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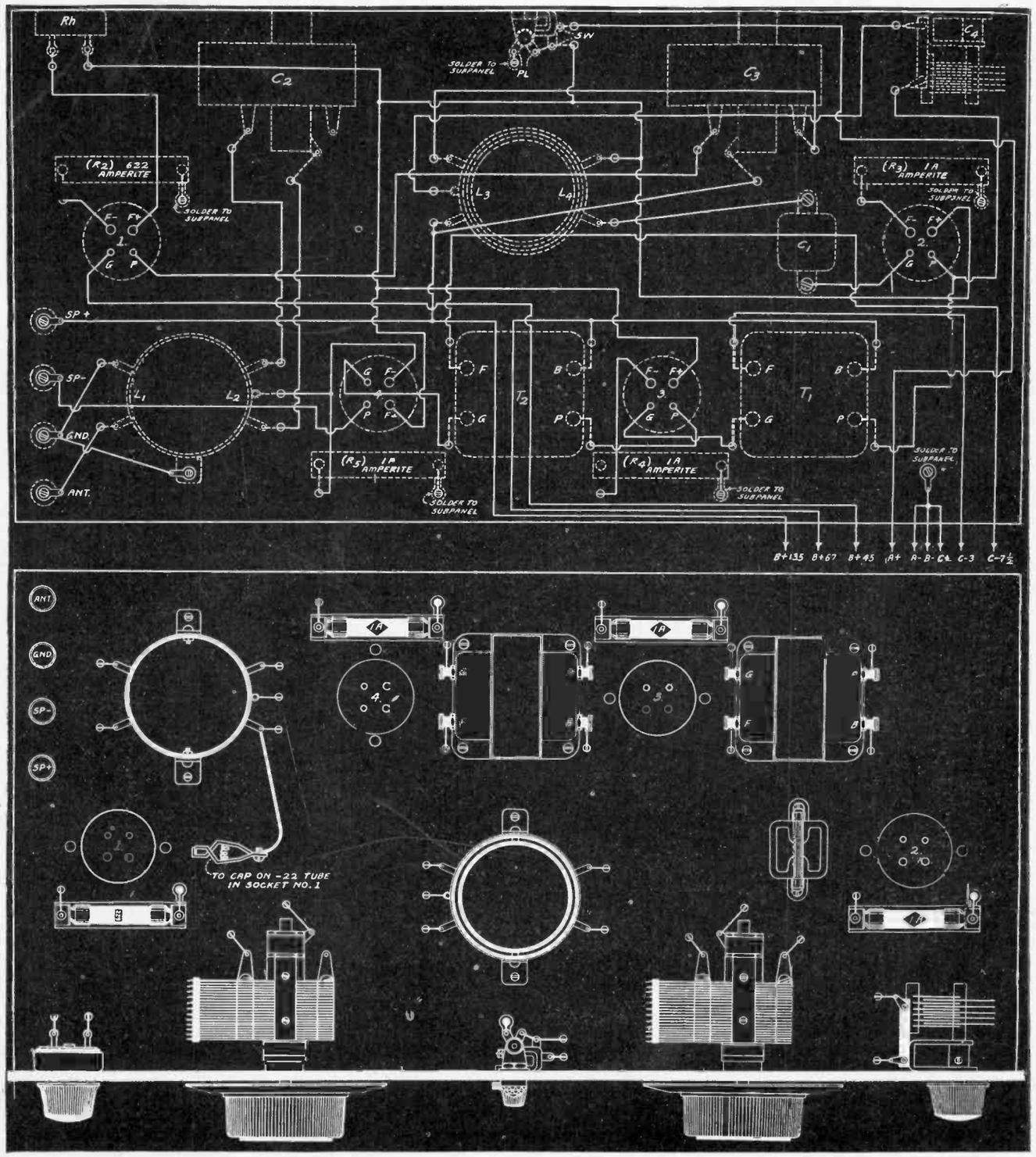

PICTURE DIAGRAM OF LAYOUT OF PARTS AND WIRING OF THE REMARKABLE UNIVERSAL SCREEN GRID FOUR. SEE PAGE 17.

RADIO WORLD, published every Wednesday, dated Saturday of same week, from publication office, Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y., just east of Broadway. Roland Burke Hennessy, President; M. B. Hennessy, Vice-President; Herman Bernard, Secretary. Roland Burke Hennessy, Editor; Herman Bernard, Managing Editor; J. E. Anderson, Technical Editor; Anthony Sodaro, Art Editor.

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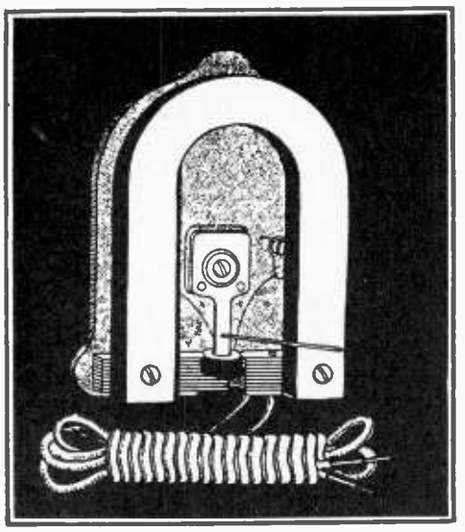

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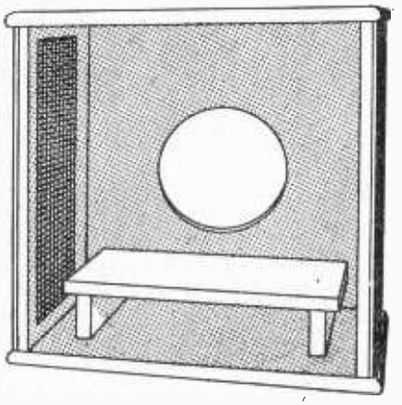

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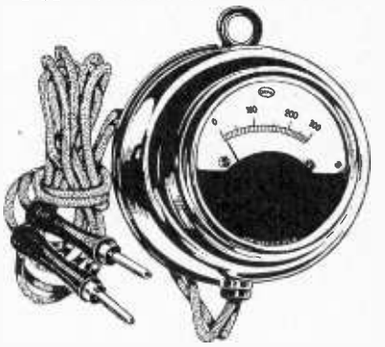

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No. 337—For reading DC voltages, 0-50 volts, 1.00
No. 339—For reading DC voltages, 0-100 volts, 2.25
No. 342—For reading DC voltages, 0-150 volts, 2.25
No. 340—For reading DC voltages, double reading, 1-8 volts, 0-100 volts..... 1.50

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145 WEST 45TH STREET NEW YORK, N. Y.

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WGY's Property Rights Invaded, Hughes Argues

SIGNALS ECHO TO EARTH FROM BEYOND MOON

Prof. Carl Stormer, Oslo, Norway, in a recent lecture before the Academy of Science, in Copenhagen, Denmark, declared that it has been proved by experiment that radio signals are echoed back from outer space 1,584,000 miles distant from the earth. It is said that the echo could not have been from the moon, because the distance to that satellite is only 239,000 miles. Neither could the reflection have been from one of the planets, for the nearest one is 25,000,000 miles away.

The phenomenon was first observed by an engineer of Oslo named Hall, who found that the signals from the Dutch station at Eindhoven acted on his receiver three seconds after the direct signal had been received. He informed Prof. Stormer of the phenomenon and they immediately arranged for experiments in conjunction with the Eindhoven Station. This station sent out prearranged signals.

Time Lag Varied

The original signal was heard and later several distinct echoes, each weaker than the preceding, but sufficiently clear to identify its origin. The echoes came at time intervals of 3, 4½, 5, 8, 13, 15 and 17 seconds. The greatest of these time intervals means that the signals were reflected from a region 1,584,000 miles away. The shortest interval accounts for a distance equal to the moon's.

Prof. P. O. Petersen, director of the Polytechnic Academy of Copenhagen, said there was no reason to doubt the statements of Prof. Stormer, for he is a prominent and acknowledged scientist.

Talk to Mars?

When asked whether he thought it possible to communicate with other planets, Prof Petersen said:

"Yes. There is nothing whatever to hinder communication through space, provided there is some one that can answer. But it cannot be attained by the use of long wavelengths, as those believe who have sent off messages to Mars. By means of the short waves we can penetrate space, and it has been proved now practically."

Prof. Petersen believes that the radio waves were thrown back by electrically charged layers or by electron layers.

Movies Broadcast By British Device

Washington.

Inventions now under test are expected to open up an entirely new field in radio in Britain, in linking up the motion-picture industry with broadcasting, it is reported in the British press.

Three new devices are reported: An apparatus for broadcasting moving pictures, a device for synchronizing films with music, and a recording machine which can be attached to any radio receiver, which will record the incoming message on a ribbon, so that it can be played at any future time through the same radio set, the Trade Commissioner at Paris, G. R. Canty, advises the Department of Commerce.

The broadcasting apparatus is claimed to be so well made that no difficulty is expected in obtaining the necessary license for broadcasting pictures. The inventors engaged in the work expect to have the machines ready for action before the end of the year.

HIGHER POWER USE IS LIMITED

Washington.

The full text of a new order by the Federal Radio Commission on daylight operation follows:

"General Order No. 53. Whenever a broadcasting station which, under its license from the Commission, is permitted to operate both during daytime hours and during evening hours, is, under said license to use a greater amount of power during the daytime hours than during the evening hours, the station will not be permitted to use its daytime power after the average time for sunset at the station during any particular month. In no event will such a broadcasting station be permitted to use its authorized daytime power at any time or in such manner as to cause greater heterodyne interference during the daytime than exists during evening operation from the use of the amount of power permitted for such evening operation. This order supersedes General Order No. 10, which is hereby repealed."

REALLOCATION ORDER CALLED VIOLATION OF CONSTITUTION

Station Asks Continuation of Injunction Against Federal Radio Commission So as to Remain on Full Time—Defense Contends Board Can Make Assignment As it Pleases

Washington.

Argument before the Court of Appeals of the District of Columbia on the injunction obtained by WGY, Schenectady, N. Y,. developed that the station's chief contention in resisting the reallocation order that deprived it of full time on the air is that the order invades its property rights in violation of the Federal Constitution.

Charles Evans Hughes headed the station's group of counsel and presented that argument as "the real core of the case."

The United States Attorney General, through an assistant, intervened because the case involved a principle that may cause "a serious obstruction in interstate commerce."

This was the first time the Commission's authority to make assignments as it saw fit was attacked in court. The case raised the point in such a way as to pave the way for other stations, which had enjoyed better advantages prior to the reallocation, to resort to the same legal method for redress of grievances.

Mr. Hughes maintained that WGY had a property right in its prior broadcasting allotment that could not be taken away without due process of law.

Appealing to the court to reverse the reallocation order of the Commission, Mr.

Reallocation Called "Politics"

Hughes argued that WGY had an "established property right" for the use of 790 kilocycle frequency (379.5 meters), which under the allocation is given to the station only on a part time basis, whereas it previously held the channel on full time.

"The Commission did not serve the public interest, convenience and necessity when it gave this channel to somebody else," he declared.

Arguments of Louis G. Caldwell, general counsel of the Commission, seeking to have the appeal dismissed, of B. M. Webster, special assistant to the United States Attorney General, who also argued in favor of the Commission's action, and of Frank J. Hogan, of counsel for the General Electric Company, also were heard by the court.

States File Briefs

The court refused to permit H. S. Manley, Assistant Attorney General of New York State. to argue on behalf of the people of New York and of WGY. Chief Justice George E. Martin explained that the rules of the court did not permit oral arguments of parties not involved in the case, but permit them to file briefs. Assistant Attorney General J. P. Carleton, of New Hampshire, also was permitted to intervene and file a brief on behalf of the people of his State.

Under the reallocation WGY was placed on part-time operation on the 790-kilocycle channel with KGO, at Oakland, Calif., also owned by the General Electric Company. The provision in the reallocation is in effect that WGY must cease broadcasting when darkness occurs at Oakland, because the signals from the two stations would interfere, causing heterodyning, whereas during daylight hours the signals do not travel so well, and no interference results.

The reallocation order assigned WGY to retain its 790 kc. frequency, but gave this to KGO as a cleared channel. Simultaneous broadcasting by both when night intervened anywhere in the area between them was prohibited. This would require WGY to shut down at 7:45 p. m., E. S. T., but the Commission suggested the two stations work out a schedule between them. The implication was that KGO should forego some afternoon programs to permit WGY to keep going until 10 p. m. This WGY refused to do, especially as KGO as a "clear channel" station was entitled to full time.

On November 9 the Court of Appeals granted WGY a writ excusing it from adhering to its reallocation assignment until the court rendered its decision on the arguments.

Caldwell contended that the "due process of law" clause of the Fifth Amendment is not involved in the hearing, adding that no property right can be acquired in the use of a channel of interstate commerce in the ether.

"A Serious Obstruction"

He was supported by Mr. Webster, who stated that the United States Attorney General wished to intervene in the case because it involves a principle that may cause "a serious obstruction in interstate commerce."

Replying to Associate Justice Josiah A. Van Orsdel, Mr. Webster said that Station WGY is violating General Order No. 40 (the reallocation order) by operating full time on a channel allocated to KGO, and was interfering with interstate commerce.

Arguing his motions for dismissal of the appeal, Caldwell stated that the General Electric Company is seeking to set aside, through its appeal, "a decision" rendered by the Commission. There has been no decision, he declared, but merely a license that is being contested.

The law specifies, he added, that an application contesting a license must be filed within 20 days of issuance of the license and that the General Electric Company had forfeited its right to appeal by failure to comply with this provision.

Cites Board's Power

The Radio Act, Mr. Caldwell argued, "permits the Commission to do what it pleases and what it considers best serves the public interest, without consulting the stations involved." The Commission, he declared, was not in error in making decisions on the two applications of the General Electric Company on its license, because these applications did not meet the rules and regulations of the Commission.

Arguing his motion that the court strike from the record the testimony offered by the General Electric Company to prove the public's interest in WGY, Mr. Caldwell said it was "full of hearsay." Moreover, he declared, the nature of this testimony gives the impression that WGY has had full-time operation since 1922.

"The fact is that it has had full time only about a year and that since the Commission came into existence," Mr. Caldwell stated.

Mr. Caldwell also contended that the case was not properly before the Court of Appeals, and that the stay from the allocation should have been obtained from a court of equity. The court can not stay the licenses granted a station, under the law, he added, but only can be appealed to in cases involving revocation of license.

Opening arguments for the General Electric Company, Mr. Hogan declared that there is a $1,500,000 capital investment in WGY, which is the tenth oldest broadcasting station in the country. In the past 12 months, he said, $240,000 was expended by the station in its operations alone, whereas the gross income during the same period was only $67,000, "showing that 75 per cent of the expenditure was for public service."

The "limited license" issued to WGY under the reallocation does not give the broadcasting service which the public convenience, interest or necessity warrants, said Mr. Hogan.

Got No Hearing

Answering the arguments of General Counsel Caldwell, Mr. Hogan declared that the station was in time in filing its application for appeal, and that the station had not been notified promptly of its revised license under the allocation. "The Commission disregarded the law and set no date for hearing on our application," he added.

"The Commission said it could give us no hearing because it could not take away from some other station something that station has no chance to defend," he argued. "That is just what it did to us—it did not give us a hearing, but took something away that we had built up all these years."

Referring to a letter received from Radio Commissioner Orestes H. Caldwell, in which Mr. Caldwell deplored that the Commission had seen fit only to provide 40 cleared channels for exclusive station operation, instead of the 50 recommended by radio engineers, Mr. Hogan declared this proved the contention of the General Electric Company that the Commission did not act in the public interest in assigning WGY to part time.

Quoting Commissioner Caldwell as saying that "the political minded members of the Commission voted against 50 cleared channels," Mr. Hogan said, it "was the political minded associates of Mr. Caldwell and not the public interest" that moved the Commission in the reallocation.

With reference to the statement of General Counsel Caldwell that WGY has been on full-time operation only a year, Mr. Hogan said that WHAZ at Troy, N. Y., operated two hours one night weekly "by gentleman's agreement" with WGY.

Former Secretary of State Hughes stated that "millions of people" are deprived by the Commission's action against WGY. Saying that the court, in his opinion, has "full liberty" both as an administrative agency of the Federal Government and as a court, to sit in the case, Mr. Hughes said that all of the property of WGY is worthless except for broadcasting.

2,400,000 Affected

By its service and its investment it has a right to a cleared channel and full-time operation, which is denied under the reallocation, he added.

The questions to be decided by the court, he declared, are the right of the General Electric Company to full service; the effect of the order of the Commission upon the station, and whether the order was "proper in the light of the effect." He argued that a population of approximately 2,400,000 people within 100 miles of WGY are denied the services of WGY on which they rely, and that many of these people are in institutions devoted to the welfare of the afflicted and poor.

"The United States, nor any State, nor any one else, owns the ether, whatever that is," said Mr. Hughes in his argument.

One of the main questions before the Radio Commission, he contended, is "Who shall do the broadcasting?"

"The Real Core of the Case"

"This case revolves almost exclusively about the question of taking property away from one person and giving it to another," he said. "This was done with the broadcasting license of the General Electric Company and is the real core of the case."

The General Electric Company, he argued, has a property right to operate WGY as a full-time station, of which it may not be deprived without just compensation. The prohibition of the use of the station, he argued, is taking a property in violation of the Fifth Amendment to the Constitution, and asked that "the order of the Radio Commission be reversed."

Jenkins Organizes

Negotiations have been concluded with New York bankers for financing commercial production and sale of television transmitters and receivers invented by C. Francis Jenkins. A corporation, known as the Jenkins Television Corporation, has been organized with a rated capitalization of $10,000,000, with 1,000,000 shares of common stock of no par value. It is expected that a public offering of the stock will be made.

James W. Garside, president of the DeForest Radio Corporation, will be president of the new corporation; A. J. Drexel Biddle, Jr., will be chairman of the board; Mr. Jenkins will be vice president in charge af research and development, and Phillip H. Diehl will be treasurer.

ONE STATION IN SEVEN FAR OFF ASSIGNED WAVE

Washington.

Capt. Guy Hill, broadcasting engineer of the Federal Radio Commission, in a memorandum to the Commission recommended the suspension for 60 days of stations off their assigned frequency by more than 1,000 cycles (1 kc.). Aside from the memorandum, he said there were more than 100 offenders.

Text of Memorandum

Here is the memorandum in full:

I have several times called attention to the fact that, however well-planned and scientifically arranged the broadcasting allocation structure may be, if the broadcasting stations themselves do not preserve their assignments accurately as to frequency, serious interference and heterodyning is bound to result.

As explaining the remaining instances of whistles and heterodynes still observed in the broadcasting band since the reallocation, I wish to call your attention to the following serious frequency deviations reported to the Commission's Engineering Department, remembering that the permissible deviation is 500 cycles and that the stations listed below deviate more than twice that amount:

WKBQ, Starlight Amusement Park, Bronx, N. Y., 25,400 cycles high; WNJ, Herman Lubinsky, Newark, N. J., 18,000 cycles low; WEVD, Debs Memorial Fund, Woodhaven, N. Y., 8,900 cycles high; WOKO, Harold E. Smith, Mt. Beacon, N. Y., 2,900 cycles low; WCLB, Arthur Faske, Long Beach, N. Y., 2,100 cycles low; WHAZ, Rennselaer Polytech, Troy, N. Y., 2,900 cycles high; WAFD, A. B. Parfet Co., Detroit, Mich., 73,200 cycles low; WKAR, Michigan State College, E. Lansing, Mich., 2,900 cycles high; KWKH, Henderson Iron Works, WSDU, Joseph H. Uhalt, New Orleans, La., 20,100 cycles high.

Repeated Offenses

Some of the worst offenders among the above stations are shown by official measurements to have been repeatedly deviating from their frequencies.

Obviously when a broadcasting station wanders over a range of 25,000 cycles, it spoils not only its own program so far as listeners are concerned, but also the programs of innocent stations on the two adjoining channels through which it swings.

In order to put an immediate stop to such destruction of the programs of stations which are faithfully adhering to their frequencies, I recommend that in each case where stations have been measured and found to be deviating from their assigned frequencies by more than one kilocycle, which is twice the allowable deviation, that the licenses of such stations be immediately suspended by the Commission.

Would Warn Others

This suspension is to be for a period of 60 days unless before that time the stations can conclusively demonstrate to the Engineering Division of the Commission that the station has obtained and installed equipment which can be depended upon to keep the station on its assigned frequency within the limits designated by the Commission.

I also recommend that stations which deviate from their frequency by more than one-half kilocycle, but not exceeding one kilocycle, should be notified that they must make adjustments to their apparatus immediately to operate within the limits set by the Commission, or the Commission will be forced to suspend their licenses.

Caldwell Resigns as Board Counsel

Washington.

Louis G. Caldwell, general counsel for the Federal Radio Commission since July, has submitted his resignation to become effective December 31. At the time Mr. Caldwell came to the Commission many legal skirmishes loomed on the radio horizon. He tackled these and won in most instances.

Mr. Caldwell does not intend to leave radio entirely. Before he became an official of the Federal Government he was closely connected with radio and he will now revert to the practice of law, specializing in radio.

Mr. Caldwell's resignation followed his appointment as chairman of the Committee of Radio Law of the American Bar Association.

AMERICAN BAR TACKLES RADIO

Washington.

The Committee on Radio Law of the American Bar Association, recently created because of the growing importance of this phase of law, held its first meeting at the offices of the Federal Radio Commission. According to an announcement by Louis G. Caldwell, chairman of the committee and general counsel of the Commission, the first meeting was held then so that the results of its deliberations might be immediately made available to Congress, at least informally.

The meeting was held at the offices of the Radio Commission to give the members of the committee an opportunity of becoming familiar with the organization and procedure of the Commission.

Other members of the committee named by the Bar Association are Edward A. Zimmerman, Chicago; Fred C. Fernald, Boston; Cassius E. Gates, Seattle; and Robert T. Swaine, New York City.

The committee has as its object a general survey of present practices in the administration and regulation of radio from the legal point of view, and the formulation of policies and procedure, according to Mr. Caldwell.

Days Grow Longer for WEAF and WJZ

The two New York stations of the National Broadcasting Company, WEAF and WJZ, now operate on longer daily schedules. WEAF uses seventeen and a quarter hours and WJZ sixteen and a half hours daily, except Sunday.

WEAF, owned by the N. B. Co., continues to go on the air at 6:45 a. m., and broadcast until midnight without intermission. WJZ, owned by the Radio Corporation of America and operated by the N. B. C., begins broadcasting at 7:30 a. m., and continues until midnight.

The new schedule increases WJZ's time on the air about four hours daily and WEAF's time an hour and ten minutes to an hour and fifty-five minutes daily.

BRAZILIAN ASKS A MONOPOLY ON WORD "RADIO"

An attempt in Brazil to obtain exclusive trade-mark rights to the word "Radio" has caused an official protest by the United States Government to Brazil, through the State Department and the Department of Commerce. The Radio Manufacturers' Association was advised that the protest probably would be successful.

J. B. Junqueira attempted to get exclusive rights in Brazil to the word "Radio," which would virtually have barred all radio exports of American manufacturers to Brazil.

The State Department advised the R. M. A. that, following receipt of the protest, the American Embassy at Rio de Janeiro had been cabled to request cancellation of the trade-mark registration as a violation of the Santiago trade-mark convention of 1923, to which the United States and Brazil are parties. The Embassy was also directed to take any necessary steps to effect the cancellation of the objectionable Brazilian trade-mark application.

The R. M. A. protest to the State and Commerce Departments declared that registration, as an exclusive, individual monopoly, of the "Radio" would be most unjust to the radio industry, both of the United States and of Brazil, declaring that "Radio" is a generic term of universal use and should not become the individual trade-mark property of any person or company.

Polymet's Stock Doubled to 60,000

Stockholders of the Polymet Manufacing Company have authorized an increase in the company's no-par value capital stock from 30,000 to 60,000 shares. Of this increase, 15,000 shares are to be issued to stockholders to whom rights will be given to subscribe in the ratio of one share of new stock for each two shares of the old stock held, at $20 a share. The right to subscribe goes to those who were holders of shares as of the close of business November 23 and the subscription rights expired December 5. N. C. Greene, vice-president in charge of sales, told stockholders that the company during August, September and October, the first three months of its current fiscal year, returned earnings of about $3 a share on the old capitalization and that the outlook for continued satisfactory earnings is indicated by the volume of orders on hand. The rate on the new stock will be $1.50 a share, the same as that paid on the old shares.

Ordinance Forbids Man-Made Static

Corning, Iowa.

An ordinance passed by the City Council makes it illegal to operate electrical apparatus which causes reasonably preventable interference with any other electric device. This ordinance is designed to protect radio listeners against interference from such devices as violet ray and X-ray machines. These devices, except in emergencies, cannot be used between the hours of 6 and 11 p. m. Penalty for violation is a fine of not more than $100 or imprisonment for not more than 30 days.

OBEY RULE ON CALL LETTERS, BOARD WARNS

Washington.

Failure of announcers to regard the order that call letters be announced at least every fifteen minutes, unless a continuity would be interrupted thereby, has led the Federal Radio Commission to ask the Radio Division of the Department of Commerce to report offenders. Citations to appear before the Commission will be issued to violators, and station license suspension may be inflicted as a penalty.

The Commission's secretary has written to stations as follows:

"By direction of the Federal Radio Commission, I am advising you that the Radio Division of the Department of Commerce has been requested to have its radio supervisors check all broadcasting stations with a view to ascertaining whether or not they are complying with General Order No. 8, issued May 5, 1927, which reads as follows:

"'For the purpose of facilitating a more accurate check on station frequencies, both by the Federal Radio Supervisors of the Department of Commerce and by the public, each radio broadcasting station, licensed under the Radio Act of 1927, is hereby directed to announce its call letters and location as frequently as may be practicable while it is broadcasting, and in any event not less than once during each 15 minutes of transmission.

"'It is understood, however, that this requirement is waived when such announcement would interrupt a single consecutive speech or musical number, and in such cases the announcement of the call letters and location shall be made at the beginning and end of such number.

"'This order becomes effective at 12:01 a. m., Wednesday, May 11, 1927, and will remain in force until further notice.'

"The Radio Division has been requested to report any violation of this order, and the secretary has been instructed to bring such reports to the attention of the Commission with the understanding that stations failing to observe this order will be cited to appear before the Commission at a date to be determined by the Commission.

Dubilier Brothers Make Aerial Plug

The Dumont Electric Co., 40 West 17th Street, New York City, Philip Dubilier, president, and Joseph Dubilier, secretary, have placed on the market a new combination aerial and light socket plug. This affords an excellent light socket antenna, also giving two socket connections, one for the set plug and the other for the AC dynamic speaker, floor lamp or any other electrical appliance. It is claimed that in addition to providing two utile electrical outlets, it sharpens tuning and reduces static disturbances. It is a well-made appliance, sturdy and handsome, molded in solid bakelite and sells at a very low list price. Jobbers, dealers and fans may obtain full information for the asking from the above concern. Mention Radio World.—J. H. C.

MORE ON UNIVERSAL

Another article by Herman Bernard on the Screen Grid Universal will be published next week.

WCCO Independent In Chain Selection

Washington.

Henry A. Bellows, director of WCCO, Minneapolis-St. Paul, has notified the Federal Radio Commission by letter that his station will discontinue exclusive contracts with any of the national broadcasting chains. Mr. Bellows declared that he will conduct the station on "an absolutely free lancing basis" and that he will select from the offerings of the National and Columbia Broadcasting companies to meet the needs of local audience.

The Commission regards this statement as important, it is said, because WCCO, which is one of the largest stations in the Northwest, is one of the first to oppose exclusive contracts between individual stations and the chains.

Mr. Bellows formerly was a member of the Federal Radio Commission.

DICTION SWAYED BY ANNOUNCERS

Details of the purposes of the American Academy of Arts and Letters in awarding a gold medal for good diction on the radio were made known.

A group of notable Americans will broadcast over a complete national hookup from the library of the Academy, New York City, on Sunday at 10:30 p. m. through the systems of the Columbia Broadcasting Company and the National Broadcasting Company.

Hamlin Garland, chairman of the Academy committee for the award of the medal, yesterday expanded on the Academy's innovation in the radio field. He said:

"Millions of our people never hear English spoken with even reasonable correctness. Into these groups the voice of the announcer should bring cultivated speech —not elocution—but good English properly enunciated. The awarding of the medal will encourage the cultivated announcer, the man who knows how to use musical terms correctly, who knows something of Italian, French and German celebrities, and who is an almost unconscious exemplar of good English speech.

"It is estimated there are more than seven hundred radio stations in America with nearly two thousand official announcers whose voices are heard almost hourly by forty millions of people. In this almost universal dependence on the radio for entertainment, the part which the official announcer is to play becomes more and more important. He comes to be a teacher, in some cases a hero to his hearers.

"What the effect of this competition will be, no one can tell, but the value of the discussion which has already arisen and which will increase in interest cannot fail of helpfulness."

END DISGUISED RECORD MUSIC, BOARD ORDERS

The full text of a new order by the Federal Radio Commission on mechanical reproduction follows:

"General Order No. 52. It is ordered that General Order No. 49 heretofore issued by the Commission on October 26, 1928, be, and the same is hereby, to read as follows:

"'All broadcasting stations shall announce clearly and distinctly the character of all mechanical reproductions broadcast by them, the announcement to precede each such program item. In such announcements each phonograph record used, whatever its character, shall be described as a "phonograph record;" each piano player selection used shall be described as played by "mechanical piano player"; every other mechanical reproduction shall be similarly described by the term generally used and understood by the public as meaning such mechanical reproduction;

"'Provided, however, that where a recording or electrical transcript is made exclusively for broadcasting purposes and is neither offered nor intended to be offered for sale to the public, the words "phonograph record" may be replaced by any phrase which accurately describes such transcription and which is of such a nature as not to deceive or tend to deceive the public as to the character of the reproduction broadcast. Every station taking advantage of this proviso shall keep a record of the phrases actually used by such station and shall communicate such phrases to the Commission on request by the Commission.'"

Hammarlund Drum Works Ingeniously

The Hammerlund Manufacturing Co., Inc., has placed on the market for the new season a new illuminated drum dial having several distinctive features. This dial is adapted for use with any circuit and is controlled by a knurled knob so cleverly devised that it can be placed in any position on the panel desired for convenience or attractive balance. A richly embossed oxidized escutcheon of exclusive design and graceful proportions is provided for the front panel. The figures and graduations are etched on a translucent celluloid scale and are illuminated from the rear by the small electric bulb provided, which consumes the minimum amount of current.

Full information may be had upon addressing the Hammarlund Manufacturing Co., Inc., 424 West 33rd Street, New York City. The new Hammarlund parts also include double tuned coils for screen grid tubes, "battleship" gang condensers and short wave inductances. Mention Radio World.—J. H. C.

ASKS COMMUTATION FOR DOOMED BOARD

Washington.

Representative White, of Maine, chairman of the Merchant Marine Committee, which has jurisdiction over radio legislation, said Congress will be asked to extend the life of the Radio Commission for a year. Unless Congress renews the life, the Commission will pass out of existence on February 23 as a licensing body. Mr. White is of the opinion that no further attempts should be made to make any considerable changes in the present radio law until a determination has been reached as to the correctness or error of the present radio policies. Some of the Radio Commissioners disagree with him.

Sarnoff on Television

"Within Three to Five Years I Believe We Shall Be Well Launched into the Dawning Age of Still Pictures by Radio, Radio Motion Pictures, Radio Television and Television in Colors."

By David Sarnoff

Vice-President and General Manager, Radio Corporation of America

MORE than thirty million people in the United States, through the electrical "ear" developed by radio, are now regularly receiving a service of information, education and music broadcast through the air. We may hear, through sound-broadcasting, the drop of a pin across the continent. When will radio equip us with electrical "eyes" that will permit us eventually to see across an ocean?

The horizon is as bright with promise for the radio "onlooker" as it is for the radio listener. Within three to five years we may expect not only to see television broadcasting on an organized scale but even to receive distant scenes transmitted by radio in their natural colors.

Sums Up Situation

Nevertheless the immediate situation is:

1. That television is still in the experimental stage;
2. That many refinements, improvements and even new engineering solutions are required in the transmission and reception of light images by radio;
3. That the broad highway in the ether necessary for the establishment of a television service requires continued research into the problem of locating suitable wavelengths.

The great problem of television is not the problem of making a magic box, through the peep-hole of which one may view diminutive reflections of passing men and events. The fundamental principles of sight transmission and reception are well understood. The greater problems of television are still bound up in the secrets of space.

Conversion Problem Great

Simply stated, the engineering problems involved in serving the eye, as radio now serves the ear, are the conversion of light waves into suitable electro-magnetic waves that can be propagated through space and converted back into light waves at the receiving end. Recent demonstrations have shown how these problems have been met under experimental conditions.

But much further development is required. We are now working towards photo-electric cells of much greater sensitivity, for more brilliant and readily controlled lighting devices, for better means of synchronizing light elements on the scanning apparatus at each end of the radio circuit.

In the enthusiasm of invention, various steps in this direction may be announced as "solutions" of the television problem.

While we are forging the electric eye, as we have forged the electric ear, we have yet to build a road through space broad enough to accommodate the necessities of visual transmission.

Size of Sideband

We can use a wave side band of 5,000 cycles for sound transmission, but we need a wave band of somewhere between 20,000 and 100,000 cycles or even more for visual broadcasting of continuing public interest. Nor is this the only problem which television faces.

The problem of radio television, is best visualized in considering the vast differences between the ear and the eye.

Electric and other modern means of covering distance have made the feet a secondary means of locomotion. The electric switch, the generator and the motor are coming very largely to take the place of the human hand. Radio and the wired telephone have extended enormously the range of human hearing.

But consider the eye, with all that science, discovery and engineering have accomplished in equipping man for the struggle of life, the eye still looks out naked upon the world, aided to a limited extent by pieces of curved polished glass.

Eye Is Cranky Organ

A sensitive photographic apparatus, the eye demands that every scene be contracted to its limited field of vision.

It tolerates but little interference.

Shake a feather before the eye and you blot out the view of a mountain. Project two views simultaneously and you create confusion before the sight. Distort a picture and you destroy its recognizable elements.

Now, contrast this to the ear. The ear receives sounds from all directions. It is able to recognize and interpret the slightest tonal differences. By an act of concentration we can almost eliminate from consciousness the noise of a room full of people, and conduct a conversation with a single auditor.

Eye Is Different Indeed

Radio broadcasting found a pliable and sympathetic organ of reception in the ear. The ear will stand for a considerable amount of noise interference, both natural and mechanical, with only a moderate loss of musical or tonal values.

Thus we have been able to overcome great obstacles to sound transmission by going over or around them. And so the sound of music may be heard over the roar of interference registered in the vacuum tubes.

But in attempting to serve the eye radio stands squarely before the fundamental problems of electro-magnetic wave propagation through space. Engineering solutions alone will not suffice to lift the bandage that has limited human vision.

A sudden blur of interference, hardly noticeable in sound broadcasting, may for an instant blot out a distant scene projected by visual transmission. Static, now overridden in the broadcasting of sound, may destroy entirely the broadcasting of sight.

"Within Three to Five Years"

Within three to five years, however, I believe we shall be well launched into the dawning age of sight by radio, involving the following developments:

1. Transmission of Still Pictures by Radio.—With the progress already made in photographic or facsimile transmission, a new and universal form of telegraphic service is being developed, when messages, pictures, documents and other business forms will be transmitted photographically.

2. Radio Motion Pictures.—The transmission in rapid succession of a series of still pictures—otherwise, motion pictures—is a logical element in the development of sight transmission. Thus an educational or other event might be broadcast by a single radio operation to 100,000 or to 1,000,000 homes in the country; the same event, distributed through present-day methods, would require a million separate deliveries of a million films to a million homes.

3. Radio Television.—The instantaneous projection through space of light images produced directly from the object in the studio, or the scene brought to the broadcasting station through remote control, involves many further problems. Special types of distribution networks, new forms of stagecraft, and a development of studio equipment and technique are required. New problems would rain in upon the broadcasting station. New forms of artistry would have to be encouraged and developed. Variety, and more variety, would be the cry of the day. The ear may be content with the oft-repeated song; the eye would be impatient with the twice-repeated scene.

4. Television in Natural Colors.—The problem of transmitting electrical currents, translatable into light waves that will reflect objects and scenes in their natural colors, is a further development which may be reasonably expected, once the fundamental problems of radio televisio have been solved. When that time comes, as I believe it will, and when three-dimensional projection is added to the art, it will be difficult to differentiate between reality and its electrical counterpart.

Cyphers Appointed WGBS Program Chief

Two members have been added to the staff of WGBS, the General Broadcasting Station, Hotel Lincoln, New York City, formerly the Gimbel Bros. station. They are Harry Cyphers and Elmer Kinsman. Mr. Cyphers will be program manager. He was for ten years a reporter and assistant music and dramatic critic on the Newark "Evening News," and spent fifteen years in the concert field.

Elmer Franklin Kinsman, former manager of WOKT, Binghamton, N. Y., has been appointed an announcer. He is a graduate of Cornell and is a pianist. He was accompanist of Frank La Forge.

Robert Eichberg, publicity manager of WGBS, has assumed the duties of assistant director in addition to his regular press work. Edgar Wallace remains as chief engineer, and Charles Ratcliffe as his assistant.

BLAN STOCKS "HI-Q 29"

Blan, the radio man, 89 Cortlandt Street, New York City, has selected the Hammarlund-Roberts "Hi-Q 29" Master as one of the best circuits of the new season. He has added an engineering staff to his force to test all parts, kits, eliminators, speakers and power packs. He has added a mail order department. Information will be sent upon request to the above address. Mention Radio World.—J. H. C.

Motorboat

Three Ways of Attac

By J. E.

Technical

MOTORBOATING was first recognized as a nuisance in radio receivers in 1925, or at the time that B battery substitutes made their appearance. It was with us before in many sets, but was not recognized for the evil that it was. It was particularly prevalent in reflex and three-stage transformer-coupled receivers. The trouble was called squealing or whistling, and the stock remedy was to reverse a pair of leads on an audio transformer. Once in a while somebody suggested that a condenser be put across the B battery to stop the noise.

Sometimes reversing the leads to a transformer stopped the squealing, but often it only changed the pitch. Sometimes the condenser across the B battery stopped the noise, but often it did not. It failed, not because it was not the correct remedy, but because it was not large enough in capacity.

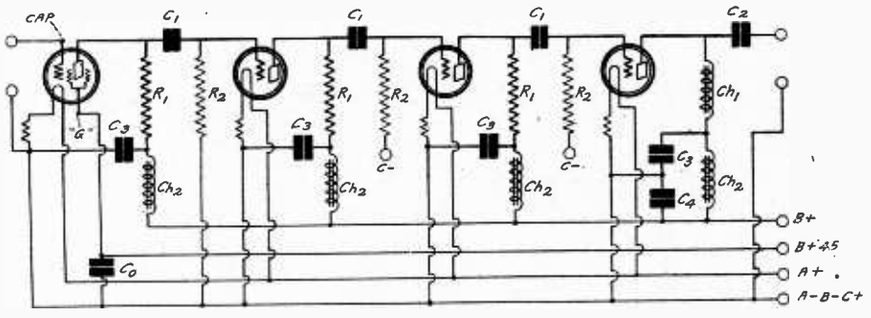

Fig. 1

THE DIAGRAM OF A FOUR TUBE RESISTANCE COUPLED AMPLIFIER IN WHICH A SEPARATE FILTER IS USED IN EACH OF THE FOUR PLATE CIRCUITS AS A MEANS OF STOPPING MOTORBOATING

Motorboating Increased

Squealing and whistling are rare in modern receivers, but motorboating is much more frequent than ever before. Generation of high-pitch noise in an amplifier has been banished by the by-pass condensers now used in the B battery eliminators or even across the B batteries. But the generation of low-frequency oscillations has increased because audio frequency amplifiers have been improved at the low frequencies and because B battery eliminators have not been improved at the same rate.

The cause of motorboating and other forms of oscillation in an amplifier is feedback through the impedance of the B battery eliminator, the resistance of the B battery, or through some other impedance common to two or more circuits. The greater the amplification in the circuit, the greater is the feedback through any given common impedance. For this reason motorboating has become more prevalent since the efficiency of audio amplifiers on the bass notes was made as high as that on the higher notes.

Resistance coupled amplifiers were efficient on the low notes from the beginning and for that reason motorboating has been associated with them more than any other type of circuit. But it is a fact now that circuits containing high-class audio transformers motorboat just as readily.

Remedial Measures

There are many things that can be done to stop motorboating in a circuit. These are based on three principles.

The first is to reduce the common impedance, and hence the feedback through it.

The second is to manipulate the circuit so that the phase of the feedback current is such as to cause only negligible regeneration.

The third is to change the circuit so that the amplification on the low and troublesome frequencies is cut down materially without at the same time cutting down the amplification on the other audible notes.

There is not a B battery eliminator made which will not cause motorboating on some receiver. It is not practical to build one so that it can operate any receiver whatsoever. It must be built so that it will operate satisfactorily the standard circuits. If such an eliminator is used on a circuit which it cannot operate without motorboating, it is possible to take steps to reduce the common impedence which it offers.

There are two methods of reducing the impedance common to two or more amplifier tubes. One is to use large by-pass condensers, and many of them. The other is to use an individual filter for each of the tubes. Both of these methods in combination must be used in some cases.

The size of the by-pass condensers required depends on the frequency of the motorboating. The lower it is, the larger the condensers must be. Also the higher the amplification at the frequency of oscillation, the larger the condensers must be.

Individual Filters Used

The use of an individual filter in each place circuit is very effective, although it is expensive. One method of employing individual filters is shown in Fig. 1. which is a resistance coupled amplifier. There is a filter section in each of the plate circuits below the coupling impedance. Each filter consists of a condenser C3 and a choke coil Ch2. These filters are in addition to the usual filter sections in the B battery eliminator, the output of which is supposed to be connected across B plus and B minus.

In some circuits resistors are used for the choke coils Ch2, but resistors are not quite so effective as chokes. Each of the condensers C3 might well be a 2 mfd. unit The first three Ch2 chokes might be the secondaries of old audio transformers The fourth Ch2 choke should be a coil of 30 henries which will carry the current for the last tube. In fact, it may be just like Ch1, which is a standard 30-henry coil designed for an output filter.

An additional filter gain is obtained by connecting the loudspeaker to minus A and to condenser C2, which should be at least 4 mfd. The usual method of connecting the speaker and C2 is across Ch1.

All the condensers used for filtering in this circuit should be rated at a voltage considerably higher than that applied to the B terminals.

Condenser C4 is included because it may have to be used addition to the final condenser in the B battery eliminator. It is in parallel with this condenser.

While the method of separate filters is shown for a resistance coupled amplifier, it applies to all types. However, it may not be equally necessary in all types.

The method of individual filters does not decrease the common impedance. It only decreases the common impedance relatively to the total impedance in each plate circuit, and it prevents feedback from one circuit to the other.

Choice of Coupling Units

The coupling resistors have a certain effect on the misbehavior of the circuit. If the coupling resistors R1 are large compared with the internal resistances of the tubes, the amplification on all frequencies is high. This would tend to increase the tendency to motorboat. But when the coupling resistors are large they are relatively larger as compared with the common impedance. This has a tendency to reduce motorboating, and usually this is the stronger influence. Hence, it is advantageous to use high coupling resistors.

The same conclusion is reached in conjunction with transformer coupled circuits. The primary impedances should be high. This makes the amplification high for all frequencies within range of the ear. It is true that it also increases the tendency to motorboat, but the separate filter method is applicable.

If the amplification is to be high it is necessary that the grid leaks R2 be high. They should be at least three times as high as the plate coupling resistors, and they should not be less than one megohm. There are exceptions to this, which will be noted.

Effect of Stopping Condensers

It was stated above that one way of stopping motorboating was to cut down the amplification on the low frequencies without doing so on the other audible frequencies. This can be done by manipulating the stopping condensers and the grid leaks. The smaller the stopping condenser for a given value of grid leak, the lower is the amplification on any given frequency. But the condensers do not reduce the amplification of the high notes nearly as much as that of the subaudible. There is a rather sharp cut-off at a certain low frequency, depending on the value of the condensers and the grid leaks.

For a given value of a stopping condenser, the amplification at a given low frequency is lower, the lower the grid leak resistance.

Reverse Feedback and Quality

If motorboating occurs at such a low frequency that it cannot be stopped by by-pass condensers and series chokes, it may be stopped by changing the stopping condensers C1 and the grid leaks R2, or any of them. Both are reduced. The effect of the stopping condensers is both to reduce the amplification and to change the phases of the plate currents. Thus they alter the feedback as well. This

ing Remedies

king Knotty Problem

Anderson

Editor

quency distortion at certain points, so that when an amplifier is apparently stable there is every reason for using filter chokes and by-pass condensers as freely as if there were motorboating. The necessity of filtering thoroughly is realized fully by the manufacturers of some of the better audio transformers. In their published circuits they recommend chokes, by-pass condensers and resistors where many would think these additions are superfluous. The difference in quality without these parts and with them is astounding. Detrimental feedback is reduced to a negligible amount.

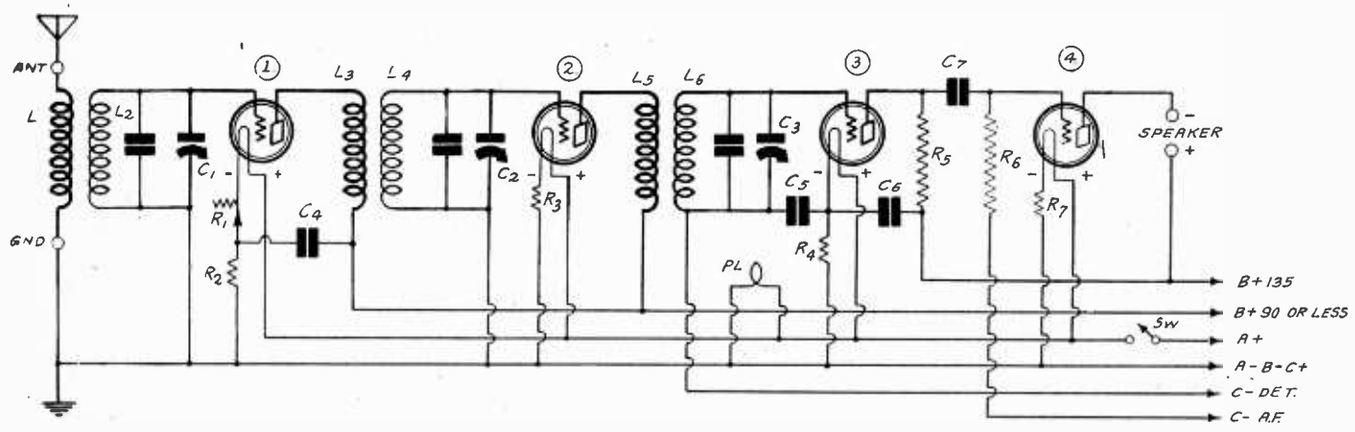

FIG. 2

IN THIS RECEIVER THERE ARE ONLY TWO PLATE CIRCUITS IN THE AUDIO FREQUENCY LEVEL. SUCH A RECEIVER RARELY MOTORBOATS BECAUSE THE FEED-BACK IN AN EVEN CIRCUIT STABILIZES THE CIRCUIT. IF THE COUPLING CONDENSER IS TOO SMALL, THE GRID LEAK FOLLOWING TOO LOW, AND IF THE LOAD ON THE LAST TUBE IS INDUCTIVE, THIS CIRCUIT MAY OSCILLATE AT A VERY HIGH FREQUENCY WHEN B BATTERY IS NOT BY-PASSED.

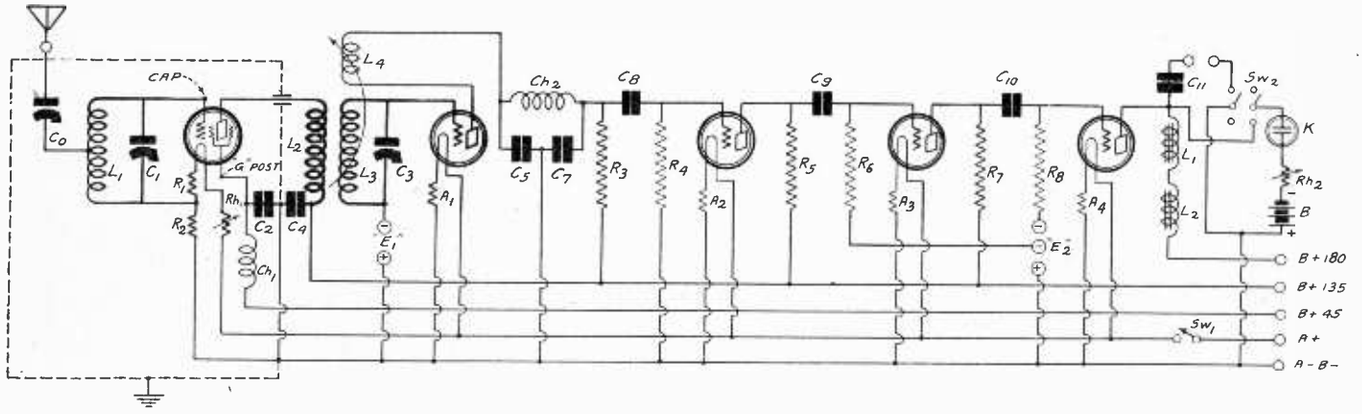

FIG. 3

IN THIS CIRCUIT THERE ARE THREE RESISTANCE COUPLERS AND FOUR PLATE CIRCUITS. IT IS THEREFORE AN EVEN CIRCUIT, WHICH IS ESSENTIALLY STABLE. IT MAY MOTORBOAT AT A VERY SLOW FREQUENCY DUE TO THE PHASE SHIFT INTRODUCED BY THE COUPLING CONDENSERS.

sometimes has an adverse result. Motorboating might start at a very low frequency, giving the effect of fading. Filters are used against this trouble.

Just because a circuit is stable and does not motorboat or squeal, it should not be supposed that all is well and that measures to reduce the common coupling are unnecessary. When the feedback through the common impedance is such as to stop oscillation, the total amplification is reduced by the feedback, and this reduction is much greater at some frequencies than at others. In other words, stability in the circuit is often an indication of frequency distortion.

Regenerative Peaks

Also, in some cases the feedback is such as to increase the amplification at certain frequencies, but not enough to cause oscillation. It is not safe to assume that the quality of the receiver is the same as that indicated by curves. Actually there may be very serious fre-

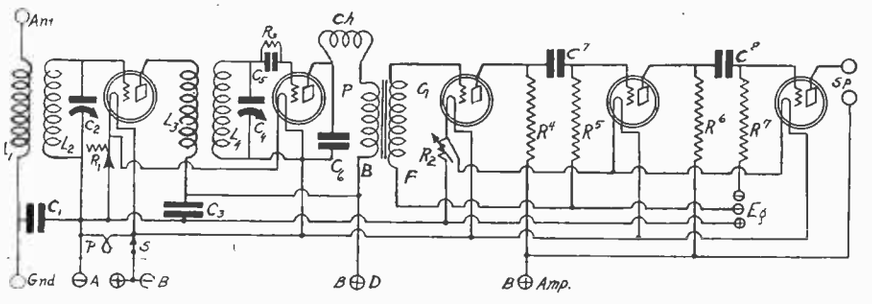

FIG. 4

A CIRCUIT DIAGRAM OF A RECEIVER EMPLOYING ONE TRANSFORMER AND TWO RESISTANCE COUPLERS. THREE OF THE PLATE CIRCUITS ARE ON THE SAME VOLTAGE TAP ON THE B BATTERY ELIMINATOR. SUCH A CICUIT MAY MOTORBOAT VIOLENTLY IF THE B BATTERY OR ELIMINATOR IS NOT ADEQUATELY BY-PASSED. BUT THE FREQUENCY IS USUALLY HIGH ENOUGH TO MAKE MODERATELY LARGE CONDENSERS EFFECTIVE IN STOPPING IT.

One Tuned Circuit

How This Device is Worked Into Audio Channel

By Adrian Brooks

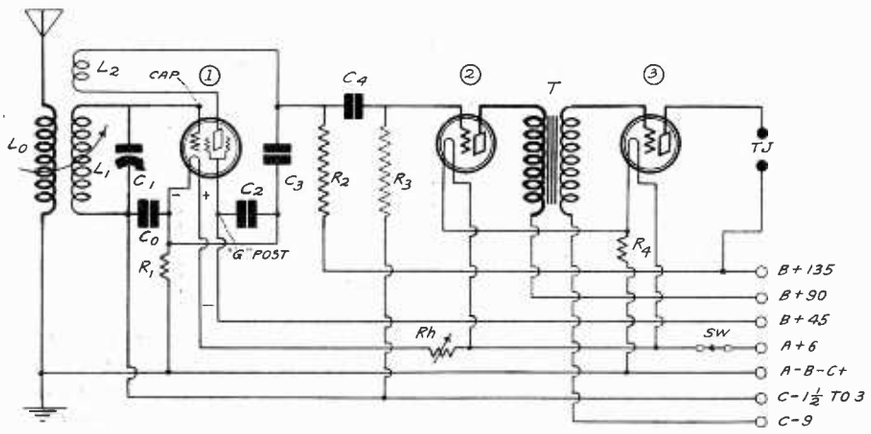

FIG. 1

A SINGLE TUNING CONDENSER IS USED FOR BRINGING IN THE VARIOUS STATIONS O THIS RECEIVER, DESIGNED FOR USE IN THE COUNTRY, WHERE THE SELECTIVITY PROBLEM MAY NOT BE AN IMPORTANT CONSIDERATION.

A GOOD little receiver for use away from the air-congested localities is the one diagrammed in Fig. 1. It is not selective enough for use in large centers, but in the country it will stand up well.

The method used is that of a single tuned circuit, with a stationery feedback coil, and no provision for varying feedback. While greater sensitivity might be attained by regeneration variation, the single control idea is strictly adhered to, for simplicity's sake, and a good result attained.

A screen grid tube is used as detector. Grid bias rectification works well with this tube, and, since that method increases selectivity, it is used.

Antenna Circuit Variable

The input is through a variable antenna coil, which may be the rotary coil of a three-circuit tuner. The secondary is tuned, as usual. The plate coil must have a greater number of turns than would be present on an ordinary three-circuit tuner, where the small winding, usually employed as the primary, is the sole remaining one.

Therefore, if you have a three-circuit tuner you may change it over for the present use by winding 30 turns of No. 24 single silk-covered wire for the plate coil. To do this you would have to remove the existing small primary winding. If you are cramped for room you may wind the thirty turns in two layers.

The first audio stage is resistance coupled, as that works well out of a screen grid tube. The second audio stage is transformer coupled, largely in the interest of stability. The circuit works well on batteries or B eliminator, and, while it is not a super-sensitive receiver or anything remarkable, it is a good, steady, dependable circuit of fair selectivity, such a receiver as any one in the house can work very easily, even a small child.

The circuit may be built up on a 7x8-inch front panel and an 8x17-inch subpanel. The antenna coil would be mounted at left on the front panel, while the rheostat would be in a corresponding position at right, with the tuning dial in the center.

The plate coil should be connected in the same order as the grid coil, with windings in the same direction. This is the "aiding" method.

The aiding method reduces resistance in the tuned circuit, the greater the frequency. The opposing method introduces less resistance reduction, the lower the frequency.

The negative grid bias method of detection makes the circuit possible from a selectivity viewpoint, since there is no grid current flowing and no damping leak in the grid circuit. The selectivity is about 25 per cent. better than it would be by the leaky-condenser method of rectification, where the grid return would be to positive A. Any positively biased grid draws direct current.

Insuring Regeneration

If no regeneration at all is obtained, increase or decrease slightly the positive voltage on the screen grid (G post of socket). This voltage is bound to be somewhat critical when this tube is used with negative grid bias, either as detector or amplifier, whether in regular screen grid fashion or as a space charge detector or amplifier.

A .00025 mfd. condenser across phones or other plate impedance may produce regeneration where other ways fail.

In the space charge method the plate voltage would be 180 and the screen grid would be connected to the secondary, while the cap of the tube, instead of going to this coil, would go to B plus 22½ volts. The G and cap connections are then reversed.

Selectivity Wanted

It is not advisable to use the space charge method, because while it is louder, it is less selective, hence the regular screen grid hookup is shown.

Many no doubt will be surprised at the suggestion that regeneration, if obtainable at one end of the broadcast frequency spectrum, can be present at the other end to any useful extent, without adjustment of the tickler. However, experience with screen grid tubes proves that they have a tendency to regenerate too much or too little, with the rotatable tickler arrangement, hence it is possible to find the right point on the "bend" with the fixed tickler, etc., by just getting enough regeneration to be exceedingly useful in conjunction with negatively biased detection.

Correct Bias Important

As important a consideration as any, in respect to obtaining regeneration in the desired degree, is the amount of the negative grid bias. In the diagram 9 volts negative are suggested, but, as always, experiments above and below the recommended bias should be made. The correct bias is determined by the B voltages and the shape of the characteristic curve. The correct point on the curve will vary somewhat with different tubes.

The B voltages on the screen grid (G post) and on the plate of the tube determine the absolute point of bias. The shape of the curve determines the relative point.

Bias Is Easy

There need be no difficulty, however, as it is easy enough to reach the correct bias by experimenting, without strict regard to the causes.

The only warning necessary is that loudest signals should not be the controlling factor, but rather the attainment of best selectivity consistent with decently loud reception.

While regeneration improves volume, it does so most on weak signals, hence on many local stations you could not tell whether you were getting regeneration or not, but you could spot inadequate selectivity in a jiffy. For a one-tube tuner this one is what may be termed surprisingly selective. Of course if you miss out on regeneration your selectivity is low.

Parts Handy

The three-tube set is the thing that everybody should want to try, especially since most of the parts therefor will be found about the house. Once satisfied, found about the house.

List of Parts

L0, L1, L2—One Screen Grid High Impedance Tuner, Model 5HT for .0005 mfd., or Model 3HT for .00035 mfd., or an existing three circuit tuner made over as directed.
C1—One tuning condenser, .0005 mfd. or .00035 mfd.
C0, C2—Two .006 mfd. fixed condensers.
C3—One .00025 mfd. fixed condenser.
C4—One .01 mfd. fixed condenser.
R1—One No. 622 Amperite with mount.
Rh—One 30 ohm rheostat.
SW—One battery switch.
R2—One Lynch .5 meg. metallized resistor.
R3—One Lynch 5 to 1.0 meg. metallized resistor.
R4—One No. 112 Amperite with mounting.
T—One audio frequency transformer.
1, 2, 3—Three standard sockets.
TJ—One pair of phone tip jacks.
Two binding posts (Ant., Gnd.).
One front panel, 7x18 inches.
One subpanel, 8x17 inches.
One nine-lead battery cable.
One screen grid tube, one -01A and one 112A (output).

The Hi-Q 29 Master

By Leslie G. Biles

[The first instalment of this three-part article on the Hi-Q29 Master, the latest and ranking Hammarlund-Roberts circuit, was published in the December 1st issue. Part II was printed last week, issue December 8th, and herewith is the last instalment of Leslie G. Biles' absorbing article on this fine circuit for custom building.—Editor]

DUE to the unusual arrangement, the mutual inductance or coupling between the primary and the secondary is much smaller than used in ordinary circuits. However, this does not mean that the energy transfer from primary to secondary is inefficient.

Where Maximum Exists

On the contrary, when two tuned circuits are coupled to each other, the maximum secondary voltage is obtained when the relation (6.28f) 2M2 equals R1 R2 is satisfied where f is the frequency to which both circuits are tuned, M is the mutual inductance in henrys, and R1 and R2 are the effective radiofrequency resistances of the primary and secondary respectively.

In the case of the coupling coils used in the receiver under discussion, the maximum secondary voltage is obtained with a coupling co-efficient of the order of one per cent. The physical arrangement of the coils as shown in the photograph of the completed receiver was chosen because it seemed the simplest way to obtain such loose coupling while still keeping the coils close to each other, thus conserving space.

Due to the inherent characteristics of loosely coupled tuned circuits each of these doubly tuned radiofrequency transformers really constitutes a band-pass filter.

While one of these double-tuned radiofrequency transformers provides an unusual degree of selectivity, the use of two such stages in cascade results in a vast improvement. As an illustration, note the response of an interfering signal at 20 kc. below resonance is only 9% or about 1/11 of the response at the frequency for which the set is tuned. This is for one stage only.

Top of Curve Stays Flat

After going through the second stage, however, the intensity of this interfering signal will have been reduced to 8/10%, or about 1/125. At the same time the addition of the second stage does not materially affect the shape of the top of the response curve. The top of the curve remains substantially the same; the sides become much steeper and the response approaches the zero line at a much more rapid rate.

The width and flatness of the top of the response curve have an important bearing on the quality of the received speech and music, because broadcast stations do not transmit on a single frequency, but rather on a band of frequencies. The width of the sidebands varies somewhat, depending on the transmitter adjustments and also on the type of program being broadcast. They are, however, generally conceded to be about five kilocycles wide for high-quality transmission.

It is therefore apparent that the receiver should be capable of amplifying a band of frequencies, substantially uniformly, if the program is to be received faithfully.

Hence the desirability of the wide flat top on the overall response curve of a high-grade receiver.

When the top of the response curve is sharp, instead of flat, all the frequencies in the band are not amplified equally. Consequently certain of these frequencies reach the detector much stronger than others, with the result that even a perfect audio-frequency amplifier and loudspeaker will be unable to reproduce the program with its original quality. This is the type of distortion referred to previously as "sideband cutting" and results in the loss or weakening of the high audio-frequencies, making the output from the loudspeaker dull and muffled.

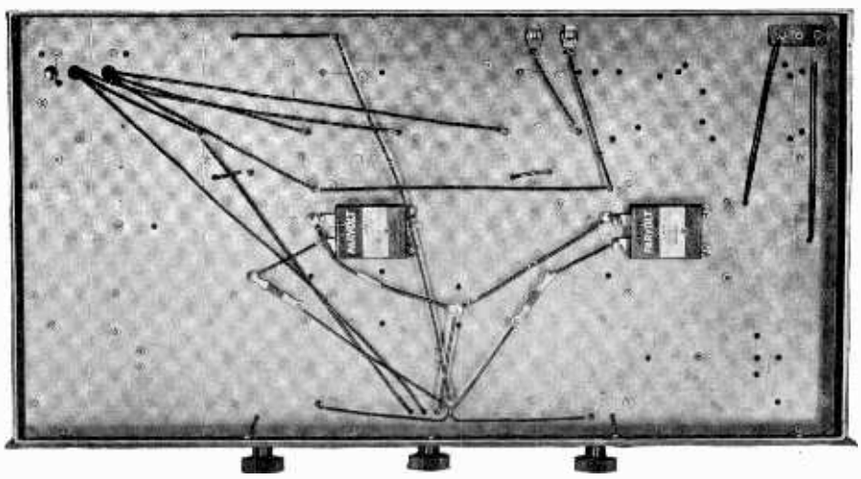

FIG. 4

BOTTOM VIEW OF THE HAMMARLUND-ROBERTS HI-Q 29 MASTER SHOWING THE SIMPLICITY AND THE NEATNESS OF THE WIRING UNDER THE SUB-PANEL.

The two double tuned radio-frequency transformers used in the Hammarlund-Roberts H-Q-29 necessitate the use of four variable condensers—one to tune each of the four coils. Since all four of the tuned circuits are identical, these four variable condensers are rotated by a common shaft, actuated by a new model drum dial having a smooth positive drive without backlash. The tuned input circuit to the grid of the first shield-grid tube, often referred to as the antenna coupler, is of the conventional type, having a tapped primary, making it adaptable to different length antennas. The variable condenser tuning this antenna coupler is on a separate shaft and has a separate drum dial, thus enabling this circuit to be tuned to exact resonance with the received signal, regardless of the type of antenna used.

Novel Volume Control

The volume control is quite out of the ordinary and is made possible only by the characteristics of the shield-grid tubes. It consists of a 100,000-ohm potentiometer connected across the 45 volt B supply. The movable arm of this potentiometer provides a variable voltage which is impressed on the shield grids of the two RF amplifier tubes. The amplification obtainable from these tubes varies within wide limits as the voltage on the shield grids is varied, being at maximum around 45 volts and dropping rapidly as the shield-grid potential is reduced. This provides a smooth control of volume within wide limits without affecting quality or tuning in the slightest degree.

While the shield grid tubes have an extremely low value of capacity between plate and grid, thus avoiding feedback through the tubes themselves as a cause of self-oscillation, this advantage is nullified if feedback occurs in other parts of the receiver. Taking this into consideration, every effort has been made to isolate all circuits in which coupling might result in instability. The negative bias for the control grids of the RF tubes is obtained by the drop across individual ten ohm resistors in series with the negative leg of each screen grid tube filament.

Since the screen grids of both these tubes are biased by the 100,000 ohm potentiometer, a 5,000 ohm isolating resistor is inserted in the lead to each of the shield grids, which are in turn by-passed by means of separate 0.5 mfd. condensers.

The plate circuits of these tubes are likewise isolated by individual filters consisting of separate radiofrequency choke coils and by-pass condensers.

In addition to the abovementioned precautions the entire RF end of the receiver is thoroughly shielded. Each stage is entirely enclosed in a snug-fitting aluminum box which is securely fastened to the metal chassis. The shield-grid tubes are so located that the leads to the control grids are as short as possible and farthest away from the plate leads, which are also short.

Standard Audio

By placing these tubes between the cans, the can sides are used also as electrostatic tube shields, effectively preventing coupling between the tube elements and other parts of the circuit. This arrangement provides the minimum coupling between output and input circuits, which is extremely important.

The audio frequency amplifier is of the standard type, consisting of two stages of transformer coupled amplification. The AF transformers used have a flat frequency characteristic over the usual AF range. A radio frequency choke coil is placed between the plate of the detector tube and the first AF transformer to prevent any stray RF voltages from getting into the AF amplifier. A 171A type tube is recommended for use in the last stage, although other types may be used if suitable A, B and C voltages are available.

SG Tube Substituted

In the 1926 Model Diamond of the Air

By Capt. Peter V. O'Rourke

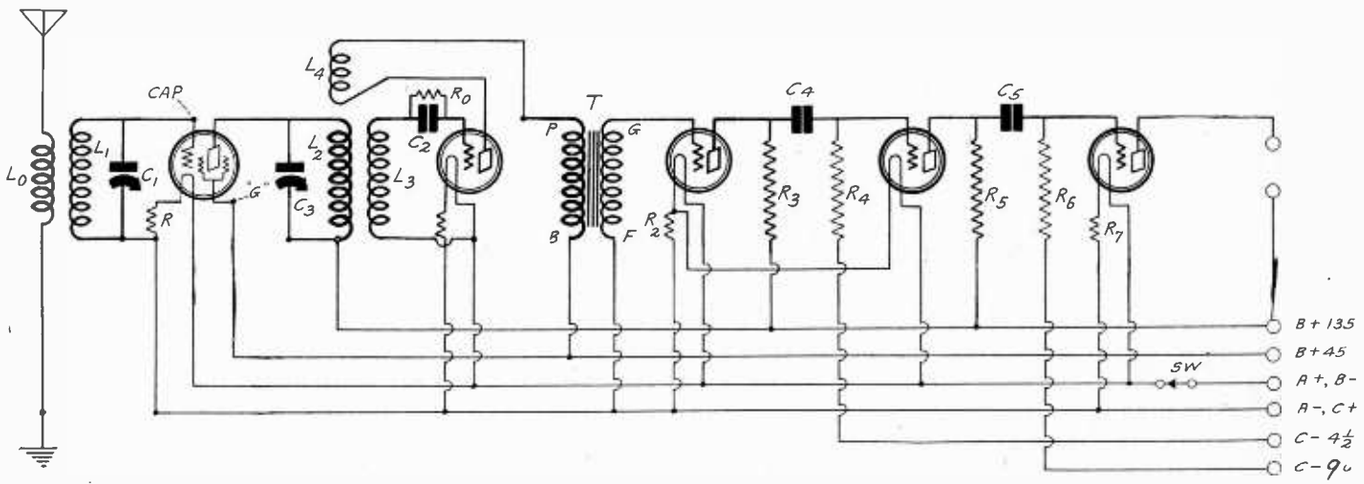

FIG. 1

A CIRCUIT DIAGRAM SHOWING HOW TO INSTALL A SCREEN GRID TUBE AS RADIO FREQUENCY AMPLIFIER IN THE 1926 MODEL FIVE TUBE DIAMOND OF THE AIR.

MANY persons who built the 1926 model Diamond of the Air, a five-tube circuit because of the extra audio stage, still have that receiver, but want to use a screen grid tube as radio amplifier. This can be done very conveniently as follows:

1. For the 1A Amperite now in the RF filament substitute a 622 Amperite.

2. Remove the connection from the grid post of the RF socket and instead connect this lead to the cap of the screen grid tube with a flexible wire and No. 45 Peewee clip.

3. Connect the vacated G post of the RF socket to B+45 volts.

4. For the present three-circuit tuner substitute a high impedance tuner, with tuning condenser across the RF plate coil, L2, leaving the secondary untuned, the tickler being connected as usual.

Hence you need one clip, one 6-inch flexible lead, one 622 Amperite, one high impedance tuner, (screen grid coil model 5HT) and a 222 tube. The antenna coil need not be changed in this instance.

The high impedance tuner has the primary as the outside winding, the secondary inside. From the rear the connections (shaft away from you) are left to right SG plate, B+135, two tickler leads, grid condenser, A+.

Only for Revamping

The diagram shows how the circuit will look when the electric changes are made—grid wire to cap, B+45 to G of socket, RF plate circuit tuned, secondary to detector untuned. This diagram, in fact the whole article, is intended only for those who now have a 1926 Model Diamond (five tubes) and who want to use a screen grid RF tube.

The alteration is both simple and inexpensive. No change need be made in the audio amplifier.

The principal changes are in the first stage and in the coupler between this and the detector. The resistor R in the negative leg of the filament circuit of the screen grid tube now has a value of 4 ohms, but it should be 20. The 622 Amperite takes care of that.

The lead that runs from the coil L1 to the grid binding post on the first socket should be removed from the socket and instead should be terminated in a small clip which will fit over the cap on the screen grid tube. That is, the coil and tuning condenser should not be connected to the G post on the socket but to the cap of the tube.

The G post on the socket should be connected to plus 45 volts.

The Screen Grid Coil

That completes the changes as far as the screen grid tube is concerned. But in order to take full advantage of the properties of the screen grid tube it is necessary to change the three circuit tuner L2L3L4. This coil should be designed especially for the screen grid tube. The primary winding should be wound with enough turns so that it will tune with a .0005 mfd. condenser C3. The secondary winding L3 should be closely coupled to L2 and it should have more turns than L2 so that there will be a voltage step-up. The tickler winding L4 need not be changed.

The jacks used in the original circuit are not shown, as their internal connections undergo no change.

The designations in the circuit diagram herewith are the same as in the original five tube Diamond of the Air. Those who do not remember the blueprint connections may refresh their recollection by obtaining a blueprint of the 1926 model.

Extra Volume Control

No volume control is provided, other than the usual tickler, as it would disarrange the front panel symmetry. A table model volume control Clarostat may be inserted across the speaker posts, or in series therewith, for volume control, if more control is desired. Except in the country it will be found necessary to incorporate.

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The Sargent-Rayment

By F. Edwin Schmitt

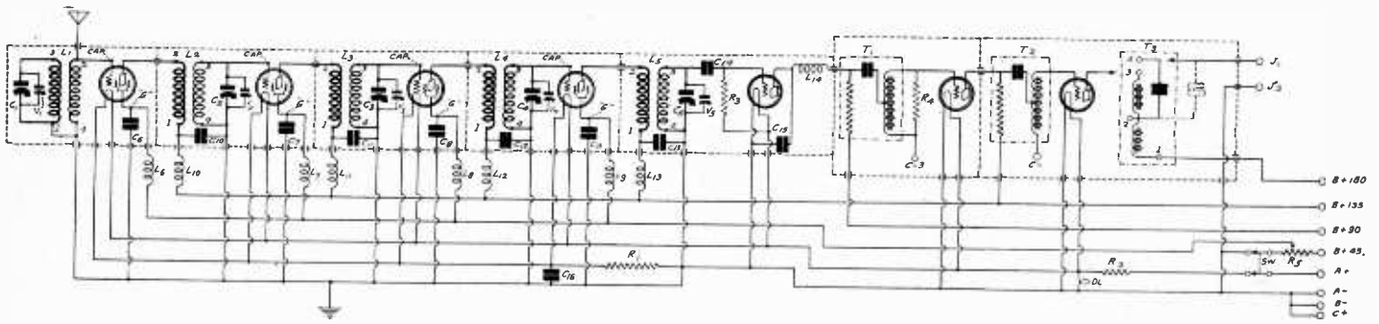


FIG. 4

THE CIRCUIT DIAGRAM OF THE SARGENT-RAYMENT SEVEN RECEIVER, WHICH INCORPORATES FOUR SCREEN GRID TUBES AND UNIFIED TUNING CONTROL.

[*Readers of* RADIO WORLD *are enjoyably familiar with F. Edwin Schmitt's articles on Silver-Marshall circuits. Here is Part II of his discussion of a real DX-getter. Part I was published last week, December 8th issue.*]

IN the Sargent-Rayment the trimmers are vernier condensers connected across the main tuning condensers. There is a knob for each of these on the panel. The verniers do not complicate tuning nor make it difficult to find distant stations, for the main tuning control alone can be used for bringing them in and the small controls are merely used to strengthen the weak signals. On local stations it is not necessary to adjust the verniers, for these stations will come in with sufficient intensity even when the tuning is not exact, and there will be no interference from stations not desired.

Where Quality Resides

Sensitivity and selectivity are functions of the circuit ahead of the detector. Quality of tone resides mainly in the audio frequency amplifier. In the Sargent-Rayment Seven the famous Clough system of amplification is used. This system has an exceptionally high voltage gain, which increases the sensitivity of the circuit. It also has a remarkably uniform frequency characteristic from about 30 cycles per second to well above 5,000 cycles. Above 5,000 cycles the amplification drops off rapidly, a fact which accounts for the absence of the disagreeable background noise and hissing strays heard in many receivers. It also accounts in part for the effective 10 kilocycle selectivity of which the receiver is capable.

The volume which may be obtained from the receiver depends largely on the type of tube that is used in the last stage, for the amplification is ample to load up any power tube now available for reception purposes. If the last tube is a —71A there will be ample volume for the average home. If a —10 is used there will be still more. And if a —50 type tube is used with suitable voltages there will be enough for a small auditorium. Where the finest possible quality is desired in the home the —50 tube should be used, as that tube will not even approach the overloading point on any volume that can be used in a home.

Provision has been made in the output circuit for any one of these tubes. On the circuit diagram, Fig. 1, it will be observed that the plate lead and the lead J1 from the loudspeaker terminate in arrows, which means that they should be connected according to the requirements of the output tube used. If a —12A or —10 type is used, connect the plate lead to terminal No. 3 on the output unit T3. If a —71A or a —50 type tube is used, connect this lead to No. 2 on T3.

If 180 volts or less is used with the —12A or —71A tube, connect the lead from J1 to terminal No. 4 as shown by the solid lines. If more than 180 volts is used, the lead from J1 should be connected through a 600 volt, 1 mfd. condenser as shown by the dotted lines.

Special attention is called to the arrangement of the filament circuit. There is no rheostat and only two filament ballast resistors. One of these, R1, is put in the negative side of the line, and the other, R2, is put in the positive. Both carry the current of all the tubes and of the pilot light. The object of the splitting up the ballast resistor is to provide a suitable grid bias for the screen grid tubes without using a battery for them.

Note also that a double pole single-throw switch Sw is used. One side of this switch opens and closes the filament circuit and the other side opens and closes the potentiometer circuit R5. Thus when the circuit is not in operation no current flows through the potentiometer resistance, even when a battery is used to supply the plate voltage.

The layout of the receiver is one of utmost simplicity, as shown last week, Fig. 2. In this photograph are shown seven metal compartments. In the first to the left is the trap circuit and one tube. In the next two are the first two tuned circuits. In the middle compartment is the drum dial which controls the tuning condensers. In the fifth and sixth compartments are the two second tuned circuits. The audio amplifier is located in the seventh compartment. Transformer T2 is not shown. for it is placed directly under T3, the output transformer.

In each of the tuner compartments is a main tuning condenser next to the panel, a midget vernier directly under this condenser, a tuning coil, a tube socket and one or two by-pass condensers. The first has only one by-pass condenser. The next four have two each. The detector compartment also contains the grid condenser, the grid leak, and the choke coil L14. The contents of each compartment are shown clearly in the circuit diagram as well as in the layout photograph.

Eight RF Filter Chokes

The radio frequency filter chokes are shown outside the shields on the circuit diagram. The actual location of these on the layout is shown in the photograph of the bottom on the subpanel, Fig. 3. There are eight of these chokes. This photograph also shows the two by-pass condensers C16 and C17 as well as the double pole single-throw switch.

At the rear on the left are shown the two jacks J1 and J2 and at the opposite corner are shown the ground and the antenna binding posts. Also at the left is shown the cable containing the battery leads.

Both Figs. 2 and 3 showed the extreme simplicity of the wiring. There are only a few connections in each compartment, and only a few more under the sub-panel. Part of this simplicity is due to the use of the shield frame work as the return circuit. When a lead is supposed to be run to ground or to minus A it is not run to a binding post, but is connected to the frame at the most convenient point. The entire metal frame work is grounded and is at A— potential.

[*The author has consented to answer questions concerning this circuit. Address him as follows: F. Edwin Schmitt, 136 Liberty Street, New York City.*]

LIST OF PARTS

L1—One S-M 141 antenna coil
L2, L3, L4, L5—Four S-M 142 RF transformers
C1, C2, C3, C4, C5—Five S-M 32OR variable condensers
V1, V2, V3, V4, V5—Five S-M 340 midget condensers
L6, L7, L8, L9, L10, L11, L12, L13, L14—Nine S-M 275 RF chokes
T1—One S-M 255 first stage transformer
T2—One S-M 256 second stage transformer
T3—One S-M 251 output transformer
C6, C7, C8, C9, C10, C11, C12, C13—Eight Polymet ¼ mfd. condensers
C14—One Polymet .00015 mfd. condenser
C15—One Polymet .002 mfd. condenser
C16, C17—Two Polymet 2 mfd. by-pass condensers
R1—One Carter H3 three ohm resistor
R2—One Carter H1 1 ohm resistor
R3—One Polymet 2 megohm grid leak
R4—One Durham 150,000 ohm resistor (optional)
R5—One Yaxley 53,000 P (3,000 ohms) potentiometer
SW—One Yaxley 740 Junior switch, double pole single throw
J1, J2—Two Yaxley 420 insulated tip jacks
One S-M 705 aluminum shielding cabinet.
Seven S-M 511 tube sockets.
One S-M 708 ten lead cable.
One National type "F" velvet vernier dial with illuminator.
Two insulated binding posts.
One knob for V1 to match knob of R5
Twenty-five feet of S-M hook-up wire.
One S-M 706 walnut base moulding.
One set of assembly hardware.

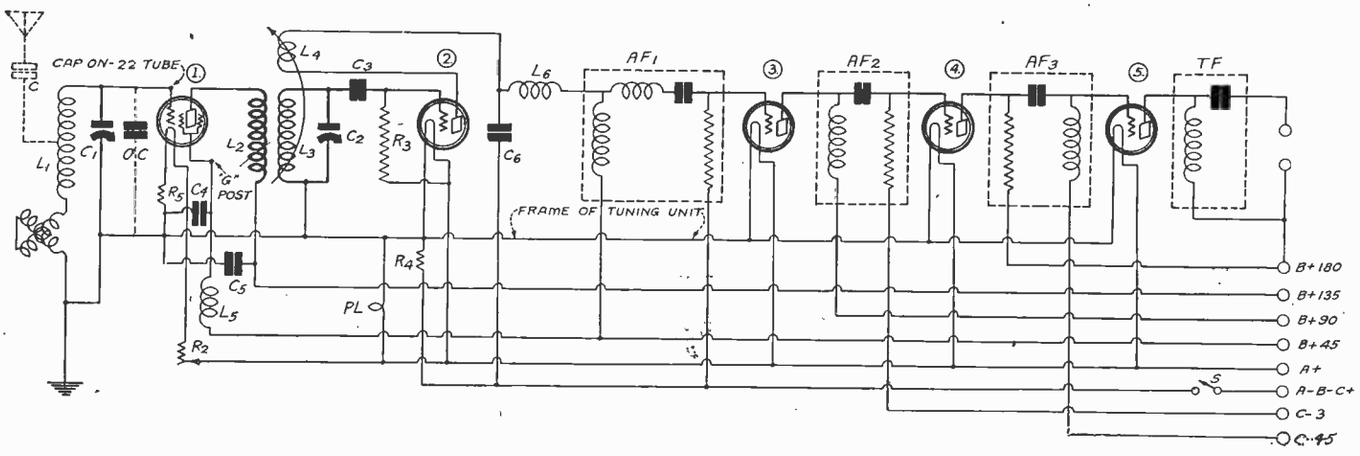


FIG. 718

THE TELEVISION RECEIVER WITH WHICH JAMES MILLEN RECEIVES MOVING PICTURES FROM WASHINGTON, D. C. THE SCANNING DISC IS AT RIGHT. AT LEFT CENTER IS A NATIONAL SHORT-WAVE RECEIVER AND AT RIGHT CENTER A THREE STAGE TRANSFORMER COUPLED AMPLIFIER WITH PUSH-PULL OUTPUT.

Radio University

A QUESTION and Answer Department conducted by RADIO WORLD, by its staff of experts, for University members only.

When writing for information give your Radio University subscription number.

MY RECEIVER has given fine quality for a year, or ever since I got it, but lately a very disagreeable hiss has developed in it. At times this noise becomes a static-like crackle. It originates in the set, for when I remove the antenna it remains.

(2)—If it is not due to some defective part, please suggest something which will help to eliminate the noise.

(3)—Do you suppose the noise originates in the power supply?

(4)—Is there any way of removing the hiss which originates in a soft detector tube?

FRANK SAWYER,
Birmingham, Ala.

(1)—The cause is probably a defective contact, which might be in any part of the receiver. The tube contacts with the socket, the battery connections and various resistors are the most likely causes. Sometimes tuning condensers are at fault. Old type sockets are prolific causes of hiss and crackling. Another possibility is a poorly spliced antenna joint.

(2)—A low pass filter having a cut-off at about 5,000 cycles, or a little higher, is effective. Such a filter may be made of an 85 millihenry choke coil in series with the plate lead of the detector and a condenser across the line. The value of the condenser might be .01 mfd.

(3)—Not likely.

(4)—The same low pass filter will cut down the tube hiss, as well as the noise from the defective contact.

* * *

WHAT IS the advantage of a synchronous electric motor over variable speed motor for television purposes?

(2)—Can a synchronous motor be used on any AC line with the assurance that the scanning disc will be correctly synchronized?

(3)—What is the objection to a universal motor for television and phonograph purposes?

(4)—Which is the better method of scanning the object; by direct or indirect illumination?

(5)—Is there any instantaneous light valve by means of which a beam of light from an arc lamp can be modulated by an incoming signal?

DONALD McDONALD,
Superior, Wisc.

(1)—If a synchronous motor is used synchronization of the scanning disc is automatic.

(2)—The transmitter and the receiver must be operated by the same power system of a synchronous motor is to be used. If they are not the receiver might run a little slow or a little fast.

(3)—The universal motor sparks, and the sparks are picked up by the receiver, causing distortion in the image. For variable speeds, therefore, an "induction motor" is preferable.

(4)—Direct illumination is the more desirable, but the indirect method is the more effective within the limits of application.

(5)—Yes, there is the Kerr cell, which consists of two prisms and a glass vessel of nitrobenzol. No light can get through the device when no electric potential is impressed across the nitrobenzol. But as soon as potential is impressed light is passed. The greater the potential the more light gets through.

* * *

I HAVE a National Screen Grid Five which gave very fine results until I made a change in the wiring. Now I cannot get it to work right. Will you please publish a diagram showing all the connections?

(2)—Is it practical to add a power amplifier following the National Screen Grid Five?

(3)—If you recommend the addition of another stage of power amplification, please show how it should be done.

WILLIAM ROGERS,
Fort Worth, Tex.

(1)—Fig. 718 gives the complete diagram of the National Screen Grid Five.

(2)—It is not practical to add another stage unless the added power used is large enough to handle the enormous volume which will result and unless the plate voltage supply be adequate to handle the entire requirement. It would be better to use a separate voltage supply for the added tube.

(3)—Connect the primary of the coupling transformer to the loudspeaker terminals in the five-tube set and the secondary to the grid circuit of the added tube.

* * *

WHAT CAUSES dead spots in radio reception? Can you explain their formation in terms of something visible and more familiar than radio waves?

JOSEPH SANIEL,
St. Louis, Mo.

(1)—Dead spots are caused by complete or partial shielding of the radio transmitter from the receiver. A locality may be a dead spot to stations in one direction and it may be quite alive to stations in another direction. A dead spot in radio is equivalent to a harbor in navigation.

Advice on Universal

How to Do a Real Job with New Screen Grid DX Circuit

By Herman Bernard

THE Screen Grid Universal, a four tube receiver described in the December 1st and 8th issues, is built on a 7x21 inch front panel, and a 10x20 inch aluminum subpanel which is self-bracketing and has the four sockets affixed. This is a comfortable space for the receiver, and, if possible, that much room should be taken, although for a special installation, as in a small console or a phonograph cabinet, it would be permissible to compress the layout somewhat.

The use of the aluminum subpanel has several advantages. First, it is decidedly attractive. Also it requires a minimum of drilling—twelve holes at most. These are required because of the special coils used, each of which requires two holes for the mounting brackets, and because of the four special holes for each of the audio transformers used.

You may want to use audio transformers you now have, hence would drill the holes for these. Otherwise all parts will mount without further attention than the insertion of a 6/32 machine screw and the turning of a nut.

Blueprint Full Scale

All parts locate themselves according to the holes provided for them, and in this you are infallibly guided by the blueprint, which is full scale.

As the metal subpanel is grounded, and as A minus is grounded, the subpanel itself should be used as the A minus lead, thus eliminating seven wires. If you do not use the aluminum subpanel you will have to connect A minus and ground to each of the lugs marked "solder to subpanel." Look at the picture diagram on the front cover and you will see six such ledgends. You will notice that the antenna coil mounting bracket has a lug put on it, on bottom of the subpanel, and since this lug is connected automatically to the aluminum subpanel, this is the seventh connection.

Besides the conductive contact with subpanel there is of course the requirement in other instances of complete, safe insulation, as when the B plus 135 lead is run from the interstage coil L3L4, through a hole in the subpanel to the B plus cable underneath the subpanel. Any time you desire to make any such connection, even with bare wire, you may use one of the insulated holes built into the subpanel as you receive it, or you may drill a hole yourself and glue an insulating collared washer to it. Such washers and additional hardware are furnished with the subpanel.

Insulated All Around Hole

Any time it is desired to secure a machine screw to the subpanel without any danger whatsoever of shorting, you may put the screw through a collared washer and place a flat insulating washer—the second type furnished with each subpanel—against the bottom. You may turn a nut against the screw without the screw or nut touching the subpanel. This is a good way to anchor the battery cable leads.

The drilled front panel and drilled subpanel combine to place the parts for you. You may consult the actual-sized blueprint if any doubt arises.

The wiring is easy. The only point that needs stressing is that the leads to the primary of the interstage coupler must be reversed from the usual order. If you will look inside this coil, model 5TP, you will see an extra form. On this the secondary is wound. The primary is outside. You mount the coil so that the binding posts are at bottom, and the mounting brackets run in a front-to-back direction, that is, not from left to right, but away from you as you look at the layout from the front panel position. The primary binding posts are at left. The one nearer the front panel connects to plate of the screen grid tube, the companion post to B plus 135. But the binding posts at right are connected in the opposite way. The one nearer the front panel goes to grid return (A plus) while the other goes to grid condenser of the detector circuit.

The reversal of the primary of the interstage coil is shown schematically in Fig. 1 by the crossing of the leads, but this is about all the information along that line that a schematic diagram can convey, and it scarcely solves the problem for the novice. Therefore the foregoing explanation was made. Also, of course, the blueprint may be followed for automatic adherence to the necessity of reversing this lead. If, under any circumstances, you do not obtain regeneration, reverse the primary leads. There are only two ways of connecting them—in phase and out of phase—so if any given way will not produce regeneration in a good tube, the other will.

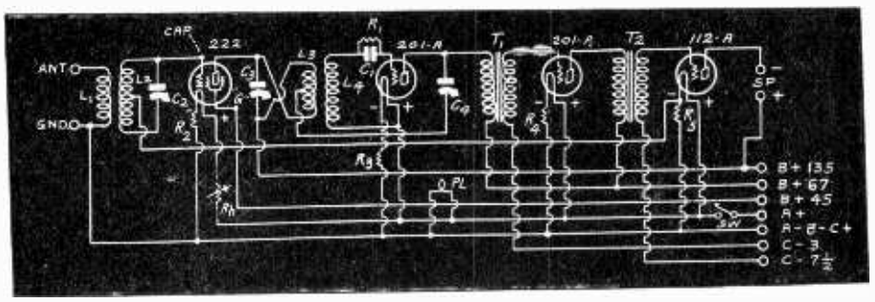


FIG. 1

BE SURE TO REVERSE THE PRIMARY CONNECTIONS OF L3, AS SUGGESTED IN THE DIAGRAM AND AS FULLY EXPLAINED IN THE TEXT, WHEN BUILDING THE SCREEN GRID UNIVERSAL.

LIST OF PARTS

L1, L2—One Screen Grid two-winding RF transformer, with center-tapped secondary; Model 5RF for .0005 mfd.
L3, L4—One Screen Grid high impedance interstage coupler, with center tapped primary; Model 5TP for .0005 mfd.
C1—One .00025 mfd. Aerovox grid condenser, with clips.
C2, C3—Two Hammarlund Midline .0005 mfd. tuning condensers.
C4—One Hammarlund junior condenser. Cat. No. MC11 (50 mmfd.)
R1—One Lynch metallized grid leak, 2 to 10 mg.
R2—One No. 622 Amperite, with mount.
R3, R4, R5—Three No. 1A Amperites with three mounts.
Rh—One 50-ohm rheostat.
T1, T2—Two National audio transformers.
SW—One filament switch.
PL—One pilot light bracket with lamp.
Two dials.
Two knobs.
One No. 45 Universal Peewee clip.
One 10x20 inch aluminum self-bracketing subpanel, with sockets affixed, and including hardware and insulating washers.
One 7x21-inch drilled bakelite. front panel.
One nine-lead battery cable.

ACCESSORIES

Four Kelly tubes as follows: One 422 screen grid, two 401A and one 412A (for 135 volts maximum), or one 471A (for 180 volts maximum).
A, B and C supplies; cabinet and speaker.

The receiver may be operated with the regeneration condenser placed at a given setting and left there, without production of any squeals throughout the entire broadcast range of tuning. This is a distinct advantage, especially when the women folk tune a set. But when you want to strengthen the signal of a far-distant station, you will use the junior condenser. A slight readjustment of the detector tuning dial may be necessary, as all forms of regeneration produce a detuning effect.

Loud DX Without Feedback

It may surprise you that distant stations come in loud without any regeneration, due to the high amplification developed from the screen grid tube by tuning the primary in the plate circuit, and by providing and step-up ratio between secondary and primary, to double the voltage.

Also, do not fail to read the discussion in last week's issue (December 8th) about the options of antenna connection. First build the set exactly according to the blueprint. Then after you have tried out the receiver for a few nights, determine whether your special circumstances require greater selectivity, and then provide that selectivity along the lines laid down last week. In New York, Chicago, and Philadelphia somewhat greater selectivity may be necessary and where builders live close to a broadcasting station, but the general rule will be that the receiver is plentifully selective when wired according to Fig. 1 and the blueprint. It takes only five minutes to introduce into the receiver any of the antenna connection options explained last week. The receiver as diagrammed this week is far more selective than the average four tube set, and likewise is much, much louder.

In brief, it is one of the best four tube designs ever presented and will produce remarkable results.

Phonograph Amplifier

It is Built Separately for Convenience and Quality

By Capt. Peter V. O'Rourke

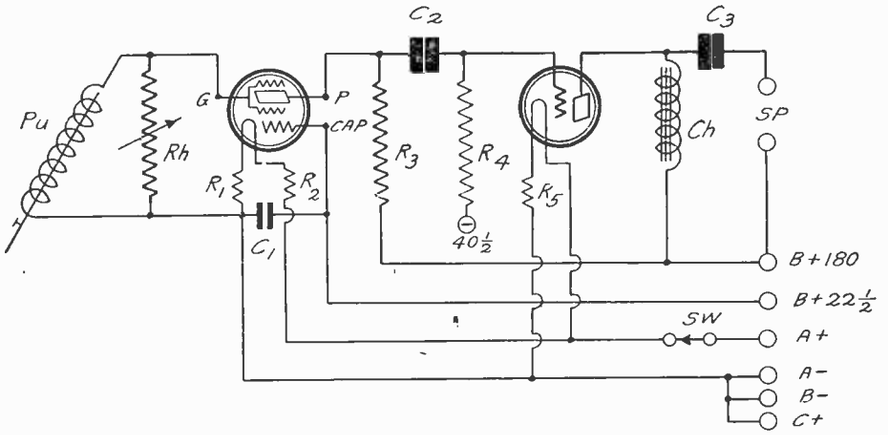


FIG. 1

THE CIRCUIT DIAGRAM OF A SIMPLE AUDIO AMPLIFIER FOR ELECTRICAL PLAYING OF PHONOGRAPH RECORDS WHICH IS CAPABLE OF REALISTIC REPRODUCTION.

LIST OF PARTS

Pu, Rh—One Pacent Phonovox pick-up unit with volume control
R1, R2—Two 10 ohm fixed resistors
R3—One Lynch metallized .25 megohm resistor with mounting
R4—One Lynch metallized 2 megohm resistor with mounting
R5—One 1A Amperite
C1—One Tobe 1 mfd. by-pass condenser
C2—One Aerovox .01 mfd. condenser, mica dielectric
C3—One Tobe 4 mfd. by-pass condenser, 400 volt test
Ch—One 30 henry choke coil
Two S-M four prong sockets
SW—One filament switch
Eight binding posts

AN audio amplifier especially built for the electrical playing of phonograph records is a great convenience. When the audio amplifier in the radio set is used, long leads from the pick-up unit have to be run to the radio receiver and they have to be connected to the set in a manner which is often neither convenient nor technically correct. Compromises have to be made between convenience and correctness and these compromises may result in mediocre tone quality.

Often the loudspeaker is built into the phonograph cabinet. When that is the case other long leads have to be run back from the radio set to the phonograph. It is much more convenient to have the amplifier where the music originates. The cost of building a separate audio amplifier for the phonograph is small, as only a few parts are needed.

It is not necessary to use more than two tubes in the amplifier used for phonograph playing, and if a screen grid tube is used the amplifier is made more economical. Further, if a 112A tube is used in the last stage, it is not necessary to use an output filter. The loudspeaker can be connected directly in the plate circuit of the last tube. If a —71A type tube is used a separate output tube, which is recommended, an output filter is required, unless a dynamic speaker is used, for this has an output transformer built in.

Adjustments of Circuit

The first tube in Fig. 1 is a screen grid tube, used as a space charge amplifier. The object of using the tube in this manner is two-fold. First, it gives a very high voltage amplification when working into a high resistance. A resistance coupler costs very little. Second, the tube acts as an automatic scratch filter, because the effective input capacity to such a tube is comparatively high. This capacity partly eliminates the high frequency noise usually heard in unfiltered phonograph music.

Two 10-ohm resistors R1 and R2 are put in the filament circuit of the screen grid tube, one in each side of the line. The grid bias is obtained from the drop in R1, which amounts to 1.32 volts when the filament current has the proper value.

22.5 Volts on Cap

The positive voltage applied to the inner grid, that is to the cap of the tube, is 22.5 volts. The plate voltage is 180 volts, applied through a coupling resistor R3 of .25 megohm. A resistor of .5 megohm can also be used if a little higher amplification is desired and if a greater suppression of scratch is desired.

The stopping condenser C2 should be not less than .01 mfd. and it should have mica dielectric. The grid leak R4 is 1 or 2 megohms. Both C2 and R4 should be of large value if the low frequency notes are desired in full strength.

Any desired output filter may be used for Ch and C3. If one is made up Ch should be a choke of 30 henries and C3 a condenser of 4 mfd. The voltage applied to the plate of the power tube is 180 volts and the grid bias is 40.5 volts.

If a small battery is placed in the amplifier to supply the grid bias for the power tube, only four power leads will be necessary, and these may be those in a four lead cable.

Resistor Controls Volume

The only volume control necessary is that which is furnished with the pick-up unit, consisting of a high variable resistance Rh shunted across the input to the first tube.

In case a dynamic loudspeaker is to be used with the amplifier it is not necessary to use the output filter C3Ch because such a speaker is always provided with a transformer the primary of which has been designed to work with either a —71A or a —50 type tube directly. But if a magnetic speaker is to be used with either of these tubes the filter must be used as a protection for the armature winding.

If the power tube is a —12A is used no filter is needed with any kind of speaker. But when this type of tube is used the plate voltage should not exceed 135 volts and the grid bias should be about 7.5 volts.

Golenpaul's Efforts Popularized Clarostats

CHARLES GOLENPAUL

The man who made Clarostat famous all over the world is Charles Golenpaul, sales and advertising manager of Clarostat Mfg. Co., Inc., 291 North Sixth Street, Brooklyn, N. Y. John Mucher and the brothers Mucher do the manufacturing.

The Television Clarostat is the latest addition to the line.

Automatic Tuning In New Kit Receiver

The Robertson-Davis Company, makers of Melocouplers and Meloformers, has brought out a new circuit, the Automatic Super-Six. It comes in kit of assembled units that fit together like a set of blocks on the aluminum subpanel and into the front panel. Nine flexible marked leads are united to turn them into the working whole, no soldering being necessary, and it is claimed that only 18 minutes and a screwdriver are necessary to have the receiver ready to plug into the light socket. The set is entirely AC. Six buttons instantly bring each of six favorite stations which can be changed at any time. For full information on these products, address Robertson-Davis Co., Inc., 412 Orleans St., Chicago, Ill. Mention RADIO WORLD.—J. H. C.

NEW HEATER TUBE

A radically different heater type AC tube has just been introduced by the Raytheon Manufacturing Company of Cambridge, Mass.

Tune in Short Waves

Separate Receiver Affords Excellent Results Economically

By Edgar Price Foster

AN entirely separate short wave set can be built at a low cost.

Glance at Fig. 1 herewith for a circuit diagram of short wave receiver that has given fine results.

We begin with the antenna circuit. This is untuned and only a choke coil Ch1 is connected between the control grid of the first tube and the filament. The antenna is connected to the top of this choke and to the control grid.

The object of using this type of input is three-fold. First, it eliminates the effect of the antenna constants on the tuned circuit so that practically any antenna may be used. Second, it eliminates one tuner. Third, it eliminates radiation.

A screen grid tube is used in the first stage to get a high signal gain. This tube is efficient at the high frequencies because it has a very low capacity between the plate and the control grid.

Correct Operation Necessary.

But the screen grid tube must be worked correctly if it is to show up to advantage. It should have a grid bias of about 1.5 volts. This is obtained with sufficient accuracy from the drop in the 10-ohm resistor R1. But this resistor is not enough when the filament voltage source is 6 volts. An additional 10-ohm resistor R2 is put in the positive leg of the filament.

Now it is desirable to have a positive volume control which is independent of the tuning. One of the most effective is a rheostat Rh put in the positive leg of the filament. It should have a range of 25 ohms.

The positive voltage applied to the screen grid has a great deal to do with the performance of a screen tube. Normally this voltage should be 45 volts, but it may be in some cases that better results will be obtained with higher or lower values. Voltages up to 67 volts should be tried and that value which gives the best results retained.

The plate voltage applied to this tube should be 135 volts, or as near that value as can be obtained with a B battery eliminator.

In order to prevent radio frequency feedback from the detector to the screen grid tube two .001 mfd. condensers C1 and C2 and an 85 millihenry choke coil Ch2 are used.

Plug-in Coils Employed

In the choice of coils there is considerable latitude. One type has six different terminals for the three-circuit tuner, permitting the optimum number of turns on all of the windings for any coil plugged in. Such a coil requires a special socket. The National short wave coils is an example. In another type one of the coils is fixed in position and in the number of turns. The other two coils are wound on the plug-in form. This type, in the present circuit, requires a socket of four terminals. Some of the larger coils require sockets of special construction, but others require regular tube sockets. The coils fitting these sockets are small in size and convenient to use. And they are as efficient as the larger coils.

If the small coils of this type are used, the primary winding L1 may be wound on a form which just fits over the plug-in coils; for example, a piece of bakelite tubing two inches in diameter and one inch long. This should be mounted with the coil socket in the center. Twenty-five turns of No. 30 double silk covered wire will do. L2 and L3 are the secondary and tickler windings on the plug-in coil, the number of turns on each depending on the wavelength range.

C3 should be a .00014 mfd. variable condenser, preferably one of the straight-line frequency type. C5 should be a similar condenser, but of .00025 mfd. capacity. The rotors of both of these condensers should be connected to minus A.

The grid condenser C4 should have a capacity of .0001 mfd. and the leak should have a resistance of 2 megohms or more. The resistor should be of the metallized type. A —01A type tube should be used for detector.

In order to force oscillation an 85 millihenry choke Ch3 is put in the plate lead of the detector.

Standard Audio Amplifier

The audio amplifier is a standard two-tube circuit with transformer coupling. The first audio tube should be a —01A and the second a —12A. The plate voltage on the first audio tube is only 45 volts, which is sufficient. But the voltage on the last tube should be 135 volts.

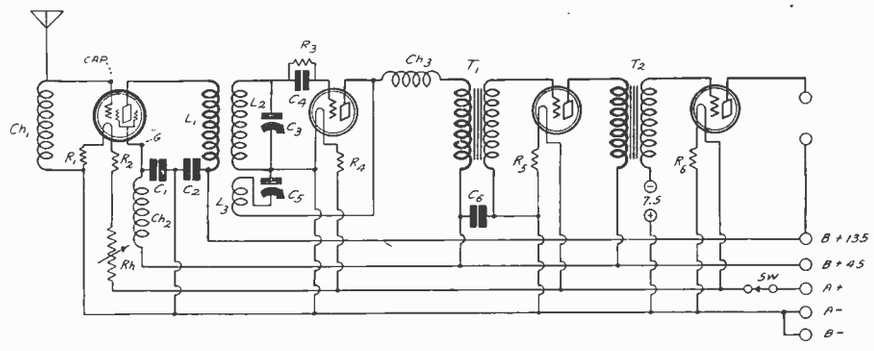


FIG. 1

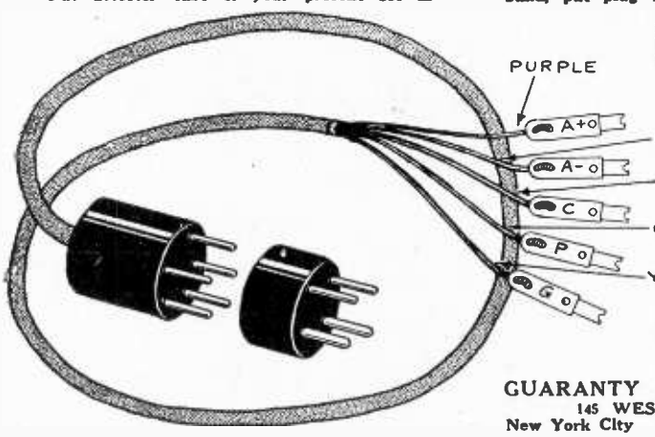
THE CIRCUIT DIAGRAM OF A COMPLETE SHORT WAVE RECEIVER WHICH CAN BE USED INDEPENDPENTLY OF THE BROADCAST RECEIVER.

LIST OF PARTS

Ch1, Ch2, Ch3—Three Hammerlund type RFC-85 radio frequency choke coils.
L1—One 25-turn coil as described.
L2, L3—One set of Air-King short wave plug-in coils. small type.
T1, T2—Two audio frequency transformers.
R1, R2—Two 10-ohm resistors.
R3—One Lynch metallized 2-megohm grid leak with mounting.
R4, R5, R6—Three 1A Amperites.
C1, C2—Two Aerovox .001.
C3—One Hammerlund ML-7 .00014 mfd. "Midline" condenser.
C5—One Hammerlund ML-11 .00025 mfd. "Midline" condenser.
C4—One Aerovox .0001 mfd. grid condenser.
C6—One Tobe 1 mfd. by-pass condenser.
Rh—One 25-ohm rheostat.
Sw—One filament switch.
Nine binding posts.
One National dial.
Five S-M UX type sockets (one for coils).

PLUG AND CABLE for any SHORT WAVE ADAPTER

Handiest thing for ANY short-wave adapter. Put detector tube of your present set in socket of any short-wave adapter you build, put plug in detector socket of your broadcast receiver. Cable, 34". Leads identified both by color scheme and tags. 5-prong plug and 5-lead cable for AC short wave adapter. May be used as 5-lead battery cable plug with UY socket. (Cat. No. 21AC) $1.50. 4-prong extra plug only, necessary addition to other for DC short-wave adapter (Cat. No. 21DC) $0.50.

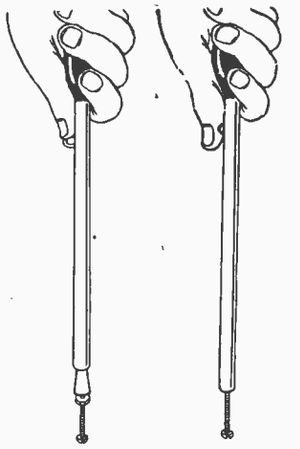


Cat. No. 21AC and 21DC ordered together $1.75.

GUARANTY RADIO GOODS CO.
145 WEST 45TH STREET
New York City Just East of Broadway

SOCKET WRENCH

FREE



Push out control lever with knob (as at left) and put wrench on nut. Push down on handle only (at right), then turn nut left or right.

ONE of the handiest tools for a custom set builder, service man or home constructor is a BERNARD socket wrench.

It consists of a 6½" long metal tubing in which is a plunger, controlled by a knob. The plunger has a gripping terminal (called a socket, hence the name "socket wrench") that may be expanded or contracted to fit 6/32, 8/32 and 10/32 nuts, the most popular sized nuts in radio.

Use the knob to push out the plunger, press down on the handle to grip the nut, then turn the nut to left for removal or to right for fastening down. Total length, distended, including stained wooden handle, 10". Gets nicely into tight places. Send $1 for 8 weeks' mail subscription for RADIO WORLD and get this wrench FREE.

No other premium with this offer. Present subscriber may extend subscription by stating he is one, and entitle himself to this FREE premium, making $1 remittance.

RADIO WORLD
145 WEST 45TH ST., N. Y. CITY
A few doors east of Broadway

Cash in on This Offer *Now!*

ONE full year's subscription for any TWO of the following magazines given to you—RADIO NEWS or SCIENCE AND INVENTION or RADIO (San Francisco) or BOYS' LIFE.

Select any TWO of these four publications, each of which will be sent to you (at only one address, however) each month for twelve months— in other words, 24 issues—if you will send in now your subscription for RADIO WORLD for two years (104 numbers) at $10.00. RADIO WORLD'S subscription price for one year is $6.00, so you gain the extra dollar by taking advantage of the liberal offer for two-year subscriptions; and, besides, you get a subscription for each of the TWO other magazines selected from the enumerated list, making a total of 128 numbers for $10.00.

If you want to select only one from among the four other magazines, you may obtain this one for TWO years, so that you will be subscribing for RADIO WORLD for two years and for the other magazine for TWO years, all for only $10.00 (both mailed to one address only).

These offers are rightly regarded as among the most liberal ever made, but as they are limited as to expiration date (see notice below) you must act now.

Please use the attached coupon.

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RADIO WORLD, 145 West 45th Street, New York City (Just East of Broadway):

Enclosed please find $10.00, for which send me RADIO WORLD each week for two years (104 numbers), and also send me, without extra cost, each month for one year each of the following TWO magazines—total, 24 issues—grand total, 128 numbers:

☐ ☐ RADIO NEWS ☐ ☐ RADIO (San Francisco)
☐ ☐ SCIENCE AND INVENTION ☐ ☐ BOYS' LIFE

If you want one of each, put a cross in a square next to the name of each of the two other magazines. If you want a two-year subscription for ONE of the above magazines, with the two-year subscription for RADIO WORLD (same grand total of 128 numbers), put two crosses before the name of one magazine.

If you prefer to pay $6.00 for only one year's subscription for RADIO WORLD (52 numbers) and get one of the other magazines for one year, without extra cost, put one cross in one square in front of the name of one magazine.

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RADIO WORLD, published every Wednesday, dated Saturday of same week, from publication office, Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y., just east of Broadway. Roland Burke Hennessy, President; M. B. Hennessy, Vice-President; Herman Bernard, Secretary. Roland Burke Hennessy, Editor; Herman Bernard, Managing Editor; J. E. Anderson, Technical Editor; Anthony Sodaro, Art Editor.

EXCELLENT unit for phonograph attachment, to play records. Connects to speaker terminals, nozzle to phonograph, $4.20. P. Cohen, Suite 1412, at 145 W. 45th St., N. Y. City.

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

10 cents a word — 10 words minimum — Cash with Order

McARTHUR'S SHELL TALLIES for scoring at bridge parties or for bridge favors. A beautiful, dainty, unusual and useful gift utterly unlike anything else you have ever seen. When you use them at your next bridge party, all your friends will want to know where you got them. $3.00 a dozen (for twelve place cards and tallies), postpaid. C. McArthur, 620 Plaza Place, St. Petersburg, Florida.

FREE BLUEPRINTS! GET YOUR SHARE! National Short Wave Circuit blueprint, exact circuit used by James Millen for tuning in television, voice, code, music, programs. National Screen Grid Five (broadcast receiver circuit) blueprint FREE also. John F Rider's B Eliminator blueprint free. Send separate request for each of the above free blueprints you desire. Custom Set Builders Supply Co., 57 Dey Street, N. Y. City.

EIGHTEEN microfarads of capacity, using Mershon condensers that will not ruin, because they're self-healing in case of puncture. This large capacity gives stability and humless quality in a marvelous new B eliminator, using the —80 full-wave rectifier tube on 50-60 cycle 105-120 v. AC maximum output voltage at 35 milliamperes is full 180 volts for —71 or —71A power tube, or lower voltage may be used for —12 or —12A power tube. The voltages are (B—) (B+22 to 45 variable) (B+67 to 85 variable) (B+90 to 135 variable) (B+180). Size 6¼ inches high by 7 inches wide. Equipped with finger-tip adjusters and insulated binding post strip. Price, all built up in de luxe metal housing with crackled gloss finish, including tube, $18.00. Immediate shipment. Send remittance and we pay cartage. Order C.O.D. and you pay cartage—Custom Set Builders Supply Co., 57 Dey Street, N. Y. City. Tel., Barclay 8659.

CAMFIELD Super-Heterodyne. Cost $120—Cash $50. Acme K1A Speaker, $10.—Harold Mantz, West Bend, Iowa.

POSITION WANTED by licensed radio operator. Ivan Fry, Minerva, Ohio.

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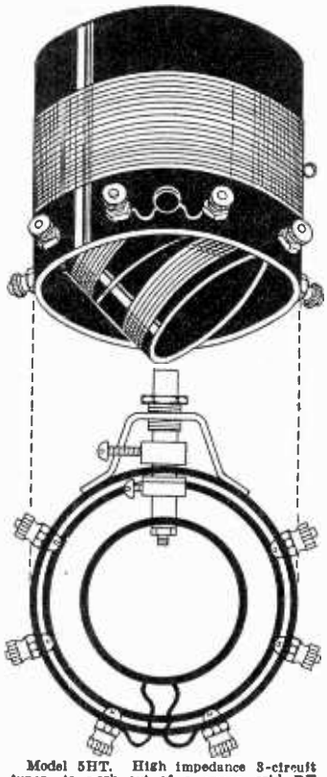
Send $6.00 —now. State which other listed publication you desire. Radio World, 145 W. 45th St., N. Y. City.

LIST OF STATIONS EFFECTIVE NOW

The fully corrected list of reallocations of stations effective Sunday, November 11th, appeared in RADIO WORLD dated November 3d. The call letters, frequency, owner and location are given by States. Fifteen cents a copy. Or send $1.00 for trial subscription of eight weeks, and this issue will be sent FREE.
Radio World, 145 W. 45th St., N. Y. C.

HOW TO USE SCREEN GRID COILS



Model 5HT. High impedance 3-circuit tuner, to work out of a screen grid RF tube. For .0005 mfd. $3.00
Model 3HT. Same as above, but for .00035 .....$3.25

WHEN a screen grid tube is used as a radio frequency amplifier, the maximum gain, the best amplification, the most volume and the most DX are obtained by tuning the plate circuit. Then this enormous amplification is itself doubled by providing a secondary with twice as many turns as the primary has. The secondary is not tuned. The high impedance 3-circuit tuner at left (Model 5HT) is an example, as is the two-winding coil (Model 5TP) at lower left. The primary in these two instances is the outside winding and the tuning condenser goes across it. The secondary is wound on a separate form that is riveted inside the primary form. Preferably mount coils with binding posts at bottom for short leads. Then the connections for Models 5HT, 3HT, 5TP and 3TP are, from right to left as you look at the back of the coil: B+135, near front panel; plate of screen grid tube; two rotary leads (for tuner only); grid and (next to panel) grid return.

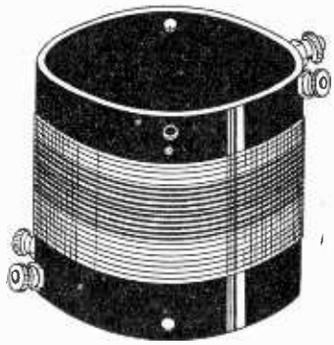
The antenna coil to use in screen grid circuits is 5A or 3A (upper right), because it is so designed as to equalize tuning. The low, almost zero, capacity between grid and filament of the tube is compensated by extra turns of wire, so that if the tube following the screen grid is of another type, for instance a regular detector, the elemental capacity difference is nullified. The antenna coupler has a continuous winding in shaded colors. The end with the larger number of distinctive turns goes to grid, the opposite end to ground. Either of the two remaining binding posts goes to antenna.

For single control screen grid sets the inductive trimmer type of antenna coupler (Model 5AS or 3AS, at right) should be used. The inductive trimmer coil for interstage coupling is Model 5TPS or 3TPS (not illustrated), but its connections are shown in the diagram at lower right. An inductive trimmer adds to or subtracts from the reactance, which is very important for resonance in single control sets. Trimming condensers only increase reactance, hence fail where decrease is needed.

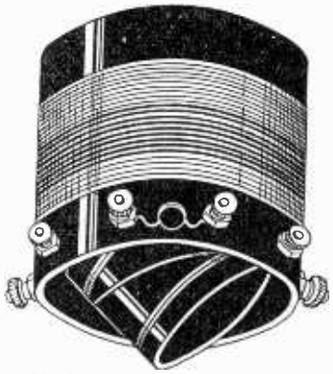
Model 5TPS Interstage coupler to screen grid tubes, with inductive trimmer. For .0005 mfd. $2.25

Model 3TPS, same as above, except it is for .00035.....$2.50

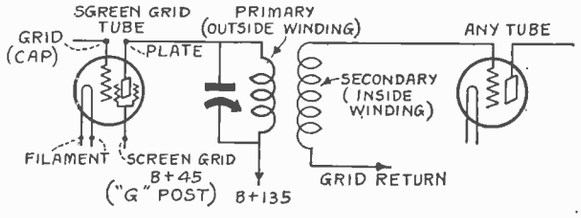
ALL ROTOR COILS HAVE SINGLE HOLE PANEL MOUNTING FIXTURE



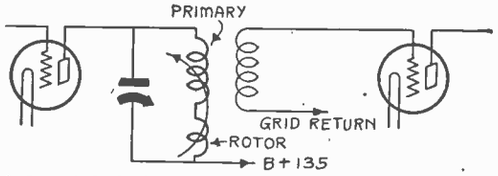
Model 5A. Conductively coupled antenna coil for input to screen grid radio frequency amplifier. For .0005 mfd. condenser. Price $1.75
Model 3A. Same as above, but for .00035 .....$2.00



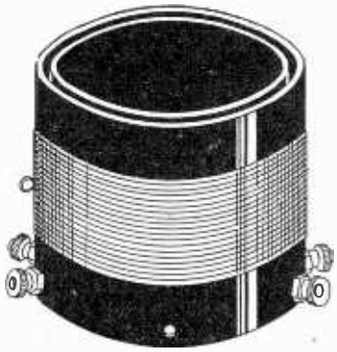
Model 5AS. Conductively coupled antenna coil for single tuning control screen grid sets. Rotor is an inductive trimmer. For .0005 mfd. $2.75
Model 3AS, same as above, but for .00035 .....$3.00



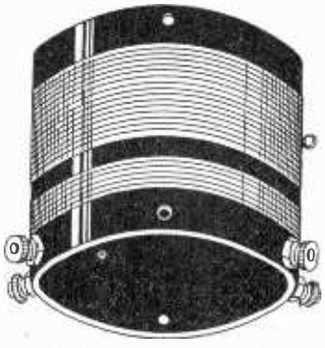
How tuned primary in plate circuit is wired for a screen grid tube. This illustrates the use of Model 5TP or 3TP, also Model 5HT and 3HT, except for the rotor coil connections.



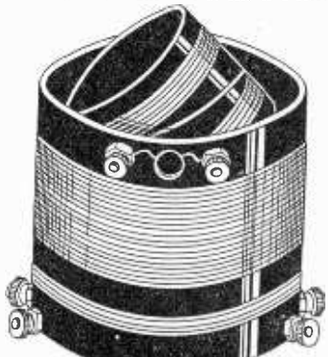
In single control circuits Model 5TPS is used as shown, for interstage coupling. The rotor is an inductive trimmer. The tube at left is a screen grid.



Model 5TP, the wiring of which is shown in the diagram directly above, is an interstage coupler for screen grid tubes. For .0005 mfd. $2.00
Model 3TP. Same as above, but for .00035 .....$2.25



Model R5, interstage coupler for replacing present coil in existing receiver when screen grid tube is substituted. For .0005 .....$1.50
Model R3. Same as above, but for .00035 .....$1.75



Model T5, standard 3-circuit tuner, not for screen grid tubes, but for all others. For .0005 .....$2.50
Model T3, same, but for .00035.$2.75

Coils for Other Than Screen Grid Tubes

When any tubes other than screen grid tubes are used as radio frequency amplifiers, standard coils are used, for instance Models T5 and T3, the three-circuit tuner shown above at right.

For the antenna coil in such a circuit use one with two separate windings, the familiar radio frequency transformer, with about 14 turns on the primary. This RF transformer is therefore used as antenna coil and as an interstage coil.

The resultant loose coupling of antenna reduces the capacity effect of the antenna and thus the standard TRF coils, with 201A, 112A, 226, 227, 199 or 240 tubes, providing the same RF tubes are used throughout, may be used in single control sets without trimming devices. This is true if the coils are absolutely matched, as Models RF5 and RF3 are.

The small winding (primary) is connected in the antenna-ground circuit, or, for interstage coupling, in the plate circuit. The large winding (secondary) is tuned and is put in the grid circuit.

Model RF5. Antenna coil or interstage coupler for any and all tubes, excepting only screen grid tubes. For .0005 .....$1.00
Model RF3, same as above, but for .00035 .....$1.25
Model T5, standard 3-circuit tuner for .0005 .....$2.25
Model T3, standard 3-circuit tuner for .00035 .....$2.50

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Please mail me at once your following coils, for which I will pay postman the advertised prices, plus a few cents extra for postage.

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This alphabetical arrangement lets the experienced worker refer directly to the one thing in which he is interested at the moment without hunting through non-essentials. The needs of the beginner are cared for.

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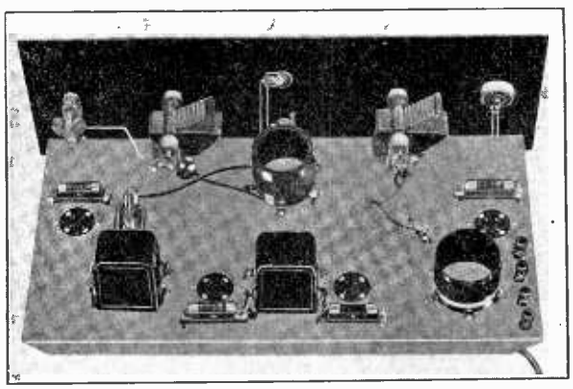

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Two dials tune in the entire wavelength band, using either .0005 mfd. or .00035 mfd. tuning condensers. The circuit affords all the selectivity you need, separates stations excellently and without "background reception," and despite this fine selectivity, affords more than enough volume, so that you must tone it down with the volume control, even on far-distant stations!

The screen grid RF tube is followed by two –01A tubes, while the output tube may be a —12A or —71A power tube, depending on whether you have 135 volts or 180 volts maximum at your disposal.

Screen grid coils especially designed for this receiver permit you to obtain any desired degree of selectivity, but always with a high level of reproduced sound. The primary of the interstage coupler is tuned, while the secondary doubles the voltage by step-up ratio.

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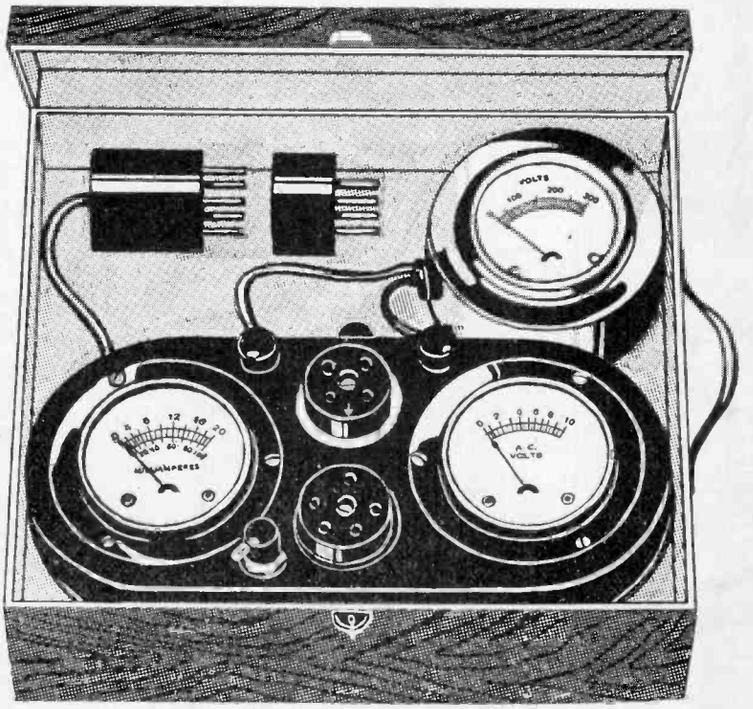

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(8) to test continuity of resistors, windings of chokes, transformers and circuits generally;

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