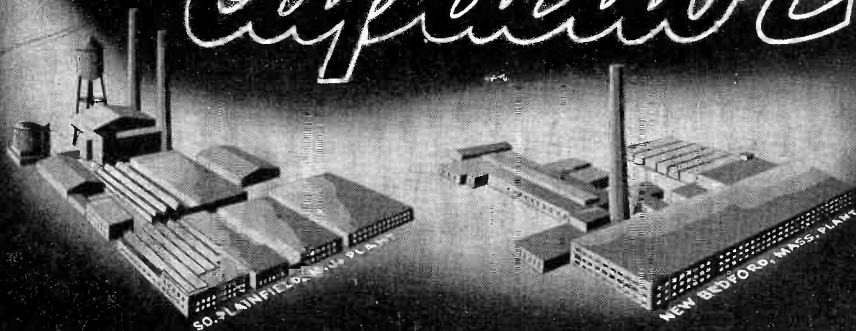


The CORNELL-DUBILIER Capacitor



Vol. 9

OCTOBER, 1944

No. 10

CORNELL-DUBILIER ELECTRIC CORP.
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These columns are open only to those who have a legitimate, WANTED, SELL or SWAP proposition to offer. The Cornell-Dubilier Electric Corp. reserves the right to edit advertisements submitted, and to refuse to run any which may be considered unsuitable. We shall endeavor to restrict the ads to legitimate offers but cannot assume any responsibility for the transactions involved.

Please limit your ad to a maximum of 40 words, including name and address. Advertisements will be run as promptly as space limitations permit.

FOR SALE — Espey FM-AM. Radio, 14 tubes, console cabinet with automatic record changer, pushbuttons, and magic eye. Over 250 records in matching cabinet. \$300. Roy Aberle, 161 Bush St., Brooklyn 31, N. Y.

WANTED — Hallicrafters communication receiver or what have you. Cash waiting. Send details as to model, condition, etc. Warren Chase, Cambridge, Vt.

WANTED — Riders 7 to 12, Jr. Voltomyst, Solar condenser checker, any 1.4 V tubes, 12 V tubes. State condition of instruments and manuals and price. Seaside Radio Service, Box 886, Seaside, Ore.

WANTED — Solar or C-D Capacitor Analyzer, also modern or late model combination tester and tube checker. State price and condition. J. R. Kinney, 2901 You St., Sacramento 17, Calif.

WANTED — Beede 0-1 M.A. 3" square type meter. Will accept the above with a V.O.M. scale. Jack Goldstein, 151-09 34th Ave., Flushing, L. I., N. Y.

WANTED — One 84 tube volt ammeter tester for auto generator, exhaust gas analyzer; magneto and generator test bench. Cash for right articles. Pennington's Garage, Wauneta, Neb.

WANTED — Hallicrafter S-27 receiver, Howard preselector with loops. Also a recorder; state make, size, speed, and condition. Paul R. Schramm, 2755 W. Carmen Ave., Chicago 25, Ill.

SALE OR TRADE — Lafayette amplifier 30 watt, 3 PM speaker output. Best offer takes it; or will swap for Precision 912 tube checker, or any Precision combination tube checker and V.O.M., or late model signal generator. Must be in perfect condition. M. J. Difini, 1698 Lexington Ave., New York 29, N. Y.

FOR SALE—Rider's I to V, practically new \$25; Superior mod. 1230 sig. gen., new \$16; Triplett mod. 426 4" sq. case microammeter, 0-500, new, \$12.50; Zenith 52 chassis, spkr., pwr. pack and push-buttons \$10. Other parts, stamp for list. J. W. Bourke, 196 Clinton Ave., Brooklyn 5, New York.

WANTED—1939 auto radio, Philco, mod. C-1608; price and condition. Rider's manuals from No. 9 to 13. State price and condition. Philann Radio service, 348 Me rose St., Brooklyn 6, New York.

FOR SALE OR TRADE—G. E. induction disc phono motor, mounted with speed control and 12 in. turntable, price \$5. Stewart-Warner short wave converter, can be attached to any radio: has tubes, cabinet with full instructions, price \$5. Philco radio, 11 tubes, price \$25. Jack Abramowitz, 118 Clara St., Brooklyn 18, N. Y. C.

FOR Sale—2 Aluminum Projector Baffles with 2 2" 6v. speakers, \$15. Rider Vol. 2, \$3.75. 1 Shure 708A Hi Impedance Microphone and 25' cable, \$16. 1 modern Radio Servicing by Ghirardi, \$3. Van's Radio Sales, 1718 S. Westmedge Ave., Kalamazoo 39, Mich.

WANTED—Any inexpensive volt-meter for experimental purposes. Will trade Manhattan Electric Supply battery ammeter. Other electronic equipment needed. C. Shiffman, 80 Hazeltin St., Mattapan 26, Mass.

FOR SALE—2 complete interphone systems, new, worth \$60. Has 5' dynamic speaker and tubes. Name your price. Al Scarpa, 1542 58th St., Brooklyn 19, N. Y.

WANTED—Thordarson transformers 15A74, 15A67, 15R05, and 87R85. Also Lansing Hi-Fidelity speaker. State price and condition. J. E. Loraine, 211 Summer Ave., Newark 4, N. J.

FOR SALE — 2 Inca chokes, 10-H 400 ohms, 200 ma. Both for \$2. Thordarson 2927 choke at 500-H, 75c. Jefferson 5 to 13 volt variable 50 watt electric train trans., \$1.50. P. Rosenblatt, P. O. Box 905, Hoboken, N. J.

WANTED — Complete instructions how to use octal adapters with Dayrad tube checker type 381 either original or photostat. Will pay. Alden Wood, 57 Chestnut Ave., Pelham 65, N. Y.

WANTED — Sig. generator, prefer Supreme or Philco, and late model tube tester. State description and price. Cash waiting. Thomas F. Wilson, 1209 Admiral Dewey Ave., Pascagoula, Miss.

SERVICE MAGAZINE, May, 1932, to March, 1942, in good condition, for \$5 Ira I. Walker, 1612 Cent Ave., Great Falls, Mont.

WANTED — Public address system, 25w with mike and radio and phono input. Also automatic record changer. Must be in good condition. Will pay cash. Mac Hoyt, 159 Bay 37 St., Brooklyn 14, N. Y.

SALE OR SWAP — Record players, amplifiers, Weston tube tester, and volt ohm meter. Want various tubes. C. Morgan, 2209 Edison Ave., Jacksonville 4, Fla.

WANTED — Good radio service man with military exemption or disability discharge, permanent place at top pay for reliable man, in pleasant, healthful climate. Character and ability references required. Loomis & Co., Las Cruces, N. M.

WANTED — Triplett Model 1613 tube tester and Model 1200-C volt-ohm-ammeter or Model 625-T. Give full particulars first letter. Cecil Fernandez, Box 1453, St. Petersburg 1, Fla.

FOR SALE — Philco audio signal generator model 044. Range 0-10,000 cycles. Slightly off calibration near h.f. end, but adjusting trimmers provided. \$25. Robert E. Altomare, 10306 Colesville Rd., Silver Spring, Md.

FOR SALE—Large VOM. Write for price and description. The Electric Mfg. Co., Hastings, Mich.

FOR SALE — Hickok Model AC 51 tube tester at \$25. Meissner Analyst Model 10-1154 at \$65. F.O.B. Brook's Electric Shop, Twin Bridges, Mont.

SELL OR SWAP — Janette Rotary Converter 32v. DC to 110v. AC. 2 Leach Breakin relays; 4 Leach 24v. relays; Sangamo fixed transmitting condensers. Want photographic equipment, lenses, model race cars, Hornet engines. Fred J. Gomme, 547 Northeast 94th St., Miami Shores 38, Fla.

FOR SALE — Wollensak wide angle lens (new) 111A 3 1/2" F:12.5; 6 1/2" Goerz Dogmar F:4.5, Compur shutter; 7 1/4", 12", 18" Turner Reich F:7.5 lens, Gundlach shutter; 15' trimming board. Fred J. Gomme, 547 Northeast 94th St., Miami Shores 38, Fla.

SELL OR TRADE — 35-mm sound track films. All new condition, some in color, \$6.50 per 2000' reel or will swap prints with you. W. L. Bourne, 870 Seward, Detroit 2, Mich.

WANTED — .22 or .38 Colt Revolver. Also .32 Colt Automatic. State condition and lowest price. Roger L. Mills, P. O. Box 511, Lawrenceville, Ill.

WANTED — Battery operated signal generator, 7A8 and 12SA7 tubes for cash or C.B. OMA oscillator, C.B. CRA oscillograph, \$25 slide rule, or typewriter. V. Taverna, 155 Blackford Ave., S. I. 2, N. Y.

FOR SALE — RCA 2" Cathode Ray tube, \$5; 2 Crystal Recording Cartridges, \$5 each; Weston 676 Counter Model Tube Tester, \$20; 3 Model B-1 crystal pickups, \$2.50 each. Want Bridges, Decade boxes, laboratory and glass working equipment. J. Ray Stanphill, 764 S. Olympia, Tulsa 6, Okla.

WANTED — Solar C E Exam-eter or Aerovox model 95 L-C checker, Electronic multimeter tubes, and phono crystals, any condition, also mike stand. Wayne Fernyhough, 1850 E. Van Buren St., Phoenix, Ariz.

FOR SALE — Sound Pictures and Trouble Shooters Manual, Cameron and Rider, \$6; Auto Radio Manual and Index, Vol. 2, Rider, \$3; Vol. 1 through 5 Rider's Manuals, \$35; Aligning Philco Receiver, Rider, \$1. Want Vol. 11, 12, and 13 Riders for cash. All volumes in excellent condition, Warren Chase, Cambridge, Vt.

(Continued on page 15)

RADIO THEORY REVIEW — — for FCC Operator Exams*

PART I

SUMMARY OF WHAT A POTENTIAL COMMERCIAL RADIO OPERATOR SHOULD KNOW OR STUDY BEFORE ATTEMPTING TO PASS THE FCC EXAMINATIONS

"It's not so tough if you know your stuff," gloats many a proud possessor of a new "ticket" as he walks out of the Federal Communications Commission examination room after successfully completing the tests for a commercial radio operator license.

It's true. The 1,300 questions outlined in the official Study Guide for Commercial Operator Examinations present difficulties only if a student at-

how much, of each subject is required, was prepared to indicate a definite line of study and not to supply answers to individual questions.

To begin with, you probably would not be reading this article if you did not already possess at least a nodding acquaintance with radio terminology. If you already know that EMF (electromotive force) is just another name for voltage and that amperage is merely another term for current, you are well on the way.

It is quite necessary to have a sound knowledge of the names of the various electrical factors. As an example, the student should know that "gilbert" is the name for a unit of magnetomotive force. He should also know that ampere turns can be changed to gilberts by multiplying by 1.26.

The mathematical meanings of micro and micromicro, kilo and meg, should also be learned.

Remember that these are preliminary steps. Without this fundamental knowledge of terminology the task of studying radio becomes much more difficult.

The meanings of other terms such as permeability, residual magnetism, inductance, and conductance are easily absorbed but some phrases, such as power factor, decibels, and ampere turns may require a little more study and concentration.

During this period of familiarization with radio terminology the student

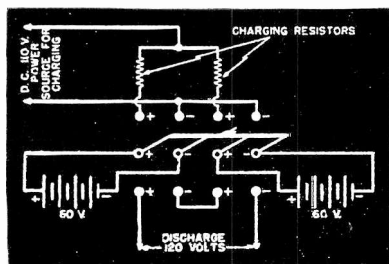


Fig. 1. Battery-charging arrangement.

tempts to study each question individually. The most vital and difficult point to determine is exactly what, and how much, of each pertinent radio subject must be covered to provide sufficient knowledge to assure a good chance of passing the examinations.

It is quite a chore for the student to figure this out. It can be done, but the FCC Study Guide offers no continuity. Therefore, this analysis of what, and

* By Carl E. Winter in "Radio News."

will doubtlessly assimilate a good deal of basic knowledge pertaining to methods of generating electricity and the nature of conductors and insulators. This will simplify the study of factors determining the resistance of

cannot be overemphasized. The student should learn it well and know how to apply the law to both a.c. and d.c. problems. It will then be a simple step to learn the very necessary power formulas as well.

A logical time to learn the principles of series and parallel connections is while Ohm's law is still fresh in one's mind. There is nothing too difficult about the application of these connections and the formulas for them. Formulas are among the few things in radio that should be memorized.

The foregoing preliminary work, if well learned, will enable the student to delve more deeply into radio lore. The following classifications and scope of subjects may be of value in directing studies along the most economic lines in preparation for the Commission's Examinations.

Condensers

A knowledge is required of the construction and electrical characteristics of condensers insofar as the effect of changes in condenser plates and dielectrics is concerned. The formulas for determining the amount of electricity a condenser will hold, and for determining the energy stored in a condenser, should be learned, as well as the formula for capacitive reactance.

Induction and Inductances

Understanding of the principles of induction is essential. There is no limit to the amount of knowledge the student can use on this subject. Briefly, however, if the factors that determine the figure of merit or Q of an inductance are known and understood, this will suffice for basic radio theory.

The electrical effects of the mechanical construction of the inductance should be learned. The factors which determine the impedance of a coil and the formula for inductive reactance can be memorized.

It is necessary to know the formula for determining the resonant frequency of a circuit and the manner in

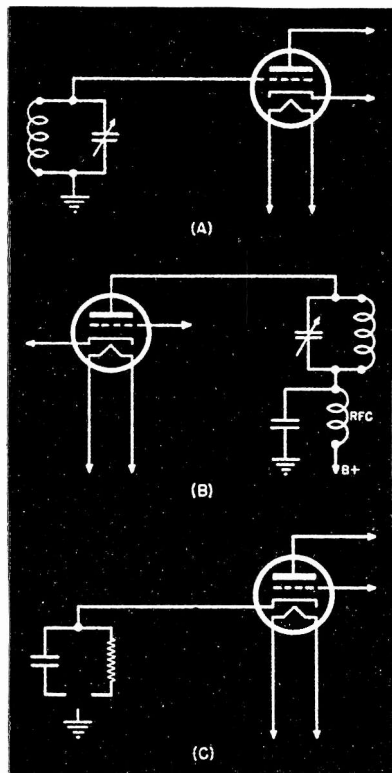


Fig. 2. Conventional radio circuits: (A) grid, (B) plate, and (C) cathode.

a conductor and, in turn, serves as preparation for learning the principal mathematical premise of radio—Ohm's law.

Ohm's law is the basic formula for all mathematical problems in radio. The importance of a sound understanding of its principles and usage

which the resonant frequency of an antenna can be raised or lowered. While on the subject, the factors which decide the resonant frequency of any given antenna should be learned, as well as the formula for transposing meters to kilocycles.

Fuses and Relays

Learn the differences between fuses and relays and their various applications.

Microphones and Telephones

It is necessary to know what high and low reactance head telephones are and what means are used to connect low impedance phones to vacuum-tube amplifier outputs.

An understanding of the operation, construction, and characteristics of the most commonly used types of microphones, such as the carbon button microphone, is also a requisite.

Meters

Meters play an important part in the FCC examinations. It is not sufficient to know the particular type of meter used to measure a given condition. A thorough knowledge of the construction and principles of operation of all types is required. Thermocouple, electro-dynamometer, repulsion, and hot-wire meters should be studied, as well as the D'Arsonval type. Learn the application of amperic hour meters and pay particular attention to the use of shunts and multipliers with the various meters specified above.

Some practice in applying the Ohm's law to meter readings is necessary. Frequency meters, while not of the type discussed, must also be understood and some knowledge of their construction, usage, and principle of operation is necessary. While the student may lack the radio knowledge necessary to understand the proper functioning of frequency meters at this point, it should not be neglected, as the subject will clarify itself as progress is made in the study of radio theory.

Batteries

The Commission desires that every applicant possess an adequate knowledge of all points pertaining to batteries. Many of us wonder why, but there it is, so it would pay for you to spend a little time in learning the construction details and operating characteristics of both lead-acid and Edison type cells. The student should know how to take care of batteries and be familiar with the various troubles which may result from improper maintenance procedure.

Learn to draw a schematic which will illustrate how to hook up two battery banks so that one bank will discharge while the other charges, and don't forget to learn the difference between primary and secondary cells.

Motors and Generators

Motors and generators must also be covered preparatory to taking the examinations. Familiarize yourself with the terminology and standard construction of various types of motor-generator units. As there are many types of d.c. and a.c. units in use, it is advisable to understand the operation and maintenance procedures for all kinds. Some mathematical problems relating to the speed in revolutions of alternators and also to output frequencies appear in the examinations. These are simple but a knowledge of the formula applied is essential.

Vacuum Tubes

Vacuum tubes are perhaps the most important part of all the radio knowledge required to pass the Commission's examinations. Here again, terminology is very important. Study all the information you can get regarding pentodes, tetrodes, and triodes. Learn what a thyratron is and how it differs from other types of tubes.

It is necessary to understand the function of every component in a vacuum tube so that the meanings of terms such as electron emission, secondary emission, and plate dissipation are clear to you. Plate impedance and

plate dissipation should be clarified, as should amplification factor and mutual transconductance.

The application of filament power to a tube is simple and the student should know what types of tube filaments can be reactivated.

Specific types of tubes, such as rectifier tubes, must be properly classified and the relative merits of high-vacuum and hot-cathode mercury-vapor tubes understood. The operating characteristics of both of these types of tubes should be studied.

Rectifiers

At this point the student should delve quite deeply into rectifier principles. Learn what a rectifier circuit is and why it is necessary. Learn how it operates and the relative advantages of half-wave and full-wave rectification. It is essential to know how to compute the ripple frequency of a given rectifier and it would be helpful to memorize the ratios between the average, effective, and peak values of a sinusoidal wave, as no doubt a question or two requiring this knowledge will appear on your examination sheet.

Simplified schematics of half-wave, full-wave, and bridge type rectifiers, single- and three-phase, should be learned. Let me emphasize that in learning schematics, do not memorize them. Learn the basic principles, as very often all that will be required of you in the examination, will be to fill in a missing line which is required to complete a circuit laid out quite differently from any you've seen before.

Before finishing with rectifiers, make certain that you understand what a copper-oxide rectifier is and how it operates.

Filters

Check back on the studying you did on inductances and see what particular points apply to filter chokes. An adequate knowledge of filter construction and its application is required. Learn the differences between con-

denser input filters and choke input filters.

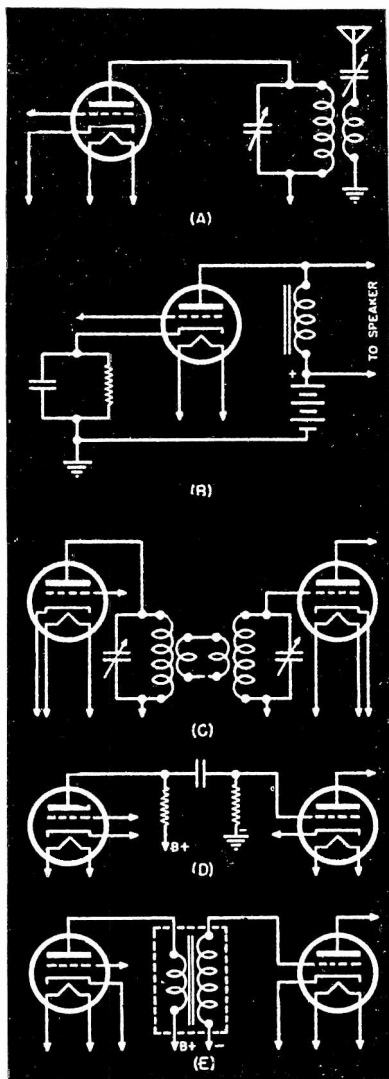


Fig. 3. Various conventional forms of coupling: (A) antenna, (B) speaker, (C) link, (D) resistance, and (E) transformer.

Radio Circuit and Tube Operation

The basic factors which determine operating voltages for all classes of vacuum tubes should be understood. As these factors depend upon the class of operation in which the vacuum tube will be employed, it is also necessary for the student to know the principles and purposes of the various classes of operation which may be applied to vacuum-tube circuits.

The circuit and electron tube factors which influence the voltage gain of a given tube must also be known as should the details of load impedance matching.

Push-pull and single-stage operations, detector circuits, and frequency-doubler amplifier characteristics should also be comprehensively studied.

Improper Circuit Operation

As the Commission considers it essential for the prospective license holder to be able to quickly locate various types of trouble and operating faults in all types of equipment, the student may be required to answer many trouble-shooter's questions in the examinations. Therefore, it is recommended that a good deal of time be spent on circuit analysis.

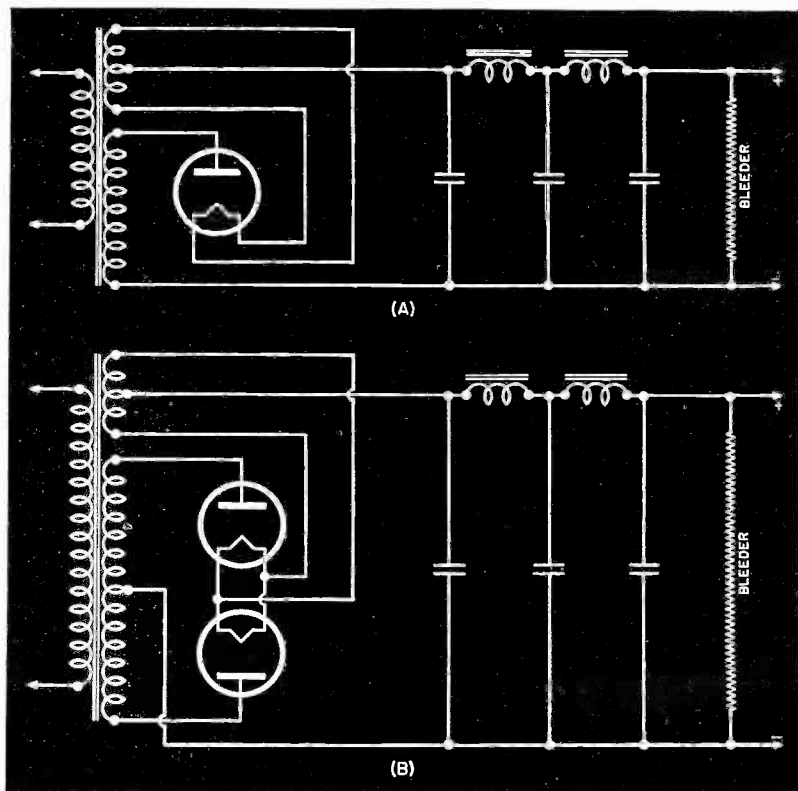


Fig. 4. Simple rectifier circuits, showing half-wave rectifier (A), and full-wave, single-phase rectifier (B).

Determine the factors which may lead to improper operation of any circuit component or the circuit itself and study them well. Make certain that your knowledge of this point is more than rudimentary as troubleshooting plays an important part in all radio work.

Coupling Systems

The student should familiarize himself with the many types of coupling systems in use. These systems are usually used to couple the plate of one tube to the grid of another tube and, consequently, it is only necessary to draw the basic symbols for each type of coupling in its proper place on a schematic. The advantages of one type of system over another should be clearly understood.

Several types of coupling systems are shown in Fig. 3.

Circuit Schematics

A student may be required during the examination to draw from mem-

ory any one of several types of oscillator or detector circuits. A simple method whereby the plate, grid, and cathode circuits may be easily learned is given.

It is hoped that the foregoing outline will assist the student in accumulating the necessary knowledge and background in radio theory required to pass Element 2 of the Commercial Radio Operator Examinations. This element, while far from being the most difficult technically, is nevertheless difficult for the beginning student to pass. By the time the student has covered the comprehensive outline given above he should be sufficiently well versed in radio lore to have a comparatively easier time with the more advanced elements required for a Commercial Operator's License.

It is quite important to remember that there is no "short cut" to radio knowledge. Study every subject fully and delve deeply into all subjects which appear even remotely connected with those in which you are interested.

PART II

OUTLINE OF ADVANCED ELEMENTS WITH WHICH THE PROSPECTIVE LICENSEE MUST BE FAMILIAR BEFORE ATTEMPTING TO PASS THE FCC EXAMS

Without adequate preparation, some trained electronic engineers would encounter a few hard nuts to crack in the

A good percentage of the exam's questions apply to the basic principles of radio and offer little difficulty to ex-

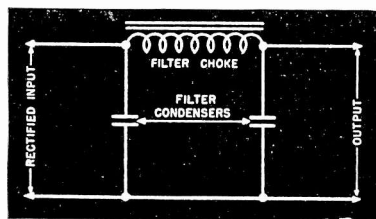


Fig. 1. Condenser input filter.

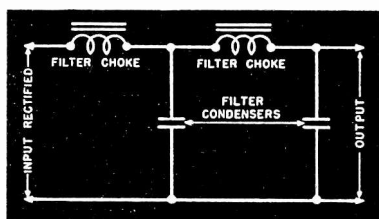


Fig. 2. Choke input filter.

Federal Communications Commission examinations for a Commercial Radio Operator License.

"hams" and ex-"servicemen," but the premise upon which the FCC examinations are based is a series of "ele-

ments," each of which requires progressively more advanced technical knowledge.

Understanding the practical aspects of the commercial operator's work and the application of radio principles to actual equipment in use are required in these advanced elements. Therefore, the following classifications, including the scope of subjects covered, may be of assistance to prospective licensees who are planning a preparatory course of study.

Mathematics

Ohm's law problems involving application of the law to circuit analy-

plicants for Radiotelephone licenses. Ratios between average, effective and peak values of a sinusoidal wave should be memorized, as problems utilizing these values occur frequently.

Formulas for computing the angle of lead or lag of current with reference to voltage in an a.c. circuit should be learned and the meanings of "leading power factor" and "phase difference" understood. Study of phase angles will be simplified if you remember that in an a.c. circuit, a series condenser causes the current to lead the voltage and that when inductive reactance predominates in the circuit, current lags the voltage.

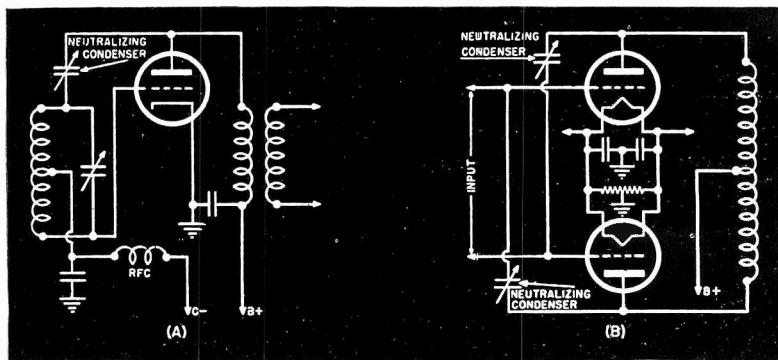


Fig. 3. Methods of neutralizing single and push-pull output stages.

sis occur frequently. These arithmetical problems are easily solved when a knowledge of when and where currents and voltages appear in any given circuit is obtained. You should know, for example, that a milliammeter connected between the center tap of a filament transformer and ground, will read the combined plate and grid currents of a simple triode stage. You should also be able to analyze other components of a circuit in similar fashion.

Ability to make mathematical computations pertaining to decibel gain or loss is required, particularly for ap-

The importance of the formulas for reactance and impedance should not be underestimated. The formula for determining impedance at resonance is essential and the values of reactance in series, parallel, and series-parallel circuits should be known.

The student should not become too perturbed at the vast array of mathematical problems which will confront him when he opens his examination sheet. All these problems are based on specific formulas and should present no difficulty provided these formulas have been learned well.

Motor Generators

Questions pertaining to motor generators will be primarily mathematical and concern the "efficiency" and "regulation" of this equipment as well as for rectifier power supplies. "Efficiency" and "regulation" are not just terms but have definite mathematical formulas which are essential.

Rectifier Tubes

Possessing basic knowledge of vacuum tube principles simplifies the specialized requirement for rectifier tubes.

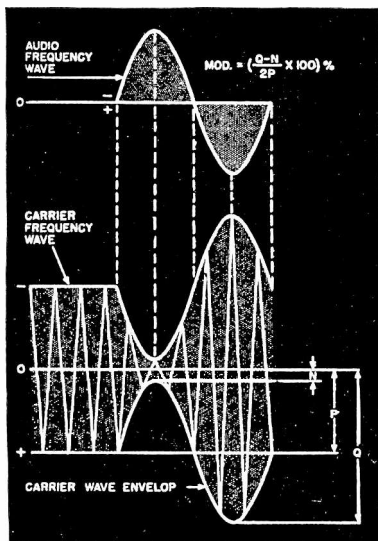


Fig. 4. Modulated carrier wave.

The various types, and their respective advantages and disadvantages should be understood; and "inverse peak voltage" mathematical problems, in which sinusoidal wave ratios are applied, occur frequently.

Rectifiers

A knowledge of the principles of rectification is not sufficient for the examinations in the advanced elements. Formulas for the computation

of ripple frequencies, the circuits for half-wave, full-wave, and bridge rectifiers should be learned. Mechanical rectifiers cannot be ignored for you may encounter a question or two pertaining to them.

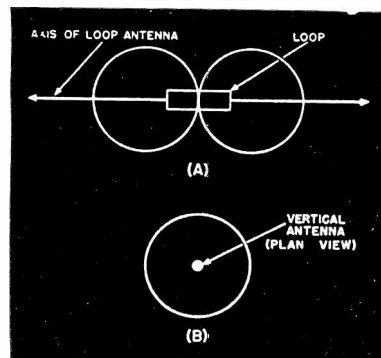


Fig. 5. Antenna directional characteristics.

Filters

The function of the filter network in conjunction with a rectifier circuit is another must for prospective licensees. The effects of inductances and condensers in filters (see Figs. 1 and 2), the characteristics of "swinging chokes" and the applications of bleeder resistances should be mastered.

An analysis of the differences between low-pass and high-pass filters, as shown in Fig. 6, paves the way for the study of attenuators, line pads, line equalizers (Fig. 7), and mixers. The functions and principles of these various networks should be mastered, and their methods of connection to, and effects upon, circuits understood.

Impedance matching, Fig. 8, and the proper termination of transmission lines should be studied, particularly by those interested in Radiotelephone licenses.

Crystals

As crystals play an important part in all radio equipment their function in stabilizing oscillators should be

studied carefully. To assure adequate knowledge of crystal principles, the student should understand the meaning of, and terms used, in referring to crystal temperature coefficients and learn to solve mathematical problems which involve the crystal temperature coefficient in determining a transmitter's output frequency.

Oscillators

Comprehension of the basic oscillator circuits such as Colpitts, Hartley,

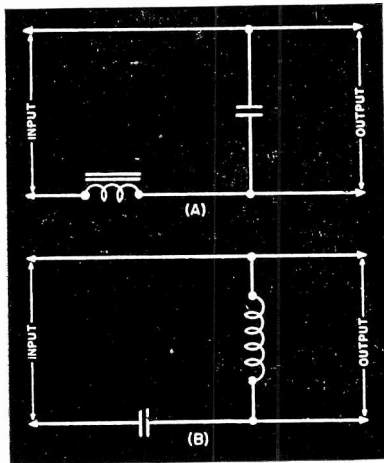


Fig. 6. (A) Low-pass filter. (B) High-pass filter. The condensers and inductors are designed to attenuate the higher frequencies (A) and the lower frequencies (B).

MOPA, and tuned-plate tuned-grid is vitally necessary. Surprisingly enough, the Commission demands a thorough understanding of ancient spark and arc oscillatory circuits.

The multivibrator, or relaxation oscillator, possesses peculiar characteristics of its own and should be studied as an individual type of circuit.

Electron-coupled, dynatron, and crystal oscillators should also be understood and the ability to draw any of the basic oscillator circuits from memory is an asset.

The student should know which oscillator circuits are particularly use-

ful for generating harmonics and understand the several methods of keying a transmitter.

Receivers

Inasmuch as many receivers utilize oscillators in regenerative circuits, the principle of regeneration should be understood. In regard to this, an understanding of the relationships of signal frequency, beat frequency, and image frequency, as well as the ability to make simple computations pertaining to them, should be mastered.

Other types of receivers, such as, plate, grid leak, power, and diode detectors should not be neglected. Sufficient knowledge of receiver principles should be obtained to enable the student to answer trouble shooting questions. Learn what the super-heterodyne circuit is!

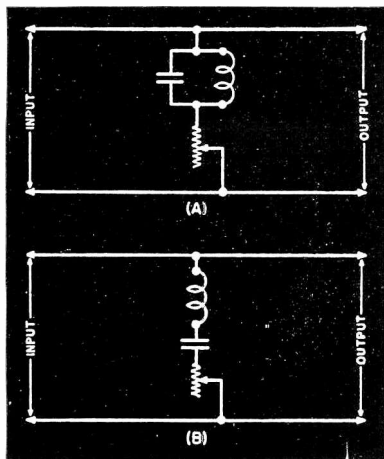


Fig. 7. Equalizers. Parallel resonance is depicted in (A) while (B) shows the equalizer as a series resonance type.

Amplifiers

A thorough understanding of amplifiers and their classes of operation is perhaps the most crucial part of the requirements. All types of amplifier

circuits should be studied, and here again the ability to trouble shoot, at least on the examination sheet, is essential. Special emphasis is placed on the principles of modulating amplifiers and the student should stress modulator circuits in his preparation for the examination.

Neutralization

The purposes and methods of neutralizing a radio frequency amplifier, how to test for proper neutralization and the instruments used in such tests should be studied. Problems covering methods of neutralization (see Fig. 3) may occur.

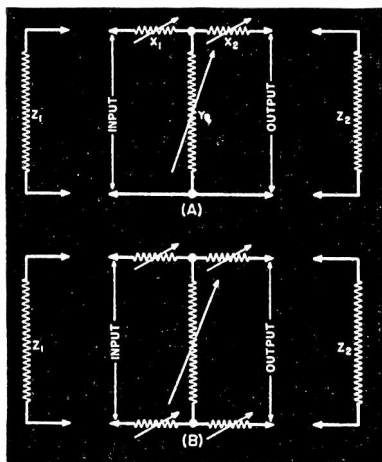


Fig. 8. (A) T-type pad. (B) H-type pad. Input terminals of the attenuation networks connect to microphone Z_1 , while the output connects to amplifier shown as Z_2 .

Modulation

The heart of all radio broadcasting systems is modulation. This is a major subject in itself, and, broadly speaking, one can't know too much about it. Particular attention should be paid to high and low level, grid and plate modulation.

Although frequency modulation is with us, insofar as the FCC examina-

tions are concerned, it remains something which the broadcast operator must prevent at all costs in his AM transmitter.

Investigate the causes of carrier and frequency shift and the results of over and under excitation! Learn exactly what overmodulation is and its effect upon transmitters! The ability to draw a carrier wave envelope and indicate on that drawing the dimensions from which the percentage of modulation is determined (Fig. 4) will be very helpful. Mathematical formulas for determining percentage modulation must be learned and trouble shooting in modulators is quite important.

The fluctuations and percentages of increase in antenna current and power during modulation should be understood. Possession of adequate knowledge of the principles of modulation will do much to clarify other principles of radio broadcast operation.

The foregoing outline might be considered the backbone of the knowledge required to pass the FCC examinations.

Getting back to mathematics, for a moment, formulas used in determining the resonant frequency of an antenna and the methods whereby these frequencies may be raised or lowered should also be learned. The directional characteristics of loop and vertical antennas must be known, as shown in Fig. 5. The formula for determining antenna resistance and current is simply an adaptation of basic Ohm's law but should not be overlooked.

For the student who is interested in the Radiotelephone license, a knowledge of the respective advantages and disadvantages of lateral and vertical methods of transcription is required.

For those prospective licensees who are trying for a Radiotelegraph license a good deal of emphasis should be placed upon the operation and trouble shooting in auto alarms. This is a complex subject but the FCC is

interested in knowing whether you can operate, adjust, and maintain the two types of auto alarms in common use. The basic principles of radio, and you will certainly know them if you succeed in passing the FCC examinations, will carry you through the complexities of auto alarms.

The most important thing for the student to remember when preparing

for the FCC Commercial Operator's examination is that without a solid background of radio fundamentals, the examination cannot be passed! The student must review radio fundamentals until this basic material becomes second nature to him when he sits down to take that important examination.

THE RADIO TRADING POST

(Continued from p. 6)

WANTED — Will pay cash for good signal generator, in good operating condition. Prefer AC operated. Any make. Corp. Irving T. Barrett, 622 Wolfe St., Fredericksburg, Va.

WANTED — 16mm sound projector and sound camera, movie equipment, films, silent or sound. Have several small radios, Gibson tenor banjo in case, and cash. Write, do not call. Perlberg, 35 Allen St., New York City 2, N. Y.

FOR SALE — Standard brand tubes in sealed cartons. Write for list. Herbert Spohn, East White Plains, N. Y.

FOR SALE — Gear reduction boxes, converters, motors, transformers, chokes, etc. Write for list. N. K. Stover, 1357 Hill St., York, Pa.

WANTED — Hallicrafters Sky Buddy Model S19R or Sky Champion Model S20R. Will swap radio parts or pay cash. Joseph Mackora, 63 Pratt St., East Hartford, Conn.

FOR SALE — Complete set of Sickles television transformers such as video IFs, audio IFs, rejection traps and diagrams. List price \$20. First \$4 takes all. Philip Ross, 280 Wadsworth Ave., New York 33, N. Y.

FOR SALE — 1 Ansco postcard camera; 1 1 Packard electric shaver; 3 Brunswick superhet 9 tube chassis; 1 RCA-Victor R32 chassis power pk. and a spkr.; Majestic 90B and 90 spks.; Fada and Baldwin chassis; Kolster K20 radios. All kinds of spkrs. L. A. Goldstone, 1279 Sheridan Ave., Bronx 56, New York.

SALE OR SWAP — Motorola Golden Voice No. 80 car set; Dayrad Raytheon No. 92 tube tester; Potter mod. A condenser tester; Eastman folding post card camera. Webster 250 push-pull power amplifier. WANT VOM or what. Glenn Watt, Chanute, Kans.

SALE OR TRADE — Supreme Audolyzer Model 562, in first-class condition. W. H. Carter, N. Poplar St., Paris, Tenn.

FOR SALE — Radio tubes, send for new price list. Have P.A. sound systems for sale. Victor J. Kozma, 3104 Wilkinson Ave., New York 61, New York.

WANTED — Condenser checker, sig. generator, tube tester, such as Precision, Supreme or similar good make. **FOR SALE** — Used tubes, audio and power trans., speakers, two amplifiers and 2 small plastic cases for radios. Royce Saxton's Radio Shop, Rt. 1, Pontiac, Illinois.

SALE OR TRADE — 6.00x16, 5.50x17, two-ply, new material, cord and composition, endless, full molded tire liners, \$1.95 each or trade for late model radios. Auto & Appliance Supply, Granby, Missouri.

FOR SALE OR TRADE — Miller F.M. 10 tube tuner complete with tubes, brand new. Will trade for Rider's manuals 8 to 13, Precision vac. tube voltmeter, mod. EV 10 or other good service equipment or cash. Nooman Jacobson, 1697 Andrews Ave., Bronx, N. Y.

SWAP — De Jur exposure meter for record changer or Tinit meter for enlarging work. Want 3 1/2 x 4 1/2 or 4 x 5 enlarger for cash. E. Sujak, 5321 W. 30th Place, Cicero, Illinois.

WANTED — Will pay from \$5 to \$10 for a .22 cal. revolver. Raymond Wolf, RR 2, Box 45A, Wishek, N. Dak.

TRADE — Tung-Sol tubes, new and sealed cartons 12SF5, 12F5GT for Superior multimeter model 1250. Smith Radio Service, 132 South 7th St., Steubenville Ohio.

WANTED — Rider manuals, vols. 8 to 13. Single vols. or complete. Theodore Loehr, 140-28 247th St., Rosedale, L. I., N. Y.

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