCHES)

Seating up to 500.—One 15- or 20-W. amplifier with 2 speakers in wall baffle.

Seating from 400 to 1,000.—One 20- or 25-W. amplifier with 2 speakers in wall baffle.

Seating from 800 to 1,000.—One 30- or 40-W. amplifier with 4 speakers in wall baffle.

Seating from 1,000 to 1,500.—One 60- or 75-W. amplifier with 4 speakers in wall baffle.

Seating from 1,600 to 2,000, in Unusually Noisy Areas.—One 100-W. amplifier with 6 speakers—2 in baffle, 4 in trumpets.

FIG. 2 (CHRUCHES)

Seating up to 500.—One 15- or 20-W. amplifier with 2 speakers in wall baffle.

Seating from 400 to 1,000.—One 20- or 25-W. amplifier with 2 speakers in wall baffle.

Seating from 800 to 1,000.—One 30- or 40-W. amplifier with 4 speakers in wall baffle.

Seating from 1,600 to 4,200.—One 60- or 100-W. amplifier with 6 speakers in wall baffle.

(Continued from preceding page)

A BIG SURPRISE IN STORE FOR...
RADIO-CRAFT for MARCH, 1940

75-W, amplifier with 4 speakers in wall baffles.

Seating from 1,600 to 3,200, in Unusually Noisy Areas.—One 100-W. amplifier with 6 speakers—2 in baffles, 4 in trumpets.

FIG. 3 (CHURCHES)

Seating up to 500.—One 15- or 20-W. amplifier with 2 speakers in wall baffles.

Seating from 400 to 1,000.—One 20- or 25-W. amplifier with 2 speakers in wall baffles.

Seating from 800 to 1,500.—One 30- or 40-W. amplifier with 4 speakers in wall baffles.

Seating from 1,400 to 2,500.—One 60- or 75-W. amplifier, and 2 speakers in baffles; 2 in projectors.

Seating from 1,600 to 3,200, in Unusually Noisy Areas.—One 100-W. amplifier with 6 speakers—2 in baffles, 4 in trumpets.

FIG. 4 (CHURCHES)

Seating up to 500.—One 15- or 20-W. amplifier with 2 speakers in wall baffles.

Seating from 400 to 1,000.—One 20- or 25-W. amplifier with 2 speakers in wall baffles.

Seating from 800 to 1,500.—One 30- or 40-W. amplifier with 4 speakers in wall baffles.

Seating from 1,400 to 2,500.—One 60- or 75-W. amplifier, and 2 speakers in wall baffles.

Seating from 1,600 to 3,200, in Unusually Noisy Areas.—One 100-W. amplifier with 6 speakers—2 in baffles, 4 in trumpets.

FIG. 5 (CHURCHES)

Seating up to 500.—One 15- or 20-W. amplifier with 2 speakers in wall baffles.

Seating from 400 to 1,000.—One 20- or 25-W. amplifier with 2 speakers in wall baffles.

Seating from 800 to 1,500.—One 30- or 40-W. amplifier with 4 speakers in wall baffles.

Seating from 1,400 to 2,500.—One 60- or 75-W. amplifier, and 2 speakers in wall baffles.

Seating from 1,600 to 3,200, in Unusually Noisy Areas.—One 100-W. amplifier with 6 speakers—2 in baffles, 4 in trumpets.

FIG. 6 (MORTUARIES)

Seating up to 400.—One 15- or 20-W. amplifier with 2 speakers in wall baffles.

Seating from 400 to 700.—One 20- or 25-W. amplifier with 2 speakers in wall baffles.

FIG. 7 (MORTUARIES)

Seating up to 400.—One 15- or 20-W. amplifier; 2 speakers in wall baffles.

Seating from 400 to 700.—One 20- or 25-W. amplifier with 2 speakers in wall baffles.

FIG. 8 (MORTUARIES)

Seating up to 400.—One 15- or 20-W. amplifier; 2 speakers in wall baffles.

Seating from 400 to 700.—One 20- or 25-W. amplifier with 2 speakers in wall baffles.

FIG. 9 (AUDITORIUMS)

Size 80 ft. Wide x 85 ft. Long with a Ceiling up to 20 ft.—Recommended: one 15-, 20- or 22-W. amplifier, and 2 speakers in wall baffles.

Size 120 ft. Wide x 130 ft. Long; Ceiling up to 30 ft.—One 22-, 24- or 25-W. amplifier, and 2 speakers in wall baffles.

Size 140 ft. Wide x 180 ft. Long; Ceiling, up to 40 ft.—One 30- or 40-W. amplifier with 4 speakers in wall baffles.

Size 350 ft. Wide x 350 ft. Long; Ceiling, 60 ft. or over.—One 100-W. amplifier, and 6 speakers in trumpets.

FIG. 10 (AUDITORIUMS)

Size 100 ft. Long x 70 ft. Wide; Ceiling, up to 20 ft.—One 15-, 20- or 25-W. amplifier, and 2 speakers in wall baffles.

Size 150 ft. Long x 100 ft. Wide; Ceiling, up to 30 ft.—One 22-, 24- or 25-W. amplifier, and 2 speakers in wall baffles.

Size 200 ft. Long x 150 ft. Wide; Ceiling, up to 40 ft.—One 30- or 40-W. amplifier with 4 speakers in wall baffles.

Size 300 ft. Long x 200 ft. Wide; Ceiling, 60 ft. or over.—One 100-W. amplifier with 6 speakers in trumpets.

FIG. 11 (AUDITORIUMS)

Size 70 ft. Long x 100 ft. Wide; Ceiling, up to 20 ft.—One 15-, 20- or 22-W. amplifier, and 2 speakers in wall baffles.

Size 110 ft. Long x 150 ft. Wide; Ceiling, up to 30 ft.—One 22-, 24- or 25-W. amplifier, and 2 speakers in wall baffles.

Size 150 ft. Long x 200 ft. Wide; Ceiling, up to 40 ft.—One 30- or 75-W. amplifier with 4 speakers in wall baffles.

Size 200 ft. Long x 250 ft. Wide; Ceiling, 60 ft. and over.—One 100-W. amplifier with 6 speakers in trumpets.

FIG. 12 (BALLOOMS)

Size 80 ft. Wide x 85 ft. Long; Ceiling, up to 20 ft.—One 20- to 25-W. amplifier with 2 speakers in wall baffles.

Size 120 ft. Wide x 130 ft. Long; Ceiling, up to 30 ft.—One 30- or 40-W. amplifier with 2 speakers in wall baffles.

Size 140 ft. Wide x 180 ft. Long; Ceiling, up to 40 ft.—One 60- or 75-W. amplifier with 4 speakers in wall baffles.

Size 100 ft. Wide x 250 ft. Long; Ceiling, 60 ft. and over.—One 100-W. amplifier with 6 speakers in trumpets.

FIG. 13 (BALLOOMS)

Size 100 ft. Long x 70 ft. Wide; Ceiling up to 20 ft.—One 20- to 25-W. amplifier with 2 speakers in wall baffles.

Size 150 ft. Long x 100 ft. Wide; Ceiling up to 30 ft.—One 30- or 40-W. amplifier with 2 speakers in wall baffles.

Size 200 ft. Long x 150 ft. Wide; Ceiling up to 40 ft.—One 60- or 75-W. amplifier with 4 speakers in trumpets.

Size 300 ft. Long x 200 ft. Wide; Ceiling, 60 ft. and over.—One 100-W. amplifier with 6 speakers in trumpets.

FIG. 14 (BALLOOMS)

Size 70 ft. Long x 100 ft. Wide; Ceiling up to 20 ft.—One 20- to 25-W. amplifier with 2 speakers in wall baffles.

Size 100 ft. Long x 150 ft. Wide; Ceiling up to 30 ft.—One 30- or 40-W. amplifier with 4 speakers in wall baffles.

Size 150 ft. Long x 200 ft. Wide; Ceiling up to 40 ft.—One 60- or 75-W. amplifier with 4 speakers in wall baffles.

Size 200 ft. Long x 300 ft. Wide; Ceiling, 60 ft. or over.—One 100-W. amplifier with 6 speakers in trumpets.

We regret that due to unforeseen circumstances we shall not be able to bring to you Part IV, Conclusion, on "Amplifiers" in this series of articles.

Please Say That You Saw It in RADIO-CRAFT
**MARINE RADIO TELEPHONE**

(Continued from page 525)

self-powered boats have a 24-volt system.

Practically all the 6- and 12-volt systems in use have one side grounded. Since many small battery-powered sets have one side grounded it is necessary to see that the proper battery lead is connected to ground. In the case of sets employing synchronous vibrators, the latter must be plugged-in in the proper polarity in order to avoid damage to the filter condensers and the vibrator itself.

On 32- and 110-volt systems in commercial boats both sides are usually free of ground and on the main panel there will be found a “ground detector” which shows when there is a short-circuit to ground due to salt water or for other reasons. Obviously if the attempt is made to operate a 6- or 12-volt set with one side grounded in some arrangement involving a battery charged by the main system, trouble may be caused, unless it is possible to operate the set on its own independent battery system. A battery charged by a very large, boats generally take more powerful systems, which can be obtained for the proper voltages.

Poor voltage regulation often found on commercial vessels must be guarded against. When the voltage is too low the set will not operate correctly. It goes too high look out for the filter condensers and tubes!

**WELLWORTH TRADING CO.**

1915 So. State St., Dept. RC-340, Chicago, III.

NOW ONLY 10c

NEW 1940 EDITION

MAIL ORDER PLANS TESTED MONEY MAKERS BUSINESS SECRETS SUCCESS SCHEMES

300 WAYS TO MAKE MONEY

A MARVEL IN TEXT! In 40,000 WORDS EXHIBITED IN 60 PAGES: you get ALL the real money-makers—dozens of profitable tested mail order plans, hundreds of confidential business secrets, dozens of practical tested formulas, successful tested schemes—actual experiences of men who have succeeded—plus less than 50 cents_Money-Back Guarantee.

A book that will inspire your own originality—the kind that turns your own ideas covering every type of full-or spare-time enterprise—it's a "master key" to business ventures truly worthy of your effort. FAST POSTPAID anywhere upon receipt of 10 cents U.S. checks or money orders.

NATIONAL PLANS INSTITUTE

246-R FIFTH AVENUE

NEW YORK, N. Y.

Please Say That You Saw It in RADIO-CRAFT

**MARIE H.**

206.-00-

WELLWORTH TRADING CO.

1915 So. State St., Dept. RC-340, Chicago, III.

**NOT A TOY!**

Electroplate for profit, hundreds of things in the home, in business, in the repair shop, in hospitals, in schools, in churches, etc. Professional electroplaters now have competition from this new process. Things that used to be sold by the piece are now sold by the pound. Electroplate in your own home! See Electroplate Rainbow for a fine example of electroplating. It is simple, easy and requires no special equipment. Once you have mastered a few simple operations you can turn out a fine job of Electroplating.

ELECTROPLATING OUTFIT! Send $50.00 for Electroplating Outfit from NATIONAL PLANS INSTITUTE, 246-R Fifth Avenue, New York. BE QUICK, AS THIS WILL SELL OUT! NOW—YOU CAN ELECTROPLATE EASILY WITH A BRUSH.

**NOT A TOY!**

Electroplate for profit, hundreds of things in the home, in business, in the repair shop, in hospitals, in schools, in churches, etc. Professional electroplaters now have competition from this new process. Things that used to be sold by the piece are now sold by the pound. Electroplate in your own home! See Electroplate Rainbow for a fine example of electroplating. It is simple, easy and requires no special equipment. Once you have mastered a few simple operations you can turn out a fine job of Electroplating.

ELECTROPLATING OUTFIT! Send $50.00 for Electroplating Outfit from NATIONAL PLANS INSTITUTE, 246-R Fifth Avenue, New York. BE QUICK, AS THIS WILL SELL OUT!

Send Cash Money or Remittance with Order. All Shipments will be forwarded by Express Collect if not sufficient postage included.
tained than that which might be desired. Also, there is the matter of multi-frequency operation.

In the private yacht field the aerial is the most ticklish subject to be taken up between the radio man and his prospective customer. In most cases the yachtsman would willingly prefer to forego all the benefits of the radio telephone which you have just spent the past week telling him about rather than to have any chance of his beautiful boat look like a little bit. It requires the utmost of diplomacy on the part of the installation man even to suggest such a thing. The yachtsman is, after all, and the goal of the longest and highest possible aerial, which is the radio man's desire, is in the end only poorly approximated. However, remember that an aerial doubled back on itself in order to increase length will not function properly.

On large yachts or commercial vessels a single wire or T between masts is the logical aerial. On middle-size boats with a high military mast, an L running forward or aft or a T running down a length of the boat, are often used (Fig. 1). If a wire running forward obstructs men at the anchor, a snap hook is sometimes used in order to carry it aside. Also remember that an aerial doubled back on itself in order to increase length will not function properly.

Another variation of the monel metal mast is one in which the lower section sets an insulator, inside the boat, on the keel. The upper section projects through the deck through a special ceramic insulator and the top 2 sections telescope into the first section for going under bridges and for storage purposes. Steel masts are not recommended around salt water because of corrosion.

On sailboats the great height of the masts is an advantage but the presence of the mast in the tendering zone often makes a detriment. Aerials must clear the sails and be as far from stays as possible. Breaking the stays with strain insulators helps a great deal. Insulators should not be under strain. Aerials, properly insulated, will make the best aerial.

Insulators on L and T antennas where fastening is by means of rubber grommets should be covered with at least 7 inches long and through-insulators should have at least a 4-inch path to ground. This is to minimize the effect of the deposit left by the salt spray and by snow from the smokestack or exhaust.

Aerial wire on the small yacht horizontal aerials can be No. 12 enameled copper but on larger vessels a standard 8 strands of No. 19 silicon-bronze is recommended in order to avoid being eaten by exhaust gases and to take the strain imposed by wind and ice. Aerials and lead-ins should not be run parallel to broadcast antennas or close to steel masts or parallel to wires in the lighting system. Otherwise a great deal of antenna current will be fed right back to ground instead of being radiated.

(C) PLACEMENT OF THE SET

Placement of the set merits careful consideration. Firstly the owner's convenience must be considered. Secondly the set must be put in a dry place. For one thing it must be remembered that pilot house windows are often left open in rough weather, exposing the equipment to rain and salt spray. Thirdly, the set must be located where the aerial may be connected to it by means of a short lead-in or at any rate, one which does not double back over the length of the aerial.

Lastly, the run from the set to the switchboard or batteries must not be too long.

(D) THE GROUND

The set must have a good ground for efficient transmission and for efficient noise suppression.

In steel boats any bolt into the hull makes a good ground. Bonding conveniently located pipes into the system sometimes improves transmission.

In wooden boats the motor base often makes a satisfactory ground but sometimes is inadequate. In this case improvement can be had by running a wire from the motor base to the system. A poor ground may always be detected by the fact that the transmitter tunes broadly; and often, by the thermo-couple meter acting improperly.

A good ground may be had by means of a copper plate at least 10 square feet in area fastened to the outside of the hull near where the set is going to be installed. Connection is made to the plate by means of a brass bolt usually 8-inch in diameter, soldered to the plate and going through the hull. The plate must be fastened by means of copper screws. We know of more than one instance where the plate was ripped off when the oak planking softened up from the water, permitting the copper nails with which the plate was fastened to loosen up in short order.

Connection from the set to the brass bolt is usually by means of copper braid although copper strip is said to be slightly better and will not corrode like the braid if it is necessary to run a section through the bilge. There should be no direct connection between the copper plate and the battery system. We know of one company which connected one of their sets in a yacht in such a manner that ungrounded side of the 60-volt system went to chassis which was then connected to the copper-plate ground. The result was a perfect electroplating bath with the copper plate and propellers as electrodes, and the ocean as an electrolyte. To the owner's chagrin it was not the copper plate which was eaten away!

The chassis of most large sets today are not electrically connected to the ship's supply, so that the copper-plate ground lead can be connected directly to chassis. In the case of some of the smaller sets, connections must be made through a condenser.

(E) NOISE SUPPRESSION

Noise elimination is a subject upon which volumes could be written.

Test Equipment

RCA Manufacturing Company, Camden, N. J.
A Service of the Corporation of America

10750 NET

Over $50 million RCA radio tubes have been purchased by radio users. ... In tubes, as in parts and test equipment, it pays to go RCA All the Way.

More than 3,000 Rider Chalans are making money for service men.
PRICED FOR CLEARANCE!

Rockbottom Prices on Overstocked New and Rebuilt Merchandise

When prices are low be wary! They’re low now—LOWER THAN THEY EVER WILL BE—hence this sale. Most of the merchandise is new—never used: some of it reconditioned. 100% satisfaction on each transaction or your money refunded.

ORDER FROM THIS PAGE. Use the convenient coupon below. Be sure to include sufficient extra remittance for parcel post charges, else the order will be shipped express and charges collect. Any excess will be refunded. C.O.D. shipments require a 25% deposit. If full remittance accompanies order deduct 25% discount. Send money order—certified check—new U.S. stamps. No C.O.D. to foreign countries.

ORDER TODAY

QUANTITIES LIMITED

PROMPT SHIPMENTS ASSURED

(Continued from preceding page)

In the case of gasoline motors, noise suppression is more difficult on boats than in automobiles since there is no metal body to shield the motor and because wires and controls extend over a great area. Remedies and methods claimed for the home experimentation and every job is different.

In battery ignition jobs the carbon-type suppressors are generally forbidden by the owner because of increased gasoline consumption. Even a motor using 1 coil suppressor on the distributor and I on each cylinder was found to have an increase of 15% in gasoline consumption. One distributor coil suppressor alone however, helps a great deal and does not increase fuel consumption much.

Other things which usually work are, to separate high-tension from low-tension wires, install a condenser to ground where the primary wire enters the ignition coil, shield the ignition coil, shield high-tension wires going to distributor or magneto. A condenser from generator to ground is also necessary.

Much noise can be removed by bonding objects which are not grounded or poorly so. Tiller ropes, oil lines, control rods, tachometer lead cables, etc., can all be shielded, and piped all may assist in re-radiating ignition noise. Heavy bonding braid run to the motor and soldered to any of these sources of trouble may help minimize noise. Screening the motor sometimes works, often produces no results.

The best job can be done by replacing all the high-tension wires with shielded high-tension ignition wire, and then grounding the shielding, but this is a rather costly procedure.

As a general rule with gasoline boats enough noise can be readily eliminated to permit satisfactory operation over fair distances with the motor running. Silent operation can be had without too much effort in reducing motor noises if the set has a squelch control and said control is set to open on a carrier strength of about 25 microvolts.

In Diesel boats the generator is the chief source of noise. In the case of certain fore-and-aft built Diesel engines, noise suppression is difficult and must sometimes be accomplished by opening the generator field during transmission.

On large yachts and commercial boats noise from auxiliaries—pump blowers, anchor hoists, refrigerators, electric toiles, and separate generator—must be suppressed. Condensers from the brushes to the frame, close to the brushes, usually do the work. On the main generator it is advisable to put fuses in series with condenser leads in order to play safe.

Other odd sources of noise which are noticed when a good job has been done on the preceding sources of trouble are as follows:

Static generated by the propeller shaft, which can be minimized by placing a copper or phosphor-bronze wiper against the shaft and bonding it to the motor.

In Diesel engines the friction of the pistons against the lubricating oil is said to generate static electricity; as does the exhaust exhaust gas going through the exhaust funnel.

(F) TUNING THE SET

Tuning of the transmitter will not be taken up here in any detail since the circuits used vary and since the manufacturer uses his own instructions with his own set. Briefly, however, tuning consists of resonating the equipment on the various
bands and matching the plate impedance to the antenna impedance for highest power output.

[G] PLANNING THE JOB

Prior to making an installation it is always advisable to inspect the boat thoroughly in the presence of the owner or of persons acting for the owner. The nature of the installation must be learned and the exact position of the aerial must be agreed upon and the exact placement of the set must be determined for all frequencies which must be considered. Also some idea of what may have to be done to suppress noise must be decided upon. Previous decisions and full agreement on the installation plus the owner on all these important matters will save much lost motion. Lengthy discussion at the time of the actual installation, with a crew of men who have been hired to do the work stand idle waiting for definite orders, can thus be avoided.

The initial installation of the equipment does not end the Serviceman's possible source of income from the job. When the yachtsman lays his boat up at the end of the season it is a good idea to remove the radio telephone and store the same for the winter. This also applies to any broadcast receiver installed aboard a yacht. In the spring when the boat "goes over" there is work to be done in putting the equipment in shape again. Minor adjustments to the transmitter are frequently necessary at this time because of possible changes in the wire length and accidental shift in setting.

Of course there is the regular service, but this does not differ materially from service on any other type of equipment except that in the case of the Federal Communications Commission that adjustments of the transmitter on the air may be made by a man with a 1st or 2nd Class Radio-telephone license.

This article has been prepared from data supplied by courtesy of Marinephone, Inc.

RECENT ADVANCES IN OSCILLATOR CIRCUITS

(Continued from page 535)

resistance and is so designed that the portion of the amplifier output which reaches it in the bridge circuit is great enough to raise its temperature and increase its self-capacity. A small static plate filament lamp (pilot lamp) of low watts rating has been found suitable.

When a battery current is first applied to the amplifier the lamp R1 is cold and its resistance is considerably smaller than the balance value. Thus the attenuation of the bridge has grounds to fit, and by evacuating the lamp filament warms its resistance approaches the value for which the loss through the bridge equals the gain of the amplifier. If for some reason R1 acquires too large a resistance, the unbalance potential becomes too small or possibly even inverted in phase, so that the amplification decreases until equilibrium is reached.

No overload occurs in the amplifier which operates on a strictly class A basis, nor is any nonlinearity noticeable in the system other than the thermal effect of R1. As the lamp resistance does not vary appreciably during the high-frequency cycle it is not a source of harmonics.

The circuit diagram of an experimental bridge-stabilized oscillator is shown in Fig. 6. The circuit consists of a single stage high-mu tube V1 with tuned input and output circuits T1 and T2 (tuned to the frequency of operation) and the usual power supply and biasing arrangements. The crystal is one having a very low temperature coefficient at ordinary room temperatures. A high Q is obtained by clamping the crystal firmly at the center of its aluminum-coated major faces between small metal electrodes, and by evacuating the crystal element container. (Suitable high-Q crystals are obtainable commercially.)

Figure 7 shows the resistance of the lamp R1 plotted against the power dissipated in its filament. The large rise in resistance for small amounts of power is due to the effective thermal insulation provided by the vacuum surrounding the filament and to low heat loss by radiation. The lamp operates at temperatures below the red point, assuring an extremely long life for the filament.

The circuits described above each have individual advantages in certain respects and each has its applications in radio communication. For example, the first circuit is particularly well fitted for stabilizing the frequency of existing oscillators to improve frequency stability. The transistor has many possibilities in both transmission and reception as it is well suited to oscillator circuits for superhet receivers, for the crystals in the crystal-controlled oscillators of ham transmitters and for test equipment. The bridge-stabilized oscillator was designed especially for use in such applications as frequency standards and for certain physical and astronomical measurements; but it lends itself well to any requirement for an extremely stable source of R.F. or A.F. power.

One existing application of the bridge-stabilized oscillator is in a "crystal chronometer"—a clock of unusual accuracy and reliability. Many other applications will undoubtedly be made as time passes.

SOUND ENGINEERING

(Continued from page 531)

objectionable. The gain is not quite enough for any research. On the other hand, I think the amplifier is working normally, but did not have sufficient gain engineered into it. The audio circuit consists of two 57's as pre-amplifiers, which are capacity-resistance coupled into 2 grids of a 53 the 2 plates of which are tied together. The resulting single lead is the input of an audio transformer, the secondary of which is connected to 2 potentiometers, each of which feeds a separate 56, which is in turn, transformer-coupled to a pair of push-pull 45's.

In other words the 56's start to separate the audio channels each to a pair of 45's. The amplifier uses a total of 11 tubes. Two 57's, one 53, two 56's, four 45's, one 80, and one 83. The physical dimensions of the job are such that it would be difficult to add in power. Perhaps, instead of putting on an additional 6-volt filament transformer, it might be possible to remove the present power transformer and wind on a 6.5-volt winding.

GEO. OLSON,
Olsen Radio Service,
Carrington, No. Carolina.

(Continued on page 571)
Order your copy NOW—the only

P.A. HANDBOOK

A Resume of the Contents of the AMPLIFIER HANDBOOK AND PUBLIC ADDRESS GUIDE

PREFACE

CHAPTER I—FUNDAMENTALS

A MATCHLESS VOLUME

CHAPTER II—CIRCUIT ANALYSIS

CHAPTER III—VACUUM TUBES

CHAPTER IV—MICROPHONES

CHAPTER V—AMPLIFIERS AND PREAMPLIFIERS

CHAPTER VI—LOUDSPEAKERS

CHAPTER VII—HORNs AND BATTERIES

CHAPTER VIII—AMPLIFIER COMPONENTS

CHAPTER IX—POWER SUPPLIES

CHAPTER X—ACCESSORIES

CHAPTER XI—RECORDING AND PLAYBACK

CHAPTER XII—MATCHING AND MIXING

CHAPTER XIII—ACOUSTICS

CHAPTER XIV—SOUND SYSTEMS

CHAPTER XV—SCHOOL SOUND SYSTEMS

CHAPTER XVI—CALL SYSTEMS

CHAPTER XVII—INTERCOMMUNICATORS

CHAPTER XVIII—SOUND SYSTEMS

CHAPTER XIX—HEARING AIDS

CHAPTER XX—MISCELLANEOUS APPLICATIONS

Order Your Copy NOW—

Clip Coupon and Mail Today!
SOUND ENGINEERING
(Continued from page 569)

The Answer . . .

While we ordinarily do not furnish any
information on the revision of amplifiers
unless a circuit diagram accompanies a
question, an exception is being made in your
case, because the original manufacturers
are out of business.

An approximation of the overall gain of
the amplifier is fairly correct. The prac-
tical gain which it is possible to obtain with
the tubes you have mentioned, is approxi-
imately 98 db.

Before making an attempt to increase the
gain of the amplifier, it will be necessary for
you to first and eliminate the source of
hum within the amplifier at the present
time. Otherwise, any increase in gain will
only tend to increase the hum level. This
is particularly true if most of your hum is
in the preamplifier stages. I would there-
fore recommend that the preamplifier cir-

cuits be carefully checked for hum sources.
See page 79 of Radio-Craft, pg. 78, "Obscure Sources of Hum in High-
gain Amplifiers."

The simplest way of increasing the gain
of the amplifier without the use of more
tubes is to change the 53 to a 57, and
eliminate the transformer which couples the
53 to both 56a7 tubes. (This transformer is
undoubtedly introducing some hum.) By fol-
lowing this procedure it is possible to in-
crease the overall gain of the amplifier by
approximately 14 db, which should be more
than enough to fulfill your needs. In sub-
stituting the 57 for the 53, you will lose
the advantage of electronic mixing, but the
circuit shown in Fig. 2, will, however, pro-
vide for individual control of both micro-
phone inputs with minimum interaction.

It is of course, absolutely essential that
the preamplifier 57's, as well as the voltage
amplifier 57 be completely shielded. Oth-
wise, the increased gain will tend to in-
crease any hum picked up within the tube,
particularly if they are situated close to a
power transformer or filter choke.

The usual precautions should be taken in
wiring in the 2nd-stage 57, and it may be
necessary to rewire the first-stage 57 in ac-
cordance with the circuit constants given
in Fig. 2, in order to attain the maximum
gain from this stage.

SERVICING "ORPHANS" AND
PRIVATE-BRAND SETS
(Continued from page 537)

choke resistance and voltage drop across
same, the total D.C. flowing can be calculat-
ed from Ohm's law.

Tests on the above circuit will not indi-
cate an open filter condenser and these
condensers should be tested separately for
capacity. Abnormally high A.C. voltages
to the rectifier plates and also to the

tube and rectifier filaments indicates
shorted turn in the primary of the trans-
former. Lack of A.C. at any secondary
point of the transformer of course indicates
an open transformer winding. The voltage
drops across the filter chokes having been
checked, the proper D.C. voltages can be
expected between X2 and X3 to ground.
Shorted filter condensers are invariably
in-
stances of metal shorts or broken intercon-
nections.

The simpler rectifier circuits, for ex-
ample the 2G5 (Fig. 2B) commonly used in
A.C.-D.C. sets with series filaments and
(Continued on page 573)
THREE STAR RADIO VALUE
You receive valuable subscription to RADIO-CRAFT PLUS A FREE COPY of 1940 Radio-Television Reference Annual

WITH our compliments, we want to send a copy of the 1940 RADIO-TELEVISION REFERENCE ANNUAL to you FREE, if you will simply take advantage of RADIO-CRAFT magazine's special subscription offer NOW. This offer is being made for a limited time only.

The 1940 RADIO-TELEVISION REFERENCE ANNUAL has 68 pages, large size 8\(\frac{1}{2}\) x 11\(\frac{1}{2}\), with over 170 illustrations. The contents of this book has never appeared before in handy book form. Its pages cover practically every branch of radio science and practice, from advanced radio work and experimentations, transmitters and receivers, back to a host of other data.

The Annuals have always been regarded as a standard reference work for every practical branch of radio operation and service. This 1940 edition also contains this reputation. Every radio man wants a copy of this valuable book, and this book will be of unquestionable value to you, too, if you will every branch of every practical branch of radio science and practice, and in the doing of it you will be ready for the important developments you big value every month. It means you intelligently informed about any developments in radio and television. You want the news, want it fully and exactly, want if first—why is why you should read RADIO-CRAFT regularly.

This special offer is made for just one purpose—we want you as a regular subscriber. The Annual, whose contents appears at the right, is not sold, but a copy is FREE to you if you subscribe now.

SOME SIZE AS RADIO-CRAFT

1940 RADIO-TELEVISION REFERENCE ANNUAL

Published by RADIO-CRAFT MAGAZINE

RADCRAFT PUBLICATIONS * NEW YORK, N. Y.

THIS COUPON BRINGS YOU THE ANNUAL

RADIO-CRAFT * 99 HUDSON STREET * NEW YORK, N. Y.

Gentlemen: Enclosed you will find One Dollar for which enter my subscription to RADIO-CRAFT Magazine for Eight Months. Send me ABSOLUTELY FREE and POSTPAID, my copy of 1940 RADIO-TELEVISION REFERENCE ANNUAL.

☐ This is a new order
☐ Extend My Present Subscription

NAME
ADDRESS
CITY

DONT DELAY — MAIL TODAY!

RC-340

Please Say That You Saw it in RADIO-CRAFT

Read the summary of contents in this FREE BOOK!

THE 1940 RADIO-TELEVISION REFERENCE ANNUAL contains a collection of the best and most important articles. Covering as they do nearly every branch of radio they form a handy reference work. In addition, many times and labor-saving kinks, circuits and wrinkles, and tests and tested by practicing Servicemen, experimenters and radio fans have been included. This book cannot be bought anywhere at any price. Yet it is yours by merely subscribing. Use the convenient coupon below.

BEGINNER'S SIMPLE INEXPENSIVE CONSTRUCTION ARTICLES


MORE ADVANCED SET CONSTRUCTION

The "High-Frequency" Broadcast Lamp Radio—How to Build a 6-Tube, 3-Valve Short-Wave superhet for the "Ham" or Short-Wave Fan—Build the "Lunch Box" 2-Roger Set—A Broadcast Battery Portable—How to Build a Four-Together 6-Tube Broadcast Set—The "2-in-1" All-Wave Radio for A.O. Operating—An Easily-Built 3-Tube Model Broadcast Superheterodyne Receiver.

THE SERVICEMEN'S SECTION


TEST INSTRUMENTS


PUBLIC ADDRESS AND AMPLIFIERS


"HAM" SECTION

Ultra-High Frequency Antenna—The Beginner's Low-Cost Amplifier—Modulator Meter—Phone Monitor—The Beginner's "Ham" Receiver—2½ Meter A.O. Receiver.

TELEVION

How to Build a 6½ tubes T.R.F. Television Receiver—Useful Notes on Television Antennas.

MISCELLANEOUS


USEFUL KINKS, CIRCUITS AND WRINKLES

Making a Flexible Coupler—Two-Winding Chokes—A Simple Amplifier and Battery As Improved No-LOAD Buzzer Driver.

NOTE: The book contains many other useful Kinks, Circuits and Wrinkles, not listed here.

(approximately) 45 ARTICLES
(approximately) 170 ILLUSTRATIONS 68 BIG PAGES

RADIO-CRAFT 99 HUDSON STREET NEW YORK, N. Y.
SERVICING ORPHANS AND PRIVATE BRAND SETS

(Continued from page 571)

half-wave rectification, or the 2826 used as a voltage doubler (Fig. 2C), are treated in the same manner. The D.C. voltages available from the doubler circuit are approximately twice that obtained from the same tube in the half-wave circuit. In the doubler circuit, the maximum voltage obtainable and the degree of regulation can usually be improved substantially by increasing the values of C and C1, up to about 32 mL, each.

OTHER POWER SUPPLIES

Secondary circuits of Vibrator Power Supplies are also treated in the same manner, an examination of Fig. 2D indicating that the circuit from the secondary of the transformer is practically the same as that of a transformer-rectifier circuit.

Battery Power Supplies need little mention other than to caution that all voltages, tests, to be of any value, must be made under full load conditions.

In checking output voltages available from Motor-Generators, Dynamotors or Rotary Converters, here again the tests must be made under full load operating conditions and while making these measurements, an examination of the commutators and collector rings should be made to see that they are free from any abnormal sparking. A check should be made to see that the machine frames are well grounded. Repairs to motor-generators, dynamotors and rotary converters should be carried out by repair shops specially equipped for this kind of work.

Knowing that the receiver tubes are in parallel with the power pack, the power pack is functioning properly and that the loud-speaker circuit is in order, the technician is now in a position to proceed, confident that existing defects in remaining sections of the circuit can be located quickly and efficiently.

The next section of the receiver which can be tested and adjusted independently is the audio amplifier, and this article will continue from that point in a subsequent issue.

BUILDING AN AMPLIFIER TO TEST AMPLIFIERS

(Continued from page 521)

reasons for this. No doubt the most important reason is its high plate efficiency. In the amplifier described this was not a prime factor. It seemed much more important to have as low a plate resistance as possible in the output stage. The 6A6G output tubes used in this amplifier have a plate resistance of 700 ohms. This is about ten times lower than the 6L6 tube even with 10% feedback. It is a known fact and can easily be shown that the lower the plate resistance of the output stage the better the frequency response. Especially when the load impedance is a speaker or anything besides a pure resistance load, the output tube is connected to a tap on the plate winding of the power transformer to supply fixed bias to the output stage. Each tube is connected to a separate control so that the bias in the output stage can be balanced. A switch is provided in the plate circuit to read the currents of either tube or both tubes, side by side. This switch is located on the lower left hand corner of the front panel.

The various output taps are wired to a selector switch normally set at the position connecting the panel speaker to the ampli-
A NEW PIPE THAT SEEMS TOO GOOD TO BE TRUE!

THAT'S WHY I CAN'T SELL IT UNLESS I SEND IT ON TRIAL—NO MONEY IN ADVANCE!

I've been a pipe smoker for over 30 years. I've bought thousands of pipes, of all kinds, with all sorts of gadgets in them, at all prices from 25¢ to $10.00 each. Whenever I saw anything new in the pipe line I'd "fall" for it. But every time I was disappointed. My pipes all reeked with "goo".

When I first heard of Dr. Shotton's Non-Condensing Sanaton, I thought it was "just another" pipe. In fact it didn't look as promising as a lot of other pipes I'd bought. But Dr. Shotton gave me one and simply said, "Try it." Well, I tried it—and could hardly believe it possible that such a simple invention could make such a big difference in pipe-smoking pleasure!

You see, all other patented pipes seem to be designed to TRAP and HOLD moisture. The object is to keep that strong, "goo" out of your mouth. As far as I'm concerned, to most pipe smokers, that the more "goo" which is accumulated IN the pipe, the more "goo" is being kept OUT of the mouth!

Dr. Shotton took another tack. He believed "goo" was the result of CONDENSATION—just as dew, or rain, or fog, or the water on a cold pipe or pitchet is the result of condensation. So instead of trapping and holding moisture, he placed a little aluminum NON-CONDENSER IN THE BOWL of his pipe—and NOTHING in the stem! And it worked! It worked so well that smokers could hardly believe it. It seemed impossible to make a pipe that would really be DRY. But the principle used by Dr. Shotton was scientifically sound, and Dr. Shotton's Sanaton pipe is really "drier, as a desert." And the method is protected by U.S., Canadian and British Patents.

Another feature of Dr. Shotton's Sanaton pipe is the fact that when tobacco "tars" accumulate in the "bore," it's the easiest pipe in the world to clean. Just run a pipe cleaner from one end THROUGH the other. It's the ONLY pipe in the world that CLEANES LIKE A GUN! One minute does it!

So—Dr. Shotton's Sanaton pipe is DRY—and CLEAN. It needs no "gadgets" in the stem, no wells or traps or filters. It's DRY and STAYS dry!

But—what's the use of making CLAIMS. I'm doing what Dr. Shotton did to ME. I'm asking YOU to try a Sanaton, at my risk of it making good. I could write a million words but they wouldn't mean a thing to a skeptical pipe smoker. One pipeful, however, tells the story! So I say, send the coupon—without money—and I'll send you a Sanaton. Try it for 10 days, then if you agree with me that it's the best pipe in the world, regardless of name or price, send me $2.00. If not—break the pipe and send me the pieces. What could be fairer than that?

If Dr. Shotton's Sanaton is all I say it is—and all that my customers say it is, it's worth more than the most expensive pipe on the market! If not, I don't want a cent. You can't lose, on this offer!

Send the coupon NOW. Be sure to check whether you want a Small, Medium or Large pipe. And—please—order on your letterhead or enclose your business card, or give me a credit reference so I can keep the "dead beats" away. Mail the coupon NOW!

Mark Foster, 7018 Euclid Ave., Cleveland, Ohio

DR. SHOTTON'S SANATON
Non-Condensing Tube Keeps It Dry as the Desert
Cleans Like a Gun

Whenever it needs cleaning!

Patented, U. S., Canada and Brit. Britain

FREE TRIAL COUPON

Please send me one of Dr. Shotton's Non-Condensing Sanaton Pipes. (Check size wanted)

- Small - Medium - Large

I will try it for 10 days. If I like it I will remit $2.00 for it. If not, I will break it up and send you the pieces and you are to cancel the charge.

Name ____________________________________________

City ___________________________ State ________________

Reference __________________________________________

Please Say That You Saw It in RADIO-CRAFT

Note: Please enclose business card or give name of a reference.
A.F. AMPLIFIER LOAD MATCHING TECHNIQUE

(Continued from page 539)

Fig. 4B should be used. This latter circuit is excellent for matching the output of an amplifier to magnetic recording heads, which are notorious for their great changes in impedance with frequency.

POWER DISTRIBUTION FORMULAS

Under varying conditions, it may be necessary to distribute power among speakers in some fixed and definite proportion. The following formulas will facilitate calculation of the correct output tap to be used:

Calculation of Output Power Distribution

1. Calculate the load power:

\[ P_L = \frac{W_L}{Z_L} \]

2. Calculate the line power:

\[ P_W = \frac{W_W}{Z_W} \]

3. Calculate the total power:

\[ P_T = \frac{W_T}{Z_T} \]

Where:

- \( W \) = Watts output
- \( Z \) = Impedance of transformer tap
- \( L \) = Load
- \( W \) = Total watt output

Example: What taps are used on the secondary of a transformer to distribute power as follows:
- 0.5-watt each to 3 5000-ohm speakers
- 3.0-watts to 2 1000-ohm speakers
- 10.0-watts to 1 1000-ohm speaker

Solution:
- Total Watts = 1.5 + 6.0 + 10 = 17.5 W.
- \( Z_L \) of A = 1,600 ohms
- \( Z_L \) of B = 7.5 ohms
- \( Z_L \) of C = 10 ohms

Output Taps =

A. 1.5 \( \frac{1,666}{1,666} \) = 143 ohms
17.5

B. 6 \( \frac{7.5}{7.5} \) = 2.57 ohms
17.5

C. 10 \( \frac{5.7}{5.7} \) = 5.7 ohms
17.5

SERVICING QUESTIONS AND ANSWERS

(Continued from page 540)

Following is a possible list of remedies.

1. Ground the “neutral” of the house wiring at the house in addition to retaining the ground at the distribution transformers.
2. Use an improved ground at the receiver.
3. Install R.F. bypass condensers from the power line to ground at the point where it enters the house, near the receiver, or in both places.
4. In some cases, it is necessary to install R.F. chokes in the line, as well as the bypass condensers.
5. Relocate the antenna so that there is less pick-up from the power line to the antenna or lead-in. Use a shielded lead-in where necessary.
6. Possible relocation of the receiver may assist in curing the condition.

SERVICING PUZZLERS

(Continued from page 538)

tubes tested normal as did the various voltages and resistors. With a signal generator, I checked the I.F. for alignment; then found that by substituting the unmodulated R.F. of the signal generator for the set oscillator, the signal would remain steady indefinitely.

Allowing the set to cool thoroughly, I tested each individual part in the oscillator circuit, using a 20,000 ohms/volt and ohmmeter voltmeter. Then allowing the set to heat for about an hour, I turned it off and rapidly tested the same parts before they had time to cool off. I found that the trimmer condenser on the broadcast coil of the oscillator showed considerable leakage. Turning the adjusting screw of this unit would cause the meter reading to vary as would the heat from a soldering iron held close to it. Replacing the mica insulation of this condenser eliminated the trouble completely. Apparently the old mica had absorbed moisture.

Wilmer N. Barnes

Modernize Your Service Shop . . . .

. . . . by building an ultra-modern test-bench. Full constructional details are given in the April issue of Radio-Craft. The bench is similar in design to the semi-circular control desks used in broadcasting studios, with all service instruments conveniently hand. This service bench will save you time and money. Don’t miss the article. Reserve your April issue NOW.

Please Say That You Saw It in Radio-Craft

www.americanradiohistory.com
THE RADIO MONTH IN REVIEW

(Continued from page 519)

for "special emission." This was later amended to 432 mc. by the Federal Communications Commission. The Aerovox Corporation, 576 W. 36th St., New York City, has the label "mica capacitors tor. Likewise the option of low-loss mica (yellow Anah) bakelite in any type at slight additional cost. This wider choice of mica capacitors is not to be overlooked in assembling quality "rigs" or handling lasting repairs. Ask local jobber for new 1940 catalog or write direct.

AERVOX CORPORATION
NEW BEDFORD, MASS.

INDEX TO ADVERTISERS

A
Aerovox Corporation .................................. 576
Amphenol Corporation ................................ 581
Ampex Corporation .................................. 581
Amplifier Co. of America .............................. 558, 560
Amplifiers Distributors Corp. ......................... 550
Arrow Sales Company ................................ 554
Theo. Audel & Company .............................. 564
B
Browning Laboratories, Inc. ......................... 676
Juristen-Applebee Co. ................................ 559
C
Capitol Radio Engineering Inst ....................... 579
Classified Section ................................. 579
Cornell-Dubilier Elec. Corp. ........................ 561
D
The Data Print Company ............................. 552
Dayton Acme Co ...................................... 562
E
Foster Products, Inc .................................. 574
Goldentone Radio Company .......................... 567
H
Hammarrlund Mfg. Co. ............................... 556
Howard Radio Company .............................. 552
Hudson Specialties Co. ............................... 569
Brande Sylva Corp. .................................. 561
K
Kenyon Transformer Company ........................ 559
L
Lancaster, Allwine & Rommel ......................... 560
Lincoln Engineering School .......................... 573
M
McGraw Hill Book Company .......................... 569
Marinestone, Inc. .................................... 569
Malson Mfg. Co. ..................................... 570
Midwest Radio Corp. ................................ 529
N
National Plans Institute ................................ 554
National Radio Institute ................................ 513
National Radio Parts Distributors A.-m. ............ 571
National Schools ...................................... 553
National Union Radio Corp. .......................... 563
New York YMCA Schools ............................. 562
R
Radio & Tech. Publishing Co. ........................ 565, 559
Radio City Products Company ......................... 564
RCA Manufacturing Co., Inc. ....................... 551, 571
Radio Servicemen of America .......................... 574
Radio Training Association .......................... 554
Radio Wire Television, Inc. ......................... 565
Radio Time Outlets ................................ 570
RCA Institutes, Inc. ................................ 564
Readrite Meter Works ............................... 570
S
E. H. Scott Radio Labs .................................. 551
Solar Mfg. Company .................................. 564
Sprague Products Company ............................ 556
Sprayberry Academy of Radio ......................... 516
Superior Instruments Company ....................... 571, 572
Thee Stack Cover ..................................... 557
Supreme Instruments Corp. .......................... 557
Supreme Publications ................................ 571, 572
T
Technifax ........................................... 574
Tripent Elec. Instrument Co. ........................ 565
The Turner Company ................................ 570
U
Universal Microphone Co., Ltd. ................. 573
W
Wellswood Trading Company .......................... 571
Wright-DeCosten, Inc. ................................ 578

SENIOR EDITORIAL STAFF

Assistant Editor: C. A. BOYD
Associate Editor: P. W. COOK
Assistant Editor: P. W. COOK
Assistant Editor: P. W. COOK

Please Say That You Saw It in Radio-Craft

Printed in U. S. A.

Bakelite-molded capacitors with meter-mounting brackets for r.e. shunting of meter windings, are now available in the remarkably complete Aerovox line of mica capacitors. Likewise the option of low-loss mica (yellow Anah) bakelite in any type at slight additional cost. This wider choice of mica capacitors is not to be overlooked in assembling quality "rigs" or handling lasting repairs. Ask local jobber for new 1940 catalog or write direct.

AERVOX CORPORATION
NEW BEDFORD, MASS.

NOISE-FREE RECEPTION

Major Armstrong's wide-band frequency-modulation system is the latest development in radio reception and transmission. Famous for its freedom from static, it is equally remarkable for its ability to transmit the full dynamic and frequency range of the original program.

The Browning Frequency-Modification Adapter offers an outstanding opportunity to progressive service men. It may readily be connected to the audio system of an existing receiver and placed within the console. Or, with the addition of an audio amplifier and speaker it becomes a complete radio in itself. High quality components provide superior performance and thorough engineering makes installation easy. Write for Bulletin 105.

BROWNING LABORATORIES, INC., WINCHESTER, MASS.

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)
**THE NEW 1130-S SIGNAL GENERATOR WITH AUDIO FREQUENCIES**

Combination R.F. and Audio Signal Generator, R.F.—100 Kc. to 100 Mc., A.F.—100-7,500 cycles. All direct reading, all by front panel switching. R.F. and A.F. excited independently obtainable alone or with A.F. (any frequency) modulating R.F. Accuracy is within 1/2% on R.F. and Broadband tests; 2% on higher frequencies. Audio frequencies in 5 bands: 300, 400, 1000, 5000, and 7500 cycles.

Giant airplane full vision, direct-reading dial. Condenser and other leakers tested to 100 megohms. All services on 90-150 volts A.C. or D.C. (any frequency). Model 1130-S comes complete with tubes, test leads, carrying handle, instructions. Size 12"x9"x6 1/2". Shipping weight 15 pounds. Our net price...

**THE NEW MODEL 1280 SET-TESTER**

A complete testing laboratory in one unit, the Model 1280 combines the Models 1250 Multitester and 1240 Tube Tester. (See specifications of each below.)

- Instantaneous Snap Switches Reduce Actual Testing Time to Absolute Minimum.
- Spare Socket and Filament Voltages Up to 120 Volts, Make the Model 1280 Obsolescence Proof
- Latest Design 4½ D'Auralon Type Meter.
- Works on 90 to 120 Volts, 60 Cycles A.C.

Even those technicians who through past purchases have by now always set SUPER-VALUES from Superior will be amazed and delighted when they read the specifications of this all-purpose instrument and then note the unbelievably low price. The Model 1280 features a 4½ D'Auralon type meter for easy reading of the variable scale, and in line with our new policy of streamlining apparatus as well as serviceability. In our new list of test equipment, one Model 1280 utilizes an aluminum etched panel, designed for beauty as well as reductiveness. This panel appearance, this unit accurately measures the CAPACITIES of mica, paper and electrolytic condensers, INDUC TANCE of coils, chokes and transformers, D.C. CRITERIA, gain or loss, of power amplifiers and public address systems, WATTS output of amplifiers, receivers, etc.

**SPECIFICATIONS**

Combination R.F. and Audio Signal Generator, R.F.—100 Kc. to 100 Mc., A.F.—100-7,500 cycles. All direct reading, all by front panel switching. R.F. and A.F. excited independently obtainable alone or with A.F. (any frequency) modulating R.F. Accuracy is within 1/2% on R.F. and Broadband tests; 2% on higher frequencies. Audio frequencies in 5 bands: 300, 400, 1000, 5000, and 7500 cycles.

Fast airplane full vision, direct-reading dial. Condenser and other leakers tested to 100 megohms. All services on 90-150 volts A.C. or D.C. (any frequency). Model 1130-S comes complete with tubes, test leads, carrying handle, instructions. Size 12"x9"x6 1/2". Shipping weight 15 pounds. Our net price...

**THE NEW MODEL 1240 TUBE TESTER**

Instantaneous snap switches reduce actual testing time to absolute minimum.

- Tests all tubes.
- Sockets for all tubes.
- No adapters.

**SPECIFICATIONS**

Complete A.C. and D.C. Voltage and Current Ranges

- D.C. Voltage: .0005 to 1 m.d., .05 to 50 m.d., 3 Decibel Ranges
- A.C. Voltage: .005 to 1 m.d., .05 to 50 m.d.
- A.C. Current: .005 to 1 m.d., .05 to 50 m.d.
- 2 Resistance Ranges: 0-500 ohms, 0-500S megohms
- Model 1130 works on 90-120 volt 60 cycles A.C. Comes complete with test leads, labroratories, tubes, and instructions. Shipping weight 9 lb. Size 12"x9"x6 1/2". Our net price...

Portable cover $1.00 additional

**SUPERIOR INSTRUMENTS CO.**

134 LIBERTY ST., DEPT. RC3
NEW YORK, N. Y.

Portable cover $1.00 additional
NEW C-D MINIATURE CAPACITORS
Going over in a Big Way!

It's the smallest 500 volt (working voltage) dry electrolytic on the market—extremely handy to use, completely eliminating exact duplicate replacements. Enough practical features to win for the Type BR "Blue Beaver" a preferred position among value-wise servicemen. And now a new version of C-D's Type BR electrolytic is ready. A "perfected" unit—finer in performance, more compact in size, more value for the money than ever before!

D. C. leakage has been reduced, thanks to a high purity aluminum foil. Higher voltage breakdowns have been achieved through C-D's high formation process.

You need this CORNELL-DUBILIER CAPACITOR ANALYZER
Ought to be in every laboratory and shop. A precision instrument, C-D Capacitor Analyzer Model BF50 measures quickly and accurately all important characteristics of all types of capacitors. Most accurate and thorough capacitor test of any instrument of its type. And the low list price makes it an all-time high in value!

Dealer $24.90
Net $24.90

CORNELL-DUBILIER ELECTRIC CORP.
1014 Hamilton Blvd., So. Plainfield, N. J. N-310

Please rush the following literature:
☐ Catalog No. 167-A on Capacitor Test Instruments.
☐ Catalog No. 175-A on complete line of C-D Capacitors.

FREE—256-PAGE CAPACITOR MANUAL FOR RADIO SERVICING

GET THE FACTS on these useful Cornell-Dubilier Test Instruments. Check the coupon for Catalog No. 167-A. It's yours FREE!

CORNELL-DUBILIER CAPACITOR BRIDGE
Here's new value and performance in a quality low-priced instrument. Cornell-Dubilier Model BN Midget Capacitor Bridge for servicemen and technicians measures all capacitors between limits of .00001 mfd. and 50 mfd. Also indicates power-factor of electrolytic capacitors.

Dealer $9.90
Net $9.90

And there's been still further improvement in temperature characteristics, in audio and radio frequency impedance characteristics. The 500 v. dry electrolytic capacitor that topped 'em all in life expectancy can now boast even greater time-defying performance! Yet the low list price for C-D Type BR "Blue Beaver" remains unchanged...a typical price is 85¢ for the 8 mfd. 500 volt wv.

Ask for the new, perfected "Blue Beaver" at your jobber's, or mail coupon for combined catalog and Capacitor Manual.