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1928 Vol-13 No-23

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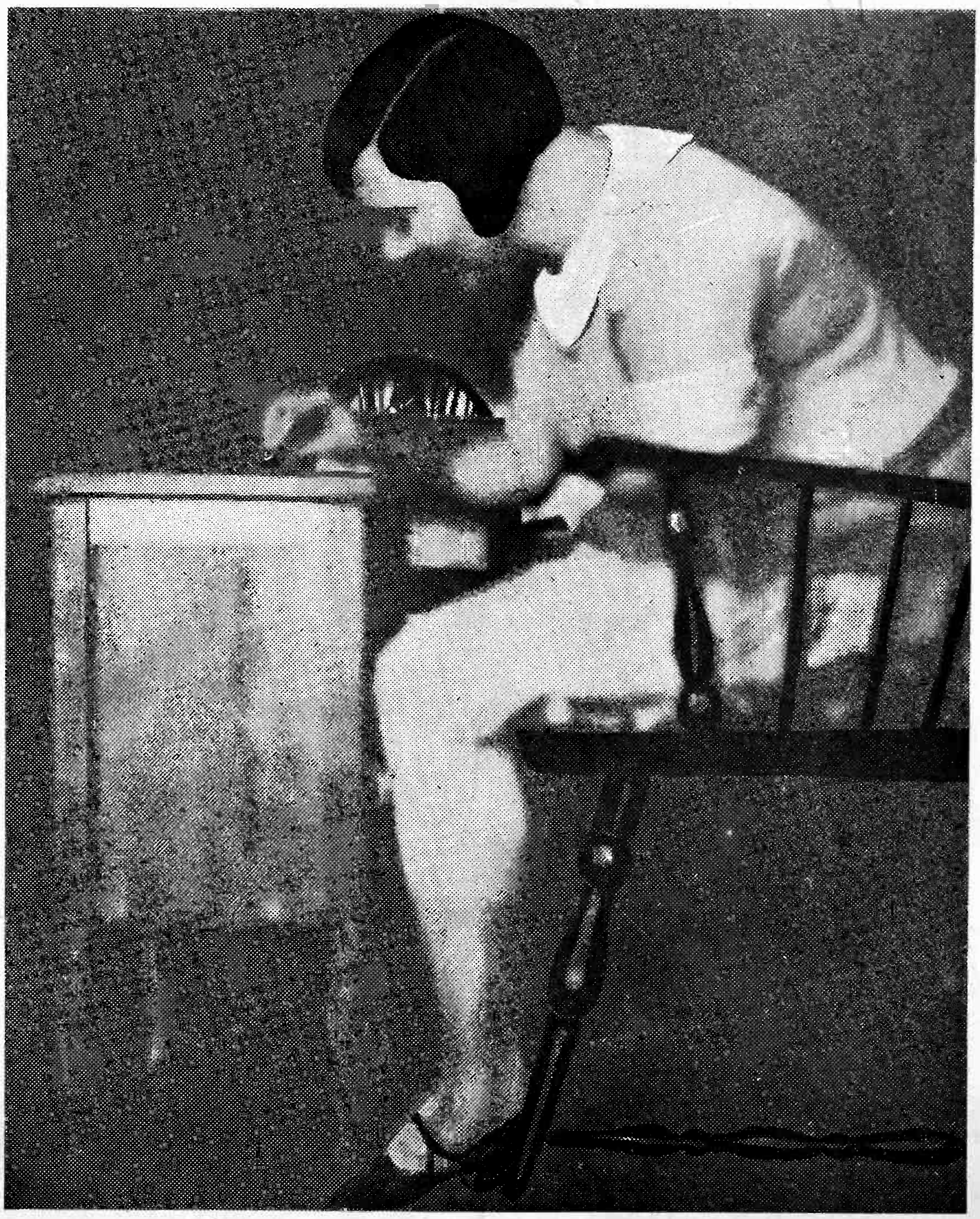
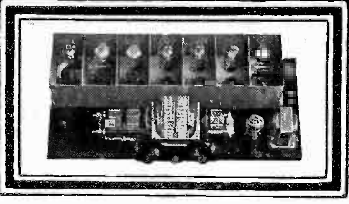
By McMurdo Silver: Building the New 720

ALL IN A TINY TABLE!



Complete installation in a smoking table. See page 3.

REMLER "29"



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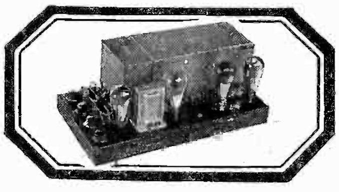

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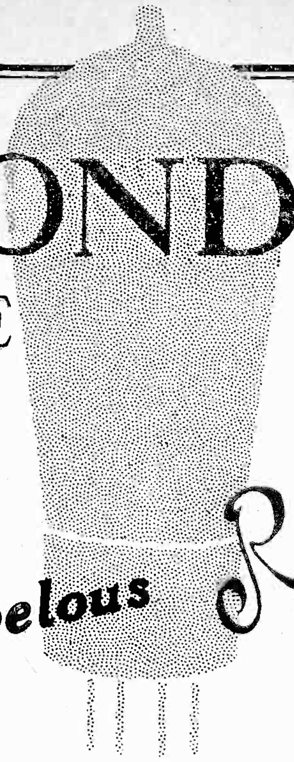

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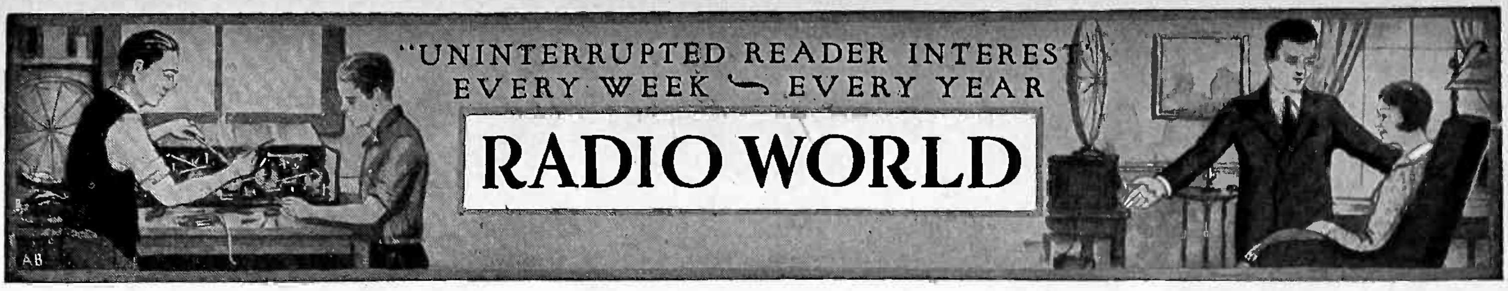

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The Smoker Model

OF THE ECONOMY SCREEN GRID THREE

By Herman Bernard

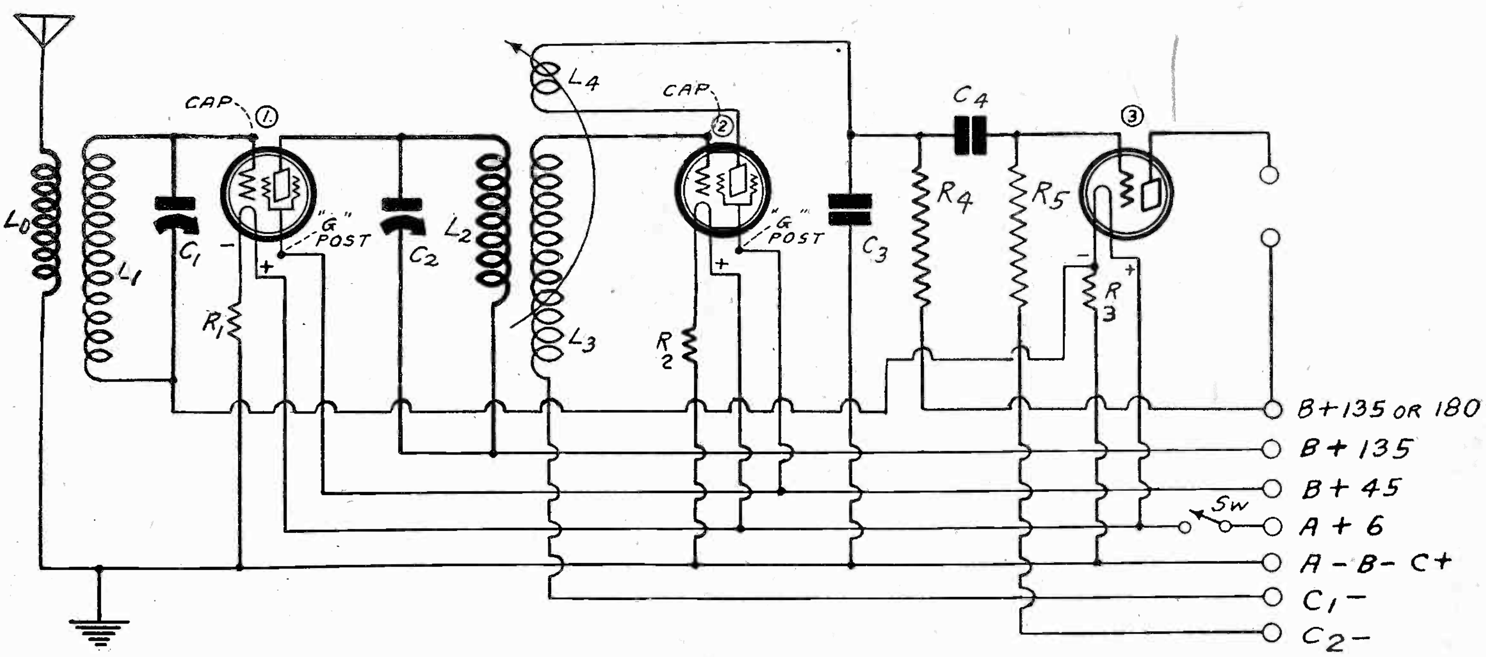


FIG. 1.

THIS CIRCUIT, ATTRACTIVELY BUILT INTO A SMALL SMOKING TABLE, MADE AN EXCELLENT INSTALLATION. THE SET WORKS A LOUDSPEAKER. A NEW METHOD OF GETTING THE CORRECT GRID BIAS FOR THE SCREEN GRID TUBE IS SHOWN HERE FOR THE FIRST TIME.

"CAN you coop up a radio installation in a little thing like that and get anywhere with it?"

A girl pointed to an unfinished smoking table, that later inspection proved to be 26½ inches high, 12 inches wide and 11 inches deep (front to back). These were the over-all dimensions.

Her question was addressed to her escort, since then become her husband. With the confidence of one who was willing to prove his word he said:

"Certainly that can be done, and I know the very circuit and parts that will make it possible."

"I wish you'd build one—for the new home," the last few words being uttered hesitantly.

"Glad to," he quickly assured her, wondering, however, if ever there would be an end of things to be gotten for the prospective love nest.

Old or New?

And so he undertook building the set into this unfinished smoking table, which he had purchased on the spot due to the whim of his fiancee; and after he got it working well, which doesn't mean he had any trouble with it, he set about painting it so that it would blend with the $248 Chinese rug that covered 9x12 feet of the parquet floored living room of the new home.

Even the flaming carmine Chinese poppies in the rug corners were saluted with equal tones discreetly worked into the smoking table; and the purple, gold, green and yellow of the rug were matched with careful eye. Then the "unfinished" piece of furniture really looked like something decidedly finished—modernistic, in one sense, because of the quirk in pyramided design and the stimulating spots of color; yet ancient, in another sense, because so much like the tones of a rug patterned after the fashions of Oriental antiquity. About four centuries prior to the Boxer Rebellion some one first thought of making a rug like that, and now a modern young husband had lifted the motif from the rug and painted it right onto a cedar box with a door on it!

LIST OF PARTS

L0L1—One antenna coupler.
L2L3L4—One Screen Grid Coil (three circuit tuner).
R1, R2—Two 622 Amperites.
R3—One 1A Amperite.
R4—One Lynch metallized resistor, 1.0 meg.
R5—One Lynch metallized resistor, 2.0 meg.
C1, C2—Two Remler .0005 mfd. twin rotor tuning condensers (on single tuning shaft).
C3—One Aerovox .00025 mfd. fixed condenser (mica).
C4—One Aerovox .01 mfd. fixed condenser (mica).
SW—One Yaxley No. 10 switch.
Eleven binding posts.
One Remler drum dial.
Two one-inch knobs (one for tickler, one for switch).
Two Frost tip jacks.
Three Benjamin sockets.
One smoking table (finished or unfinished).
One small 6-volt storage battery.
One dry trickle charger with built-in relay.
One B eliminator.
Two screen grid tubes and one 112A tube.
One speaker.

Charger on Interior Wall

Having obtained the smoking table, which has not served a smoker's needs even once, unless listening to the broadcasting of La Palina Smoker be in kind, the young man, still a fiance, procured a B eliminator that would fit into those dimensions, leaving room for a small storage battery and a trickle charger.

This was made possible by placing the B supply on the bottom, and next to it the battery, with the dry trickle charger, however, screwed to one of the interior walls.

The receiver proper, therefore, had to

(*Continued on next page*)

Bride's Whim Valuable

(Continued from preceding page)

be built in the remaining space, and as this was aloft, as it were, the thing to do was to use a strictly economical circuit, put the sockets on the bottom of the table top, upside down, similarly mount the remaining parts—and—well, that's all there was.

Time Constant

It took him just ten minutes to select an appropriate B eliminator, five more to be convinced of the storage battery choice, two more to obtain the necessary trickle charger, so he would never need send the battery out for recharging, and then he drew the circuit.

It took considerable time to mount the dials in sunken fashion, almost as much time as it took him to wire the set, and yet the very day after his fiancee had suggested in her own way the appropriateness of such a small installation, he was demonstrating it to her in their prospective home!

Tone Quality is Eye Appeal

"It looks too cute for anything," she exclaimed. "Isn't it a darling?"

"Did you notice the fine tone quality?" he asked.

"Yes, and do you know it takes up so little room, and has casters on it and everything, so that we'll be able to move it right into any room of the apartment without trouble." (They had three rooms.)

It was true indeed that the tone quality did not take up much room, because tone can occupy the same space that something silent and more solidly physical occupies, like a chair or table.

"I think the tone's immense, and the volume's plenty," he remarked.

Her reply:

"And you can improve it by putting some tiny bric-a-brac ornaments on top, or carved ivory, if ivory is not"—here she cast an inquiring glance at him—"too expensive."

And so they didn't get anywhere in particular. He wanted to talk about the operation, performance, tone, selectivity and easy tuning of the set (fishing for compliments), and she was all astir over aesthetic considerations (the table was her idea.) Between them, therefore, they proved that the converted smoking table, with the war paint on it and all, appealed both to the technically and artistically inclined, whether the artistry be in circuits or the technique in art.

Both admit it was a happy choice. And it cost so very, very little. Including every blessed thing that went into it or that was used externally—tubes, sockets, coils, condensers, battery, charger, B eliminator, etc.—he spent less than $70. And when he was finished he had just what she wanted. That seldom happens.

Volume Enough, Absolutely!

This table, like most of them, I suppose, came equipped with a drawer. Of all the things not needed for good radio reception a drawer may safely be awarded first prize. Besides, this drawer occupied a position that would interfere with the use of any circuit, so he deftly removed the front panel of the drawer, threw away the residue of the drawer, and glued the panel nicely into place, after the tiny slices of air space were plugged up with plastic wood. But this was done after the circuit was built, otherwise he would have heaped unnecessary inaccessibility upon his usual number of shoulders.

The circuit was the Economy Three, of which some discussion along purely technical lines was published in the July 28th and August 11th issues of RADIO WORLD. Yes, it gave enough volume. Yes, he could make the tickler tickle.

It is true there was only one stage of audio, and it was resistance coupled, to boot. But he used a good screen grid tube as the radio amplifier and a good screen grid tube as the grid biased detector—and fed their gift of voltage to the 112A power tube with confidence that when the speaker was connected it actually would be worked well by the output. And it was. Indeed, it was! Still is, in fact!

"First Time Anywhere"

One little method he used, for obtaining the correct negative grid bias for the radio amplifier, was to connect the grid return of this tube to negative filament of the single audio tube. It was a very simple solution, and a good one. Moreover, this is the first time the secret has been published anywhere. You can see for yourself from a glance at Fig. 1 that the method is sound and clever. Or maybe a glance is not quite enough. Some introspection, then!

The resistor in series with the negative filament of the screen grid radio amplifier (tube No. 1) is a No. 622 Amperite. This drops the 6 volts of the storage battery to 3.3 volts for the filament, hence drops 2.7 volts. The negative filament is 2.7 volts positive in respect to negative A battery. Now, the power tube is of the 5-volt variety, and the No. 1A Amperite R3 drops the 6 volts to 5 volts, hence accounts for one volt. The negative filament of the last tube is one volt positive in respect to negative A battery. Well, as the screen grid filament is 2.7 volts positive in respect to negative A, and as the negative filament of the power tube is one volt positive in respect to negative A, connecting the grid return of the first tube to negative filament of the last makes the grid return of the first tube 1.7 less positive (hence negative) in respect to negative filament of the same RF tube. That's just as it should be.

Odd Voltage

Usually 1.5 volts negative bias is recommended, but 1.7 is sometimes even more favorable. The 1.7 figure is never given orthodox attention because of the assumed difficulty of obtaining such an odd voltage for any purpose. A dry cell has 1.5 volts and that's why you see so much about 1.5 for bias.

The circuit has the screen grid RF amplifier, regenerative grid biased screen grid detector and a stage of resistance coupled audio.

One of the secrets of its success is the use of Screen Grid Coil for the three-circuit tuner. This coil has a primary wound for .0005 mfd. tuning, a secondary with nearly twice as much inductance as has the primary, thus giving substantially a doubled voltage due to step-up, and has a tickler with comparatively few turns. To insure regeneration (not much of which is needed) and aid detection—which is regular screen grid detection by grid bias—the fixed condenser C3 is included. It may be .00025 mfd. without adversely affecting the higher audio frequencies.

(Other illustration on front cover).

[This concludes Part 1 of the article on the Smoker Model. Part II, the conclusion, will be published next week. All questions concerning this circuit or parts used should be addressed to Herman Bernard, c/o RADIO WORLD, *145 West 45th Street, N. Y. City.]*

Advisory Board for Each Station Proposed

Washington

Every broadcasting station in the country would be required to have a board of ten of the leading citizens in its community, acting without compensation, to advise and assist it in providing programs in the "public interest, convenience and necessity," under a plan evolved by Commissioner Harold A. Lafount, representing the Pacific Zone.

Commissioner Lafount said that he will submit the plan to the full Commission in the near future. He expressed the view that it would make possible compliance by stations with the provisions of the radio law providing for adequate public service.

The plan, said the Commissioner, is that every broadcasting station, large, medium or small, be required to obtain the voluntary service of 10 "public spirited" citizens to act as a board to the station, suggest the types of programs of interest to the particular community, and otherwise assist the operators of the station to provide efficient and desired service.

All of the 650-odd stations in the broadcast spectrum would be requested to submit the names of proposed members along with their applications for relicensing of their stations.

"A Proper Move"

The present system is for the issuance of licenses for 60 days' duration.

"I believe that such a system would be a proper and vital move in the direction of serving the public interest, convenience and necessity," said Commissioner Lafount.

"It would be particularly beneficial to the broadcasting stations in small communities, that do not have on their staffs program directors whose function it is to select talent, material, and otherwise arrange programs designed to meet the desires of listeners."

Commissiener Lafount said that the boards should be as representative of the communities they serve as is possible consisting of outstanding individuals in as many different walks of life as could be procured.

WGES Has a Board

Mayors, he said, should have places on their station advisory boards, and in cities where there are more than one station, each station would be required to have its individual voluntary board.

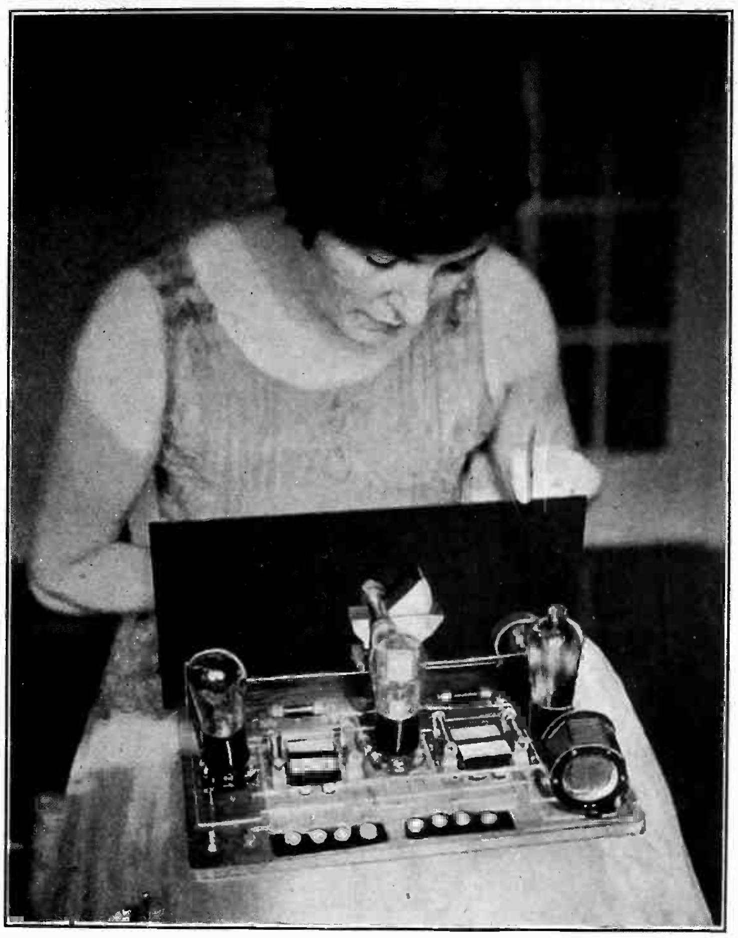
Explaining that his plan would be submitted soon, the Pacific Zone Commissioner said that, if adopted, it probably would become effective coincident with the Commission's proposed plan for reallocation of broadcasting stations, now in process.

WGES, of Chicago, operated by the Chicago "Evening Post," has a voluntary advisory board on programs that has been working successfully, according to the Commission's records.

"Down" Means "Up"

Loudspeakers and Stations Improve in Low-note Spectrum, So Audio Transformers Are Made to Go Down Lower, Hence the Quality Goes Up

WHAT ONE CONDENSER DID



ONE COIL AND ONE CONDENSER GOT GOOD RESULTS

Use of a negative grid biased screen grid tube as a detector, with a solitary condenser for tuning the only radio frequency coil in the receiver, produced good results. Two stages of audio added made the speaker speak up. The usual primary and secondary were used, but the fixed tickler was made large enough to produce oscillation at high wavelengths, by reversed phase. An antenna series condenser of the pressure type was turned until oscillation stopped. Thus no squeals were produced over the broadcast band. More details will be published next week.

DEVELOPMENTS in loudspeakers made in recent months have resulted in instruments which have extended the reproducible range of frequency by some 75 to 100 cycles downward. At the same time there has been a downward extension of the frequency range transmitted by broadcast stations.

These factors have combined to revise the requirements for satisfactory performance of audio transformers. A year ago there was little justification for audio transformers reproducing frequencies much below 100 cycles, since none of the speakers then available was capable of producing an audible sound at such frequencies, even if the sound was present in the broadcast transmission, which it was not.

As a result of these developments, the low frequency cut-off of audio transformers has been moved steadily until transformers are demanded which will amplify 60, or even 30 cycles.

Overcoming Difficulties

The design of such transformers has not involved any new principles, but rather the overcoming of practical difficulties involved in the adaptation of well-known principles.

The problem of raising of the lower end transformer characteristic is primarily one of increasing the input inductance of the transformer, although the lowering of the plate impedance of tubes has had the effect of improving the characteristics of transformers of earlier designs.

The inductance of the transformer depends upon three factors: the number of turns of wire on the coil, the size of the core, and the permeability of the core material.

The gain in inductance which may be had by adding primary turns is limited by the fact that the secondary turns must also be increased unless the turns ratio is lowered. The result is the loss of high frequencies as a result of coil capacity.

When Cores Saturate Easily

The high permeability nickel alloys are being used to an increasing extent for audio transformers. These alloys of nickel and iron have the property of high permeability at low flux densities, the conditions encountered in audio transformer primaries.

These alloys have some disadvantages, however. The high permeability is maintained over a rather limited range of flux density, and falls off rapidly at higher or lower values.

Simply stated, such cores saturate easily.. This difficulty is becoming more important as the plate currents of vacuum tubes are increased.

A more serious objection yet is that the transformer is permanently damaged by an increase in field strength such as might result from accidental connection in a circuit without a C battery, or where a C battery was run down or where the plate current was abnormally large for any other reason.

Such temporary increase in flux through the core permanently changes the characteristics of the material.

Silicon steel, on the other hand, is not permanently affected by increases in flux.

Question of Ruggedness

The frequency characteristics of the transformer is of course affected by core saturation while it exists, but the effect is not lasting.

These considerations render the nickel alloy transformers particularly valuable for special laboratory work, or in commercial installations where care is taken to insure operating conditions.

The ruggedness of the silicon core type of transformer, however, recommend it for general experimental use where conditions are frequently hard upon delicate apparatus.

All the electrical advantages of the nickel alloys may be obtained with silicon steel by adjustment of other factors in the design.

It was found that when the lower end of the characteristic had been extended as desired, by changes in the coil and core, there was a tendency to resonance at high frequencies as well as a falling off of amplification. These difficulties were overcome by changes in coil design.

The resonance effects at high frequency are due to leakage reactance, i. e. flux not linking both primary and secondary coils, and by coil capacity.

The loss of amplification at high frequencies is due to internal coil capacity, principally in the secondary. It was found possible to reduce both these effects by a form of coil construction which sandwiches the primary between two sections of the secondary.

Flat Characteristic

This type of winding not only reduces leakage reactance by increasing the coupling between primary and secondary, but also reduces the internal capacity of the secondary by breaking it up into two sections.

In the Type 585 Transformers silicon steel has been used as a core material. The coils are of the sandwich type described above. The result of this construction is a transformer possessing a practically flat frequency characteristic from 30 to 6,000 cycles.—The General Radio Experimenter.

The Four Types of Fil

By Garmic

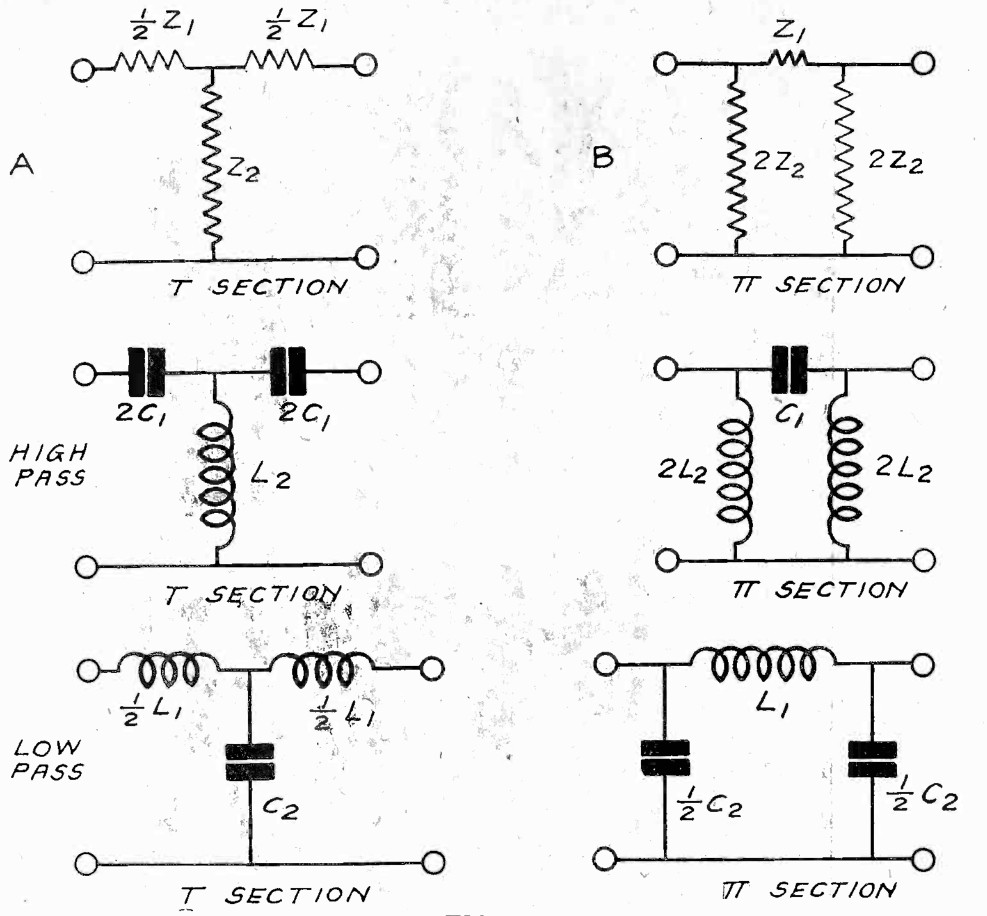


FIG. 1

SEVERAL TYPES OF FILTER SECTIONS. LEFT COLUMN SHOWS T SECTIONS AND RIGHT COLUMN PI SECTIONS. TOP ROW SECTIONS OF GENERAL IMPEDANCES. MIDDLE ROW SHOWS HIGH PASS SECTIONS AND BOTTOM ROW LOW PASS SECTIONS.

In many radio and audio circuits it is often necessary or desirable to suppress certain bands of frequencies, and to transmit uniformly all frequencies outside those bands.

For example, it may be desirable to suppress all frequencies above 10,000 cycles in an audio amplifier to decrease as much as possible interference caused by frequencies above that value. Or again it may be desirable to suppress all frequencies below a certain frequency, say 30 kc, in order to separate audio frequencies from radio frequencies. In Many of the audio frequency amplifiers it is often desirable to suppress all frequencies lying below 500, 1,000, 3,500 and 5,000 cycles in order to observe the effect on the intelligibility of the omitted bands.

This band suppression is accomplished by electrical filters, often called Campbell filters in honor of their inventor. There are many types of filter, such as low pass filters, high pass filters, band elimination filters, and band pass filters, so named for their general characteristics.

A low pass filter is an electrical network which passes all frequencies below a certain value. The filters used in B battery eliminators are of this type.

A high pass filter is one which passes all frequencies above a certain value. The loudspeaker filter consisting of a condenser in series with the speaker and a choke coil across it is of this type.

A band pass filter is one which passes a certain band of frequencies and suppresses all others outside that band. Every tuned circuit used in a radio receiver is a specialized type of band pass. A band elimination, or suppression, filter is one which suppresses a certain band of frequencies and passes all others. Most wave traps are of this type.

A filter is supposed to consist of an infinite number of identical sections, and a section is a combination of an inductance and a capacity, or of impedances. There is a series impedance usually designated by the subscript (1), as Z1, L1, C1, R1, and there is a shunt impedance usually designated by the subscript (2), as Z2, L2, C2 and R2.

Terminations of Filters

No practical filter can consist of an infinite number of sections. It must be terminated. The theory of the filter consisting of an infinite number of sections applies to one or more sections provided that the terminations be chosen properly. Every infinite filter has what is called the iterative impedance, or characteristic impedance.

If a filter section be placed between two impedances which are equal to the iterative impedance then the section works the same way as if it were placed in an infinite series of identical sections. Hence the iterative impedance is a most important property of the filter.

Filters are divided into two general classes, depending on their terminations. One is the T section which is terminated at mid-series. This means that the shunt impedance Z2 is put between two halves of the series impedance Z1 as shown in Fig. 1, A. The other is the pi section which is terminated at mid-shunt. In this the series impedance Z1 is put in one unit and the shunt impedance is in two units of twice the value of Z2, as shown in Fig 1B.

There are other terminations of the filter sections but they are not so important as the mid-section terminations.

The frequency which determines the limit between the transmitted and the suppressed band is called the cut-off frequency. Every filter in reality has two cut-off frequencies. In the case of a high pass filter one of these is infinitely large and is not considered. In the case of a low pass filter one of the cut-offs is at zero. In the case of band pass and band suppression filters both frequencies are finite and different from zero.

Design Formulas

When the cut off frequencies and the iterative impedance are known it is easy to calculate values of inductance and cap-

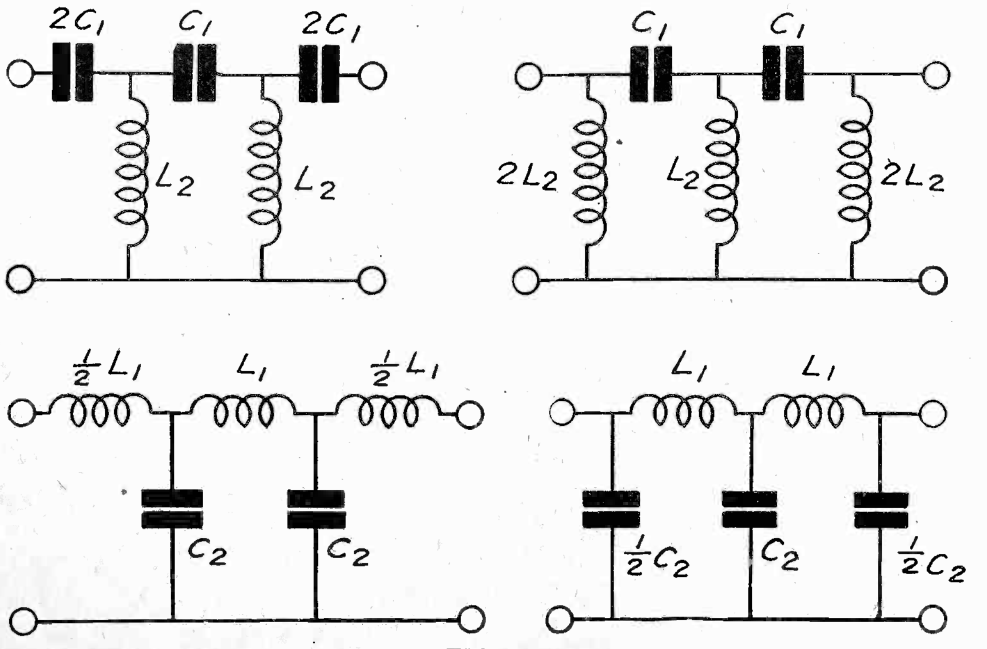


FIG. 2

FOUR FILTERS OF TWO SECTIONS EACH, SHOWING HOW THE END IMPEDANCES ARE COMBINED. UPPER ROW SHOWS HIGH PASS FILTERS AND LOWER ROW LOW PASS FILTERS. THE FILTERS IN THE LEFT COLUMN ARE COMPOSED OF T SECTIONS AND THOSE IN THE RIGHT OF PI SECTIONS.

ers and Their Functions

Eddy

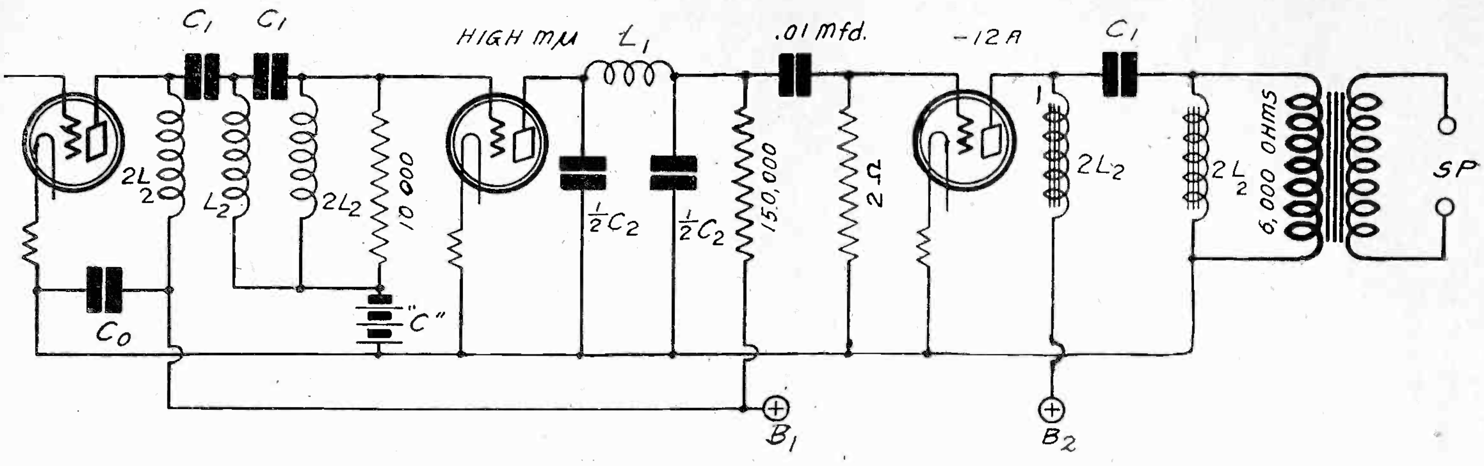


FIG. 3

A CIRCUIT SHOWING HOW HIGH PASS AND LOW PASS FILTERS MAY BE CONNECTED IN A RECEIVER. THERE IS A TWO-SECTION HIGH PASS FILTER BETWEEN THE FIRST TWO TUBES, A ONE-SECTION LOW PASS BETWEEN THE SECOND AND THIRD TUBES, AND A ONE-SECTION LOW PASS BETWEEN THE POWER TUBE AND THE LOUD SPEAKER.

acity which should be used. Let Z be the iterative impedance and F the frequency of the desired cut-off, then for the high pass filter C1=.07958/FZ farads and L2 .07958Z/F henries. For the low pass filter L1=.3183F/Z henries and C2=.3183/FZ farads.

Suppose we wish to interpose a low pass filter between the power tube and the loudspeaker having a cut-off at 10,000 cycles. Let us assume that the AC resistance of the tube is 6,000 ohms. This is to be the iterative impedance. Then applying the low pass formula we find that L1=.3183x6,000/10,000 henries, or 191 millihenries, and that C2=.3183/6,000x10,000 farads, or .005305 microfarad.

These values are distributed according to the indications in Fig. 1. Since the pi type section is better suited to the case the total inductance is put in series and one half of the capacity across the line on each side of the coil. That is to construct such a filter one coil of 191 millihenries and two condensers of .0026525 mfd. would be needed.

In a practical case some deviation is permitted both in the cut-off frequency and the iterative impedance. Hence the nearest size commercial condenser should be used, using one large and one small if necessary to get a close approximation. The inductance coil should then be wound to have such inductance that the product of L1 and C2 is the same as it would have been had the exact values been used. If that is done only the iterative impedance is different, the cut-off remaining the same.

The loudspeaker is supposed to have the same impedance as the tube, that is 6,000 ohms. If it does not it is possible to satisfy the condition of the filter by putting a transformer between the speaker and the filter such that the primary impedance is 6,000 ohms and the secondary impedance equal to that of the speaker.

High Pass Filter

Suppose now that it is required to suppress all frequencies below 50,000 cycles and transmit those above. This requires a high pass filter. Let us assume that the filter is to match a tube having a plate impedance of 10,000 ohms. Substituting these values in the design formulas for the high pass filter we get C1=.00015916 mfd. and L2=15.92 millihenries.

If a pi section is used one condenser of .00015916 mfd. should be used in series and two coils of 2x15.92 millihenries should be put across the line, one on each side of the condenser. This filter can be connected directly to the plate of the tube since the plate current can flow through the first shunt coil. The output side of the filter can be matched to the input circuit of the next tube by using a 10,000 ohm grid leak.

If the T section high pass filter is used it is necessary to feed the plate of the tube through a high inductance choke, the impedance of which is so high that it does not alter the conditions. Again a grid leak of 10,000 ohms may be used to match the output circuit.

The suppression and the transmission of a section are relative. There will be some transmission in the suppression band and some suppression in the transmission band. If one section will not separate the currents sufficiently additional sections may be added, all sections being identical. When two or more sections are used it is possible to combine inductances and capacities. Fig. 2 shows how high pass and low pass filter sections may be combined. T sections are shown at the left and pi sections at the right. High pass filters are shown above and low pass filters below.

If one section of filter suppresses the currents in the ratio of 100 to 1 then two sections suppress the currents in the ratio 10,000 to 1.

Fig. 3 shows a circuit in which there are three filters. Between the first and the second tube is a two-section, pi type high pass filter working between 10,000 ohm impedances. If the inductances L2 and capacities C1 are chosen as above it will pass frequencies above 50,000 cycles and not those below.

Following the high mu detector is a one-section, pi type low pass filter. It is working between impedances of 150,000 ohms. It may have a cut-off of 10,000 cycles. This would not only eliminate the radio frequencies in the output of the detector but also much of the noise due to audible frequencies above 10,000 cycles.

In the output of the last tube is a high pass filter working between 6,000 ohm impedances. It is of the pi type. It should be designed to have a cut-off as low as practical. Suppose it is to be 30 cycles. Then the formula for C1 for a high pass filter gives C1=.442 mfd., and the formula for L2 gives 15.916 henries. Thus two coils of 31.832 henries should be used. If the cut-off is to be at 15 cycles the capacity of the condenser should be doubled as should the inductance of the two coils.

It should be remembered that the cut-offs are not sharp in the filters, particularly in practical filters which contain resistance. Hence the cut-off frequency should be chosen lower for a high pass filter and higher for a low pass filter than the cut-off desired. The ratio of the desired cut-off and the one chosen need not deviate from unity by more than 5 or 10 percent.

The effect of resistance in the coils is mainly a loss in the region of transmission.

MARTY CAMBER WITH CHILDS

The large fan following and many radio friends of Marty A. Camber will be glad to know that he is now with Childs, 66 Cortlandt Street, New York City. This is one of the palatial Metropolitan radio stores where everything under the sun in radio is obtainable, and Camber has full charge of the "B" eliminator, power pack and amplifier department. His stock covers all the modern "A" power units, standard eliminators, power amplifiers and all classes of rectifier tubes. Camber is well qualified for this position, having served his apprenticeship with prominent manufacturers of electrical apparatus, knows radio thoroughly and has had a wide merchandising experience with equipment of this type having handled it in some of the leading radio stores. He believes in selling service and satisfaction with every piece of apparatus and all his customers are satisfied ones.—J. H. C.

THROUGH THE GATEWAY

Thousands of fans are passing through the open gate leading to a better knowledge of the finer points of radio, via the treatise, "The Gateway to Better Radio." This is put out by the Clarostat Manufacturing Company, Inc., makers of the famous line of Clarostats for every purpose, 285 North Sixth Street, Brooklyn, N. Y., and the demand has been so great that the edition is nearly exhausted. The work of some of the ablest engineers in radio, it contains over 20,000 words of plain, understandable text with the practical applications shown by 88 fine illustrations. It answers all the perplexing problems that arise to annoy fans in their everyday use of radio. Those who cannot conveniently procure this valuable work from their dealers may obtain it direct from the above concern by forwarding 25 cents to cover mailing and wrapping. Mention Radio World.—J. H. C.

Leakage Effects

By Captain Peter V. O'Rourke

Contributing Editor

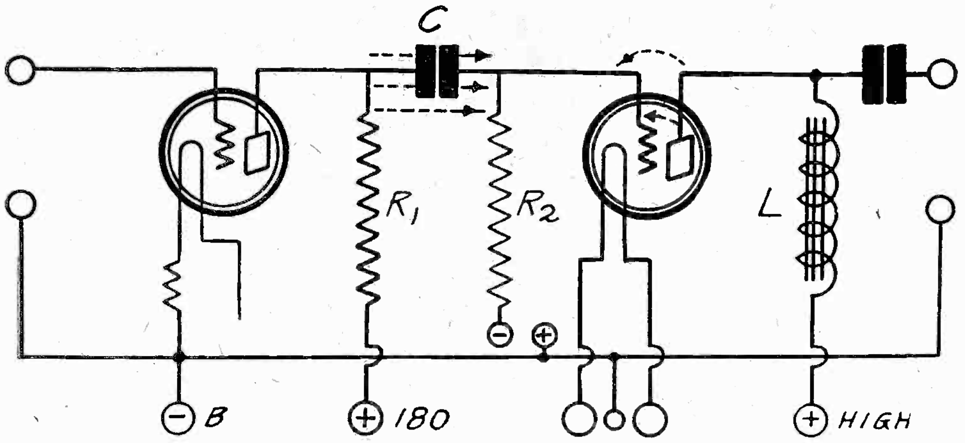


FIG. 1
CIRCUIT DIAGRAM SHOWING HOW STRAY LEAKAGE FROM PLATES MAY PRODUCE DISTORTION.

THE fact that the last tube in a resistance coupled amplifier often misbehaves when the grid leak resistance is too high is well known. The cause is not so well known. It is often said that the cause is blocking. That indeed may be the cause, for there is no general agreement just what blocking is.

Some say that blocking occurs when the grid of the tube goes positive, and that as a result of going positive it goes so much negative that the plate current in the tube is completely shut off. The mysterious process going on in the tube which makes this possible has never been explained by anyone.

Certainly a very lucid explanation is necessary, and perhaps an ingenious one, to make anyone see why the grid goes negative when it is positive! Let us hope that the explanation be forthcoming or that the absurdity no longer be repeated.

Two Limiting Effects

There are two limiting effects which will cause distortion in the amplifier. If the grid goes very much negative with respect to the filament the plate current will be cut off. If the signal voltage is high enough, and if the normal bias on the grid is great enough, this will happen during part of the cycle. The negative side of the signal wave will be cut off and greatly reduced.

If the grid bias is not high enough, and if the signal voltage is high, the signal tries to drive the grid positive during part of the cycle. But it does not succeed by more than a fraction of a volt. The grid current set up as soon as the grid is positive develops a voltage drop in the grid leak which counteracts the effect of the signal.

The more the signal tries to drive the grid positive, the more the grid current opposes it. The signal may be such that one would expect the grid to be 50 volts positive, but actual measurement of the grid potential shows that it is only one volt or less.

If the signal voltage is such that one would expect the grid potential to be about one volt, actual measurement will show that it is just over zero.

Peaks Cut Off

This action of limiting the grid potential might be called blocking, for an effective type of blocking it is, but the grid is not excessively negative. It is either zero or slightly positive.

When the signal voltage is such that it would drive the grid positive if the grid current permitted it, the positive peaks of the signal are not represented in the plate current. They are chopped off and flattened out. The same occurs to the negative peaks when the grid swing is excessively negative. If the grid bias is correct and the signal voltage excessive, both the positive and the negative peaks will be cut off, but the positive peaks will be cut off more.

The remedy for both of the distortion effects is simply to bias the grid right and then limit the input voltage so that the grid neither goes too much negative nor too much positive. Or more accurately, so that the input voltage would not try to drive the grid too much positive.

Little trouble is ever experienced from a too negative grid. But not so for a positive grid. The applied grid bias may be adjusted just right for the tube and the plate voltage applied to the tube, but that is no assurance that the actual grid bias is that which is applied at the low end of the grid leak. In fact, the actual grid voltage is never the same as the applied grid bias. It always lies closer to zero. And the amount by which the actual grid potential differs from the applied grid bias depends on a multitude of things. And the performance of the tube depends on the actual grid potential.

It has been found that when the grid leak resistance is low the actual grid potential is more nearly equal to the grid bias applied, and for that reason low grid leak resistances have been recommended as a means of preventing "blocking." Under average conditions, if the resistance is .5 megohms the difference between the applied grid bias and the actual grid potential is so small that it is not noticeable in the operation of the tube, but it is quite noticeable on the plate current.

What Causes the Difference

In most cases of failure of resistance coupled amplifiers, which cannot be attributed to motorboating, the trouble is the difference between the actual grid potential and the applied grid bias. And that leads to the causes of this difference.

In Fig. 1 the circuit of the last two tubes in a resistance coupled amplifier has been sketched. It will be observed that the grid of the power tube is almost completely surrounded by positively charged conductors. It is separated from these positive conductors by insulators of various kinds. There is only one connection to a conductor which is at a negative potential, and that is the grid leak.

It will be recalled that no insulator is a complete insulator. Every insulating material has volume and surface conductivity. The volume conductivity of the materials used for insulators of condensers, grid leak mountings, tube sockets, tube bases and tube envelopes may possibly be neglected, for ordinarily very good insulating material is used for them. There may be exceptions, but most of these have now been weeded out.

Surface conductivity is much more serious, for it is more subject to temperature and moisture changes as well as to deposition of dust and metallic spray.

It is the conductivity of the insulators between the positively charged elements and the grid which causes the trouble. There is a leakage current through the bodies of and over the surfaces of these insulators which tends to nullify the leakage through the grid leak. This leakage tries to make the grid as positive as the most positively charged conductor around the grid from which there is any leakage. In Fig. 1 some of these leakage paths are shown in dotted lines. There is one from the plate of the power tube to the grid outside the tube and another inside it. There is one through the stopping condenser C, and there are others outside the condenser and through the resistor mountings.

Most of the leakage from the plate to the grid of the power tube is undoubtedly in the socket and the base of the tube. But the leakage through the metallic spray deposited inside the tube cannot be overlooked. It is well known how a clear-glass electric lamp turns black with use, caused by a deposit of metal projected from the hot filament. A similar spray is projected from the filament of the vacuum tube and it is deposited inside the tube on all surfaces exposed to the filament light.

Outside the tube, whether it is on the socket or on the resistor and condenser supports, the leakage is mostly through deposits of carbon dust. This dust is a fairly good conductor. But moisture also plays an important role, since it will dissolve salts contained in some of the dust and produce a good conducting electrolyte.

Proof of Effect

The effect of the leakage can be proved very easily. Let a milliammeter of suitable range be put into the plate circuit of the power tube. Note its deflection when all the voltages are normally applied. Then remove resistor R1. This removes all the leakage from the top of R1 to the grid through the condenser C and through the resistor and condenser supports.

Again note the plate current. It will drop a little, showing that the grid battery is more effective, since it has less leakage to buck. No test can be applied by removing the positive voltage on the power tube, for then no current would flow at all. But if the potential of the grid could be measured with the high voltage on the plate removed it would be found to be considerably different. It would be equal to the grid voltage applied.

A static voltmeter with sufficiently high insulation could be devised for measuring this voltage, but it would not be simple. But removing R1 is sufficient proof.

As stated before, the difference between the grid potential with R1 in place and removed depends on the value of R2. The higher R2, the greater the difference. If no difference is shown the insulation is good or else all the leakage comes from the plate of the power tube.

Effect of Voltage Drop in R1

It is not the voltage applied to the low end of R1 that determines the leakage from the plate of the first tube shown and the grid of the second tube, but it is the effective voltage at the top, or the effective voltage on the plate. This is less than the applied voltage by the amount of drop in R1. The higher R1, the greater the drop. Hence one way of reducing the leakage is to make R1 large.

Series Filament Lure

Author Gives Advice on Sequence of Tubes and Tells of Easy Precautions to Take

By D. E. Replogle
Raytheon Engineering Staff

BECAUSE the usual battery tubes are a tried, tested and perfected product in the first place, and, in the second, because they are available in special types for meeting the specific requirements of radio reception and amplification, there are definite advantages in series-filament operation. In fact, the existing battery type receiver may be readily converted to full socket-power operation, eliminating A, B and C batteries, yet without sacrifice of the results possible only with general and special battery type tubes. It is for the purpose of aiding those interested in this simplest and most efficient form of full socket-power operation that the following notes are presented on series-filament wiring.

In sets utilizing five or more tubes, the general order of these tubes should be, starting from the negative end of the series: (1) detector, (2) second audio tube, (3) first audio tube, (4) radio-frequency tubes. The actual order of the radio-frequency tubes is not important. It is advisable, however, to employ the 200-A tube as the detector, because this tube requires a negative grid bias, allowing the grid return to be connected directly to the ground.

Most Plate Current Here

The second audio tube is placed next in series, because it represents the largest component of plate current, and placing it here requires that only the detector carry this additional load. It is obvious that with this scheme the detector filament also carries the load of the other plate current. In order to prevent overloading this tube, a variable resistor may be placed across it which will serve the double purpose of a by-pass for the excess current, and also of a volume control.

When this scheme is followed, however, the variable resistor should not be allowed to reach a value in the neighborhood of a zero resistance, i.e., short circuit, because if the detector tube is short-circuited, the load will be removed from the audio amplifier, causing howling; or again, if the resistor is not large enough, decreasing to low values of resistance will cause considerable current to flow through it with a possibility of overload.

The matter of obtaining the proper bias on all the tubes in the receiver may necessitate, where a gang control is used, bringing the ground end of the secondary coil directly back to the negative filament of the associated tube.

Zero Bias for RF

In the case of the RF this will mean a zero bias, and the arrangement may be made more flexible and any desired bias obtained by properly utilizing series resistors between tubes.

However, the radio frequency circuit must be completed by means of the sizeable by-pass of low power factor. The low power factor is required so that the additional resistance introduced into the tuning circuit is negligible. The condenser must be large enough in capacity so that no appreciable reactance drop occurs, and also so that the effect on the tuning may be minimized.

With the arrangement of the tubes as cited, it is usually possible to obtain biases for all of the tubes but the second audio. The bias for this tube is obtained from the power unit, and the advantage of this arrangement lies in the fact that a choice of the type of power tube is made available.

A volume control which will function quite satisfactorily is a variable resistor connected across either of the audio transformer secondaries, assuming a transformer-coupled audio system. This is usually conducive, with poor or mediocre transformers, to better quality and also reduces the tendency of the audio amplifier to howl. In this connection it may be found that with series-filament connections, audio howling may occur which was not present before re-wiring. Frequently, it is possible to remedy this by reversing one of the audio primaries.

Two For You

There are just two problems to bear in mind when undertaking series-filament wiring, namely; first, to make sure the proper voltages are applied to filament, plate and grid of each tube; secondly, to confine the radio-frequency currents to their proper circuits, by means of choke coils and by-pass condensers at the crucial points.

Series-filament wiring usually does not entail radical changes in the remainder of the circuit, the most usual and only one being that cited in the case where the gang condenser is employed.

When peculiar systems are encountered, however, it may be necessary to introduce additional equipment which must not be confused in its function; i.e., the circuit proper must not be changed by its addition, for every attempt is made to preserve the electrical identity of the arrangement. An example would be the so-called R. F. L. neutralizing system in which a voltage of the proper phase and magnitude is inserted in the grid return of the radio-frequency stages.

This would place one of the coils in the filament leg of the tube.

Isolation Necessary

With the series-filament operation, the various filament circuits must be isolated, and this is accomplished by the addition of chokes and by-passes. We may say generally in this connection that series-filament connections result in giving the filaments of all tubes a more or less common circuit in a far greater sense than the usual parallel connections. The problem in this regard, then, is to insert chokes and by-passes so that the radio frequency circuits of the various tubes are kept separate and distinct.

The data just given are for the —01A or other quarter ampere filament tubes. The power supply source is the Raytheon BA, with its 350 milliampere output at 200 volts, which is sufficient for filament, plate, power and grid biasing purposes. The power tube may be of the —71 type, with 180 volts on the plate and with the filament operated raw AC from a special filament winding on the transformer.

When filaments are connected in series it is assumed that all the tubes normally take the same filament current. But this does not prevent the use of a tube requiring a different filament current from being used in the series. For example, a screen grid tube can be connected into the series of —01A tubes by shunting the screen grid filament by a resistor of 25 ohms.

Pre-view and Review

"QST" FOR AUGUST

Many articles of interest to broadcast fans as well as amateur operators appear in the August number of "QST."

Ross A. Hull tells about "Overhauling the Transmitter for 1929" in an eleven-page illustrated article. This not only tells how to overhaul the receiver to fit it for 1929 transmitting conditions but it shows how, both with photographs and experimental curves.

In "Concerning Lunar Effects on Electromagnetic Waves" Greenleaf W. Pickard takes issue with the conclusions of C. E. Paulson in his article on the same subject. Mr. Pickard in a forceful argument shows that the effects Mr Paulson attributed to the moon are more logically attributable to the sun and to magnetic disturbances He combines the curve obtained by Mr. Paulson and curves obtained by observing sunspots, the diurnal variation in the earths horizontal magnetic field and radio reception, and points out that they all bear a strong resemblance, indicating that sunspots are the cause of the variation

Acoustic Wave Filters

R. B. Bourne contributes an intensely interesting and instructive article on "Acoustic Wave Filters and Audio Frequency Selectivity." He discusses the theory of the acoustic wave filters by comparing them with the electrical wave filters. He shows that the cut-off and attenuation formulas in both types are the same when the acoustic equivalent inductance and capacity are used for the electrical values. He also shows how to construct acoustic wave filters having definite frequency cut-offs. In an appendix he develops the formulas for the electrical filter and transforms them to fit the acoustic case.

In defining the acoustic inductance and capacity he uses the inch as the unit of length, which is all right. But the formulas also contain the density of air, and he does not state in what units this is measured. This omission really amounts to giving no definition at all. But Mr. Bourne points out that in the formulas the density cancels out, so the omission has no effect on the final form of the formulas.

The acoustical filter may be used to eliminate much of the noise in the output of a continuous wave telegraph receiver.

Common Sense Television

Herald P. Westman, Technical Editor, tells "Some More About Amateur Television," giving some really common sense instructions of how to make a successful scanning disc, and why.

"Filter Circuits" is the title of a mathematical article on filters by Clyde Farrar, Engineering Department, University of Idaho. Conditions governing the correct design of filters are given and the theory is supported by oscillograph curves. Those who are designing filters for B battery eliminators will find many useful points in this article.

An AC

Short Wa

By Roger

SHORT wave adapters for both DC and AC receivers have been described. When a DC adapter is described some fans want to know if it can also be used for an AC set. And when an AC adapter is described others want to know if it can also be used for DC sets.

The answer in both cases is no.

Easily One or Other

When an adapter is designed to work with a DC set it can be used for that only. Similarly when the adapter has been designed for AC it can be used for that only.

But that does not exclude the possibility of so designing an adapter that with a slight change it can be made one or the other. It can be done by the use of a Universal plug, and either of UX or UY in the adapter.

Not many would be interested in building such an adapter, for very few have both DC and AC sets. Practically all have one or the other. Hence it is not necessary to build an adapter that will work with either but simply to describe one which can be built for either, one which may be transformed from one to the other by a few simple changes.

Picture Wiring Diagram

A picture wiring diagram of such an adapter is shown in Fig. 1. The full lines in this diagram represent necessary connections for a DC adapter. For this circuit it is necessary to use a standard UX socket, one having four prong contacts.

When used for a DC set the five prong terminal plug is first inserted into a four prong receptacle shown at the left and then this four-prong base is inserted into the detector socket in the broadcast receiver. This four-prong adapter is so arranged that all necessary connections are made to the filament and plate connections in the detector socket, leaving the lead for the cathode C open, since this is not used in DC adaption.

When the adapter is to be used with an AC set a Y type socket is built into the adapter, one having five prongs. In wiring this the dotted lines are followed. There is really but one essential difference between the two, and that is the lead from the cord terminal C to the cathode C on the Y type socket. This lead is connected to the otherwise F minus filament line to established contact between the cathode and the low potential side

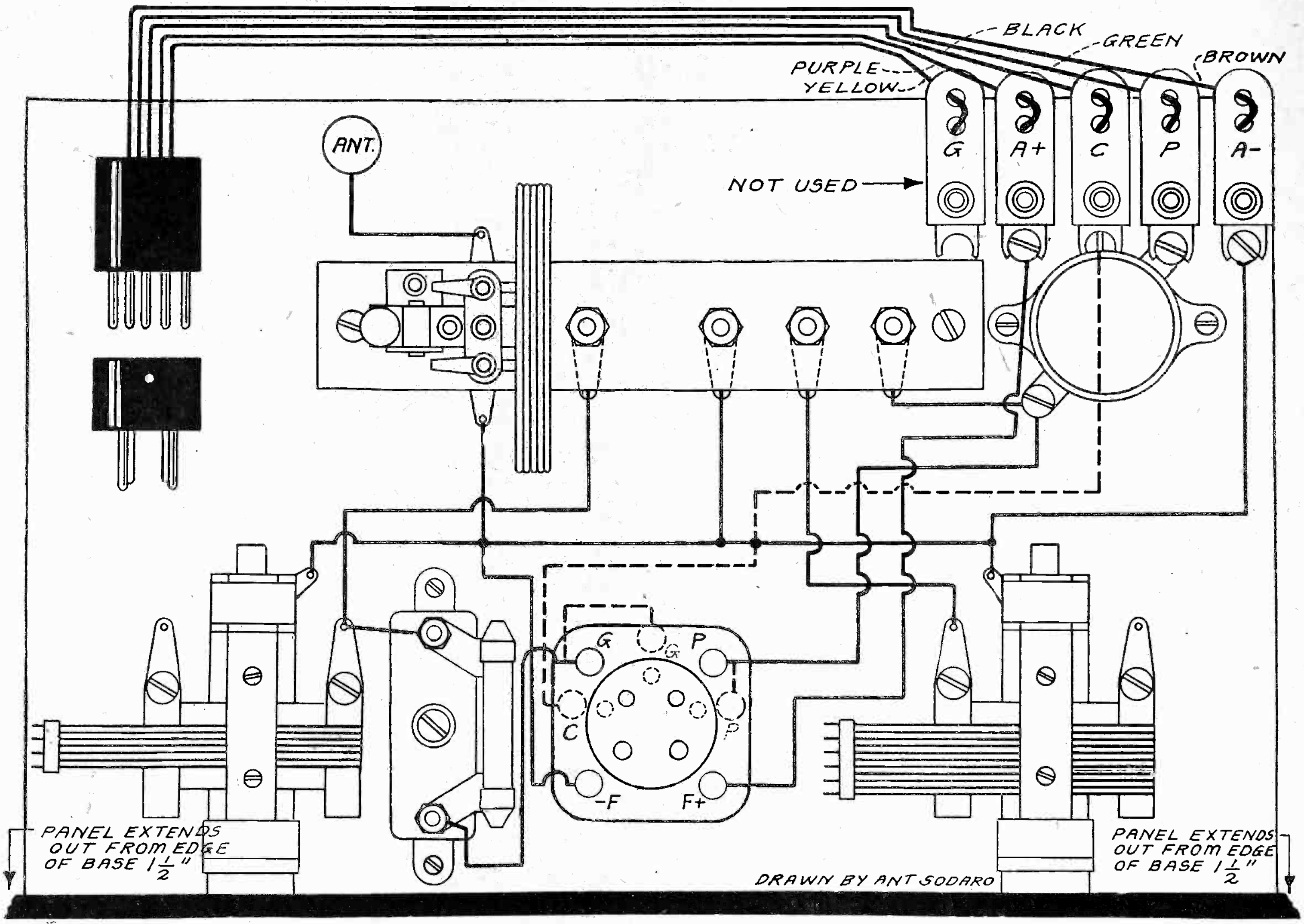


FIG. 1

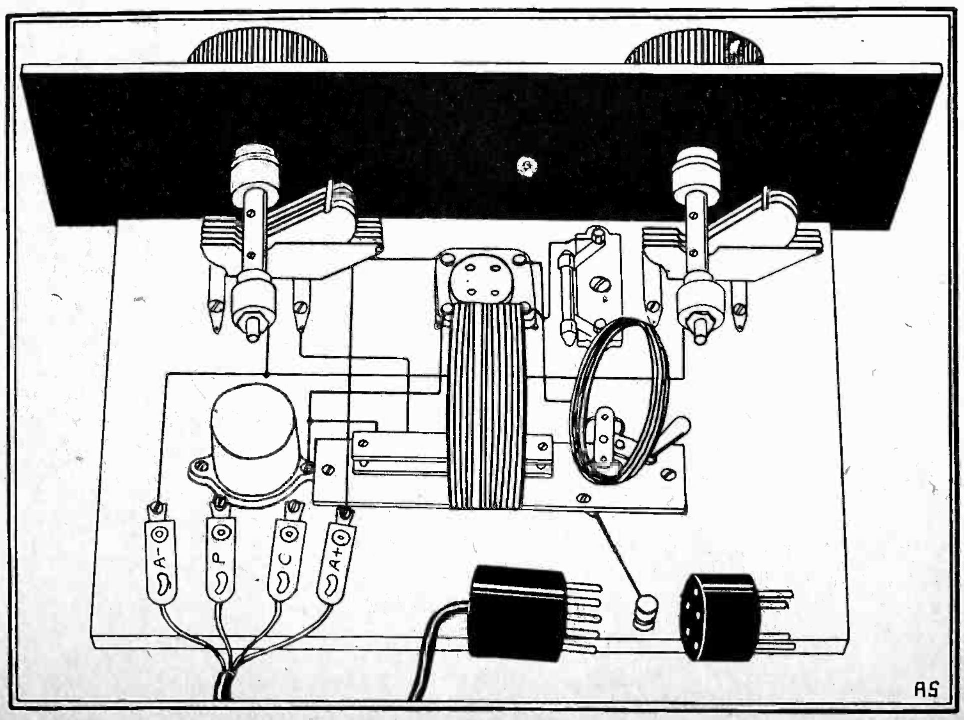


FIG. 2

or DC
ve Adapter

rooks English

of the tuning coil and the variable condensers.

This connection ties together the cathode and one side of the heater circuit. But this does not alter the operation of the adapter so long as there is only one contact. Often this connection is made thus in sets built for AC alone.

When the adapter is to be used with an AC receiver the five-prong plug alone is used. It is plugged into the detector socket of the broadcast receiver and all necessary connections are made automatically. Either there is no connection between the cathode and the heater circuit in the AC broadcast receiver, or if there is one, it is necessary to make sure that it is on the same side of the heater circuit as in the adapter.

Testing the Circuit

It is well to make sure that there is no connection between the cathode and the heater circuit in the receiver before the adapter is plugged in. This may be done with a battery and either a headset or a voltmeter. Connect the meter or headset in series with a 1½-volt cell and then connect the free terminal of the battery to the cathode in the receiver and the free terminal of the meter or headset to the heater. If there is a pronounced click in the headset or a deflection of the meter, there is a connection, and it is not necessary to make any connection between the cathode and the filament circuit in the adapter.

If there is no indication of a connection between the heater and the cathode in the receiver, then make the connection of the dotted line from cable lead C to socket post C in the adapter to the heater as shown in Fig. 1.

Fig. 2 shows a perspective of the adapter as seen from the rear. It is wired for DC and hence it contains an X type socket. The lead from the cathode terminal C is omitted.

Since Fig. 1 is pictorial, the layout of the adapter may be obtained from that. The layout of the panel is shown in Fig. 3. All necessary dimensions are given in this figure for the correct drilling of the panel. The subpanel, for a 7 x 14 inch front panel, is 7 x 11 or 12 inches.

The tuning condenser, which has a maximum capacity of .00014 mfd., is shown at the left in Fig. 1. The regeneration control condenser is at right. This has a maximum capacity of .00025 mfd. Between the socket and the tuning condenser is the grid condenser and grid leak. A variable pressure type of condenser is shown in the grid circuit. It is .0001 to .0005 mfd. Use the loudest adjustment.

Value of Leak

The grid leak across it should have a value of about 2 megohms, but other values should be tried, depending on the value of the condenser. For high sensitivity a high resistance should be tried, depending on the value of the condenser. For high sensitivity a high resistance should be used, say up to 10 megohms. But if the circuit blocks, due to a too strong signal, leaks as low as .5 meg. should be tried.

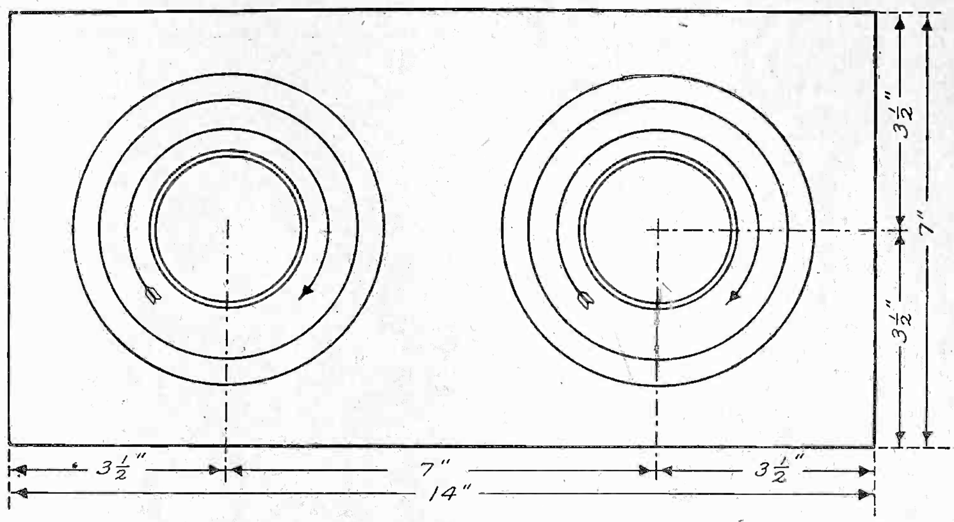


FIG. 3

Plug-in Coils Used

A set of three plug-in coils, the receptacle for which is shown back of the socket and variable condensers, is used in the adapter. These coils cover the short wave range from about 16 to 107 ranges to prevent blanks. A coil which will extend the range up to the broadcast band may be wound or bought in tubing form and mounted by the builder.

At the right end of the coil receptable is an 85 millihenry RF choke coil which aids in the regeneration and prevents high frequency curents from straying into the receiver.

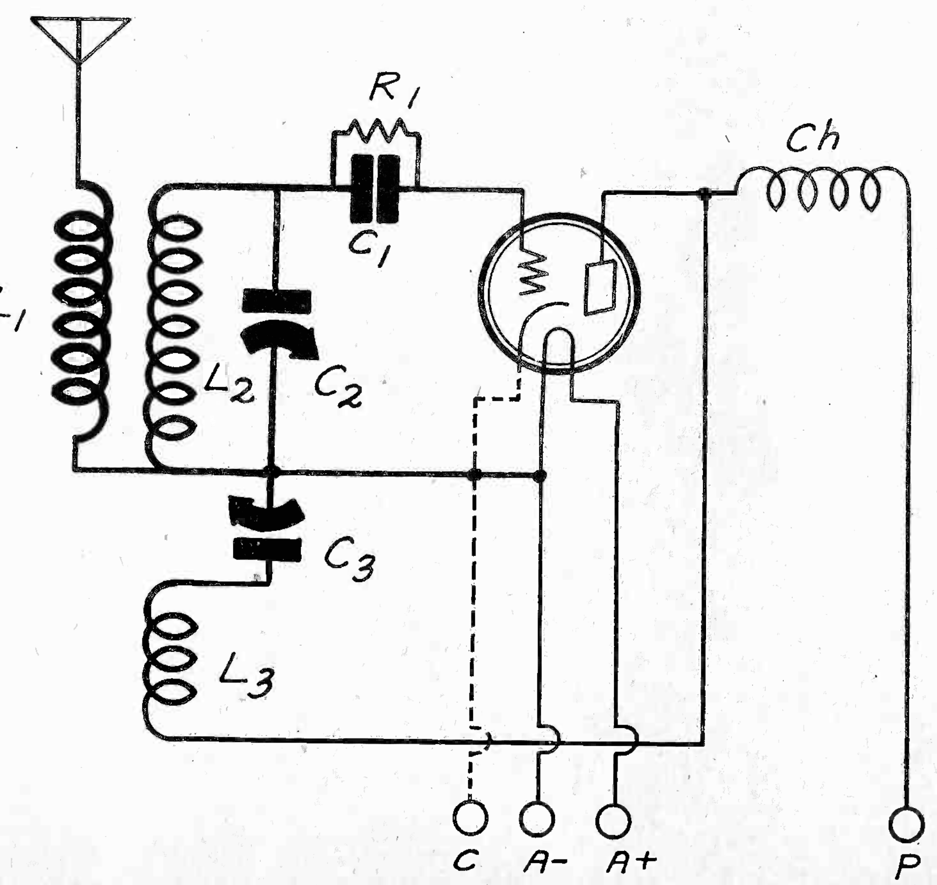


FIG. 4

THE CIRCUIT DIAGRAM OF A SHORT WAVE ADAPTER WHICH MAY BE USED FOR EITHER AC OR DC SETS. FOR DC OMIT THE DOTTED LINE TO C AND THE CATHODE.

List of Parts

One Hammarlund plug-in coil receptacle with antenna coil.

One set of three Hammarlund short wave plug-in coils.

One Hammarlund 85 millihenry RF choke coil.

One Hammarlund .00014 tuning condenser.

One Hammarlund .00025 mfd. variable condenser.

One X-L vario-denser with grid leak clips, capacity .0001 to .0005 mfd.

One Lynch metallized 2 megohm grid leak.

One Silver-Marshall X type or Y type socket.

One Universal cord and plug (No. 21 AC for AC sets, Nos. 21 AC and 21 DC for C sets).

Two Karas Micrometric dials.

One 7 x 14-inch front panel.

One 7 x 11-inch baseboard.

One Eby binding post.

AF Constants Balanced by Tested Ratios

The two audio stages of the S-M 720 consist of the new Clough transformers, T1 and T2 in the circuit diagram. These are really auto-transformers, the entire winding constituting the secondary and the plate-to-battery part of the winding comprising the primary. A detailed exposition of this system of audio coupling was published in the June 23rd issue of RADIO WORLD.

The Clough auto-transformers have resonating condensers and plate resistors all sealed in individual pots.

These transformers have an effective transformation ratio of about 4.3 for T1 and 3.5 for T2, and through a phenomenon of resonance obtained from proper proportioning of the auto-transformer windings, the condenser, and the resistance, together with the plate resistance of the tubes used, a rising low-frequency characteristic is obtained which provides a hump in the amplification curve just below 100 cycles.

The desirability of this curve cannot be over-emphasized, for it is in the range of this hump that broadcast transmission begins to fall off seriously and where average loudspeakers are most deficient in response.

In addition to this rising low note characteristic, hysteresis distortion, due to the direct plate current of tubes flowing through transformer primaries, has been practically eliminated by isolating the direct current from the transformer windings and causing it to flow through the plate resistances, 1-2. This filtering feature gives a distinctness and brilliancy to the individual notes of a musical program.

For the benefit of the dyed-in-the-wool fan who may think to improve ordinary transformers by either choke or resistance parallel-feed, let it be stated that this cannot be done by rule-of-thumb methods. The Clough system has to be carefully proportioned experimentally to attain the results described.

Station After

When the S-M 720 Scr

By M

Head of

[A brilliant instalment of the author's article on the new Screen Grid Six was published last week, issue of August 18th. This week the final instalment is printed. In next week's issue, dated September 1st, and in the following issue, September 8th, operating and other new details will be printed.]

* * *

THE custom set builder and the home constructor are discriminating and exacting, because they are well trained in the observation of broadcast receiver performance, and quickly look for sensitivity and tone quality.

To meet the requirements of such as these the Screen Grid Six was designed, and it is destined to win the exultant approval of the most discriminating. With its record of from 40 to 100 stations in an average evening's tuning—stations brought in at Chicago from Canada, Mexico, East Coast and West Coast—it beckons to every real devotee of ultra-sensitivity. Combined is a high degree of selectivity (from 10 to 15 kc separation) and a splendid audio channel, utilizing the new Clough audio transformer system.

Six tubes, each one in a superbly-performing circuit! Three stages of screen grid radio frequency amplification! Ease of operation! Fine appearance! Splendid tone! These are indeed achieved.

It is difficult to describe the receiver without straining the reader's credulity, but the performance has been abundantly proven, as set forth in the August 18th issue of RADIO WORLD.

Easily Outclasses in Tests

A model of the Screen Grid Six-exactly the same, part for part, as described last week, and made up from the official kit —far outclassed a factory-made, six-tube, two-dial AC receiver that cost twice as much. On the Screen Grid Six, with no more effort than to move the dials about one degree at a time, stations only 10 k.c. apart were tuned in and out. Stations in New York, Los Angeles, Eastern and Western Canada and at intermediate points, were received with the volume of local stations.

Still another model, loaned to the proud owner of a ten-tube Super-Heterodyne brought in more stations, with greater volume, better selectivity, and finer tone, than did the Super, much to its owner's amazement!

One Station After Another

Other tests, in steel frame buildings and elsewhere, proved conclusively that the Screen Grid Six would outperform for sensitivity, selectivity, ease of operation and tone quality, every set against which it was tested, among them being a popular seven-tube screen grid Super, an eight-tube Super and a variety of ready-made and kit-set and seven-tube receivers ranging in price from $69 to more than $200, both AC and DC models, with and without complete shielding.

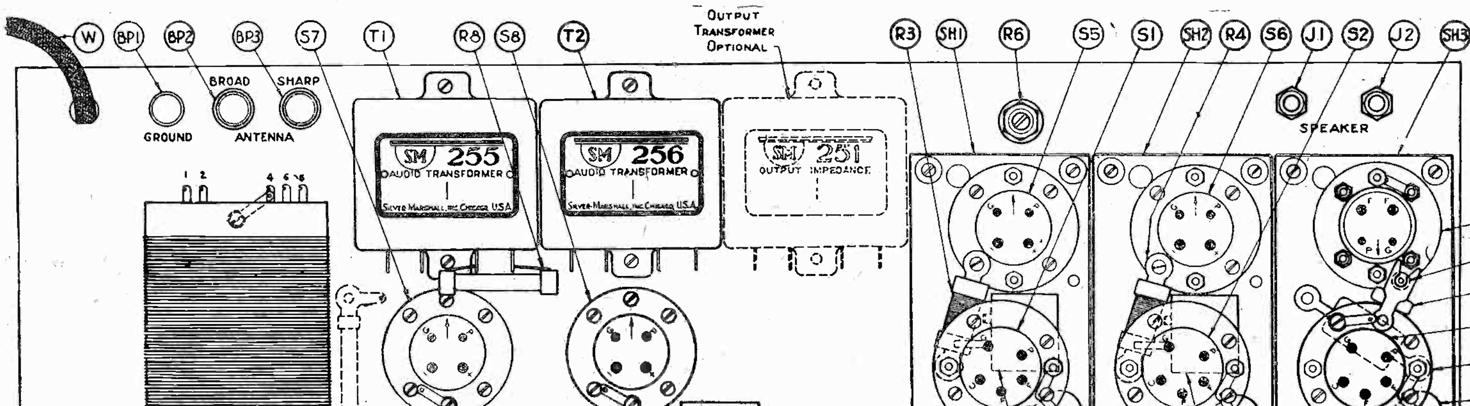


FIG. 6

THE LAYOUT OF PARTS ON THE CHASSIS, SHOWN WITHOUT WIRING, BUT WITH PARTS DESIGNATED ACCORDING TO THE SAME CODE USED THROUGHOUT THE ARTICLE

One of the most gratifying circumstances, aside from the ease with which the Screen Grid Six outperformed other sets, was the enthusiastic report, received from all who tested it, that station after station, distant and local alike, "popped" in and out as the two dials were tuned

Station Pops In
Grid Six Is Operated

rdo Silver

arshall, Inc.

together and gave one and all the biggest thrill they had ever had in operating a radio set. Although all had heard of sets the dials of which were "alive" with stations, the Screen Grid Six was the first practical receiver to bring in a station for almost every dial degree—sometimes more than one per degree!

The schematic diagram and photographs published last week, and the pictorial diagram and additional photograph published this week, clearly disclose the construction. However, as many prefer to work from blueprints, these are available at very small cost.

A full understanding of the individual parts employed in the receiver and their uses can be gained from study and comparison of photographs, drawings, and parts list.

Mechanically, the receiver consists of a pierced metal chassis 21½" long, 10" wide and ⅝" deep. On top of the chassis are fastened, at the left end, the antenna coil, L1, the antenna tuning condenser, C1, as well as antenna and ground binding posts BP1, BP2, BP3, and the hole for the battery cable W.

To the center rear of the chassis is the audio amplifier consisting of the two transformers T1, T2, and two tubes S7, S8, with space left either for two large type transformers, or an output transformer in addition to the small, compact types specified.

To the right front is the three gang die-cast condenser C2, C3, C4, tuning the three shielded R. F. circuits housed in the copper shields SH1, SH2 SH3, just behind this condenser.

Parts Locations

The two condenser assemblies are tuned by the drum dials D1, D2, visible through the windows of the front control escutcheon, E.

Below the vernier knobs of the dials are, to the right, the volume control potentiometer, R1, to which is attached the on-off switch, SW, and to the left is the selectivity condenser, C5, in series with the antenna. The positions and uses of the various bypass condensers and resistors are evident from a study of the circuit drawing.

* * *

[Full-sized blueprints, showing the wiring of this receiver in picture diagram form, blueprint schematic diagram and an eight-page building instruction sheet are available.]

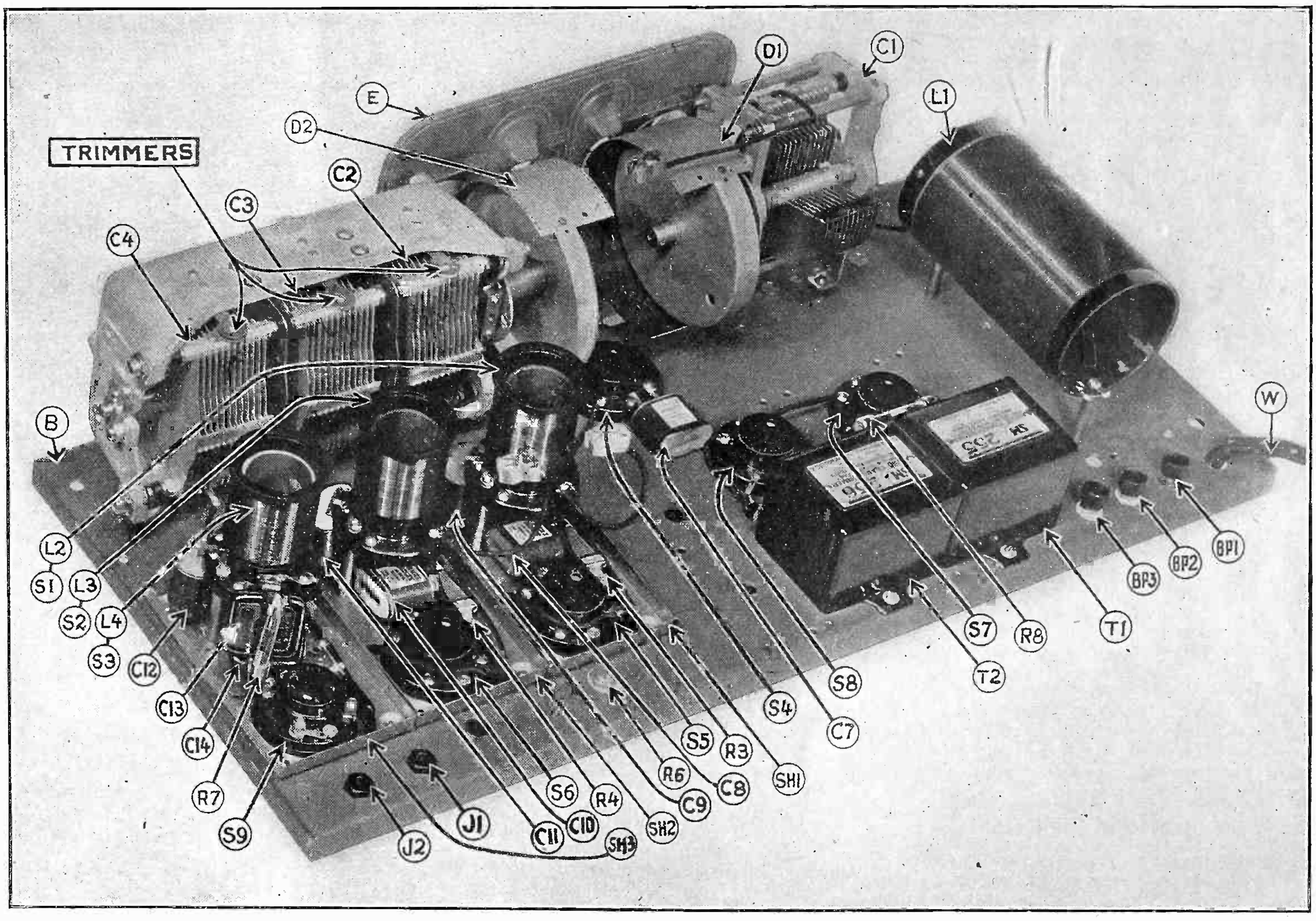


FIG. 6

DETAILED ASSEMBLY VIEW, OF THE S-M SCREEN GRID SIX (NO. 720), WITH THE PARTS CODED BY LETTER AND NUMBER TO CORRESPOND WITH THE DESIGNATIONS IN THE LAYOUT DIAGRAM PUBLISHED ON THE OPPOSITE PAGE. THE SAME SYSTEM OF IDENTIFICATION IS USED IN THE LIST OF PARTS. THIS ILLUSTRATION GIVES PRACTICALLY ALL THE DETAILS FOR MOUNTING OF PARTS.

Tubes to Use And Currents They Require

The SM-720 requires for operation three UX222 tubes, one UX201A (or preferably UX112A) detector tube, one UX201A (or preferably UX112A) first AF amplifier tube, and any power autput tube, such as UX112A, UX171A, UX210 or UX250, provided suitable A and B supply is available.

In the circuit shown, a UX112A or UX-171A output tube may be used at will, though with the UX171A the addition of an output transformer is desirable to protect speaker windings.

If a 210 or 250 tube is to be employed, it is best to light it from the B power supply transformer, which will have such a filament lighting winding (7½ volts).

Proper connections for UX210 or UX250 tubes can be accomplished through an adapter, with no change in receiver wiring, or by bringing out separate filament leads from the socket, S8, to be connected to the filament lighting winding, across which should be connected a center-tapped balancing resistor.

Between the center tap of this resistor and the B minus binding post, a 1500-ohm C bias resistor, shunted by a 1 mfd. condenser, should be connected. The voltage drop across this resistor from the B supply provides C bias for the power tube.

The plate current consumption is about 20 m. a. with 112A output tube, or 30 m. a. with 171A output tube.

How Much Modulation?

Many Who Suggest Increase as Means of Improving Transmission Don't Know What They're Talking About, and Here Are the Reasons Why

By Capt. Peter V. O'Rourke
Contributing Editor

MUCH criticism has been directed at the present broadcasting structure on the ground that the carrier waves have not been modulated sufficiently. Naturally this criticism has come from persons not familiar with broadcasting requirements.

These critics have pointed out that the carrier wave travels much farther than the modulation and that the carrier is capable of causing interference thousands of miles away from a transmitting station when the signals can only be heard satisfactorily a few hundred miles away. These critics would have hundred percent modulation.

From many points of view this would be exceedingly desirable. But unfortunately there are technical factors involved which limit the degree of modulation that is permissible. One of these is the fact that sound intensities vary, sometimes as much as 100,000 to 1. Another is that as the degree of modulation increases the distortion introduced by the detector in the receiver increases rapidly.

Range of Sound Restricted

Suppose that the modulation when the sound intensity is unity is one percent. The modulation would then be 100 percent when the sound intensity was 100 units. When the sound intensity was 100,000 units the carrier wave would be 1,000 times overmodulated. Terrific distortion would result.

Now suppose that the modulation was 100 percent when the sound intensity was 100,000 units. Then the degree of modulation when the sound intensity was unity would be .001 of one percent. The quality of the stronger sound would perhaps be tolerable, but that is doubtful. The quality of the weaker sound would be excellent, but that quality would be of no avail for nobody would hear it in the receiver. It would be too weak.

Now as a matter of fact the sound intensity at the modulator does not vary as much as 100,000 to 1. It is never permitted to vary more than 1,000 to 1. Thus the natural relative intensities occurring in orchestral music, for example, are never heard in a radio receiver. The control man at the mixing panel sees to that. He only permits a variation of 1,000 to 1. If he allowed the full variation every listener would at once say that the modulation of the station was terrible. And it would be.

Listener Not Cheated

But the listener does not need to feel that he is being cheated just because he cannot hear the full intensity range of orchestral music. The illusion of reality is not defeated by the 100 to 1 contraction of the intensity, because even if the listener were in the presence of the orchestra he would not hear the entire intensity range. His ears would accommodate themselves to the intensities automatically, increasing their sensitivity on the weak sounds and decreasing it on the intense sounds.

If this accommodation could be effected automatically in the transmitter the control man would not have much to do. But the microphone is not subject to fatigue to the extent that the ear muscles and the auditory nerves are.

The ear accommodates itself to different sound intensities in somewhat the same way that the eye accommodates itself to different light intensities. It is true both organs show a lag in the accommodation, and during the transition period from weak to strong intensities there is a feeling of discomfort and pain. The man at the mixing panels saves the listeners much of this by limiting the sound intensities so that they are bearable.

Thousand to One Range

Even with the 1,000-to-1 range in the transmission leaves a wide range of degrees of modulation. Suppose the modulation is 100 percent when the sound intensity is 1,000 units. Then it is only .1 percent when the sound intensity is unity. The louder sound should be heard as well 1,000 miles away from the transmitter as the weaker at one mile, assuming the same adjustment of the receivers. Or in front of the same loudspeaker the louder sound should be heard 32 times as far as the weaker sound.

The other factor which limits the degree of modulation permissible is the introduction of harmonics in the detector. This increases with the degree of modulation. Suppose the amplitude of the carrier is A and the amplitude of the modulating wave is B, then the ratio of the second harmonic to the fundamental is B/4A. Thus if the modulation is 100 per cent, that is A equals B, the harmonic is ¼ as strong as the fundamental. If it is .1 as strong the distortion is quite noticeable. When the modulation is only .1 percent the strength of the second harmonic is only .025 as strong as the first harmonic or fundamental. This distortion is entirely negligible. Thus both good and bad quality must be expected in the band. It is necessary to look to the short waves for television channels.

Already several bands have been assigned for television purposes and they are being allocated to television experimenters in 100 kc. channels.

The General Electric Co. is sending out television signals over 2XAF, 9,550 kc or 31.4 meters, as well as over WGY, 790 kc. the regular broadcast channel.

When using the Hammarlund short wave adapter for receiving the short wave television signals from 2XAF the 40-meter or medium coils should be used. The signals will come in near the lower end of the dial. In some cases it may be necessary to employ the 20-meter, the smallest coil and set the tuning condenser near maximum. But normally the signals come in the range of the 40-meter coil.

The transmission takes place on Tuesday, Thursday and Friday from 1:30 to 2 p. m. E. D. S. T. and on Sunday from 10:15 to 10:30 p. m. E. D. S. T., simultaneously from 2XAF and WGY. The scanning speed is 20 per second and the number of holes in the scanning disc is 24.

See the constructional article on pages 10 and 11.

Television In Range of SW Adapter

One of the limiting factors in television is the lack of channel width. To have a clear and sharp image of about 1½x1½ inches it is necessary to have a channel width of about 100 kc. The maximum width permitted in broadcasting is only 10 kc. This is one reason why pictures now being received are blurred.

Since the broadcast band is already overcrowded by music and speech transmission, there is little hope that any television channel will be assigned in that same receiver depending on the relative loudness of the sound received.

It has been the practice recently to make the average modulation 40 percent without overmodulating on the loud passages. When the modulation is 40 percent the second harmonic in the detected signal is .1 as strong as the fundamental. But the trend seems to be to decrease the modulation in the interest of quality. Thus it has been reported that one high power station is being rebuilt in which the modulation is to be only 8 percent. That means that the second harmonic will be only .02 as strong as the fundamental.

Lower percentage of modulation means that more power must be put into the carrier wave in order that the same sound intensity may be received That can be done without any harmful effects if the station operates on a cleared channel.

KFI Uses a Crystal; Modulates Only 8%?

Los Angeles.

To keep the station on the air as much as possible, the staff of KFI did most of the actual installation during the night after the station had signed off. Each night they tore out a little of the old equipment, add some of the new, then put the old back again so that the station would resume its programs at eight o'clock the following morning.

The station in a publicity release said: "According to Walter Tierney, of the Bell Laboratories in charge of installation, the new crystal control unit with its eight per cent modulation, more than doubles the strength of KFI without increasing the power of the station. Radio fans are asked to wire or write any noticeable change in KFI's reception."

X-L IN NEW QUARTERS

X-L Radio Laboratories, makers of Variodensers and X-L Push Posts, are in new quarters at 1224 Belmont Avenue, Chicago, where larger floor space and increased equipment permit both greater and more economical production. The former quarters were at 2424 Lincoln Avenue.

Separate Supply for C Bias Built for the Receiver

No provision was made for any grid bias on two of the tubes in the resistance coupled amplifier shown in Fig. 1, last week's issue. An adjustable voltage is desirable for both of these tubes. The bias on the power tubes adjustable between 60 and 90 volts. The bias on the tube preceding it should be adjustable between zero and 6 volts.

This bias may be supplied by either a battery or a C battery eliminator. A battery may be the better electrically but it is not so convenient. The voltage is not easily adjustable unless a battery of cells is used having a tap for every cell. And then the voltage may be varied in steps not less than 1½ volts.

It may seem extravagant to use a C battery eliminator just to supply voltage without current. But it is just this fact, that voltage alone is required, that makes a C battery practical. It takes up only a fraction of the room that a large C battery would, its voltage is adjustable without jumps, it does not run down, it avoids the electrical complications of a resistance drop in the plate voltage supply circuit, and it is more economical to operate than either a battery or a resistance drop. It gives a steady hum-free bias of any desired magnitude.

Design of C Battery Eliminator

The design of a simple C battery eliminator is shown in Fig 4. For rectifier tube a —99 is used. Its plate and grid are connected together to form the plate of the rectifier. The filament is connected across the filament battery in the receiver. A suitable amperite or a 50 ohm resistance R2 is connected in the positive leg of the filament, not in the negative as is usually done.

The input transformer T1 may be a 1-to-1 audio frequency transformer. One of the old-time push-pull output transformers may be used provided that only half of the primary is employed on one side. Almost any audio transformer of low ratio may be used, but if the ratio is high it is necessary to cut down the input voltage by using a high resistance for R1.

This variable resistor should be used in any instance for it is one of the output voltage adjustors. It controls the total output voltage. It may have a maximum value of about 10,000 ohms when a 1-to-1 transformer is used and 25,000 ohms when a 1-to-2 step-up transformer is used.

The choke coil L1 may be the secondary of almost any audio frequency transformer, or the secondary and the primary connected in series aiding. Extremely little current will pass through this choke, so that there is no saturation effect and the inductance will be high.

Low Capacity Condensers

As a very low direct current will flow in the choke coil comparatively small by-pass condensers may be used and still have satisfactory filtering. In fact C1 need not be larger than ½ mfd. and C2 need not exceed 2 mfd. Condensers of 200 volt test will be all right for the voltage will not exceed about 100 volts.

R3 is a 500,000-ohm potentiometer. It serves a voltage divider. The voltage across the entire resistance is adjusted by means of R1 until it suits the power tube. It should be about 84 volts. It cannot be measured by any other voltmeter than a vacuum tube meter, and the power tube itself can be used for that purpose.—G. M.

Indian's Set MARKED BY STABILITY

By Gerald Mohawk

Native American Indian

[Part I of this article was published last week, issue of August 18th, wherein the author recommended the use of two B eliminators, to prevent motorboating, and the inclusion of a C eliminator. Part II, the conclusion, follows.]

THE three circuit tuner should be wound for a .0005 mfd. and C4 should have this capacity value.

The regeneration depends largely on the size of by-pass condenser C6. The larger this is the more readily does the tube oscillate. But this condenser should not be larger than .0005 mfd. for a larger value will noticeably cut down the higher audio notes.

The radio frequency current in the plate circuit of the detector is segregated from the audio frequency current by the low-pass filter composed of C6, C7 and choke coil Ch3. The choke may be an 85 millihenry radio frequency coil and C7 may be a fixed condenser of .00025 mfd.

The filament current in the detector tube is limited to .25 ampere by means of an amperite R3.

The detector operates with grid condenser C5 and grid leak P2. No variable grid leak is required. A fixed metallized leak of 2 megohms works satisfactorily. The condenser C2 should be of .00025 mfd.

The detector tube may be a —01A, a —12A or a —40 high mu tube. The high mu tube is the most sensitive as a detector when the load on the circuit is a high resistance, as in this case.

Audio Amplifier Design

We are now up to the audio frequency amplifier. The object of this part of the receiver is to amplify, without any frequency discrimination, the small audio voltages delivered to it by the detector, to a level which is sufficient to operate a power tube and a good loudspeaker. And it is to operate without trouble from noises, fluttering, motorboating and blocking.

Whether or not it does what it is expected to do depends on the design and on the choice of values.

It can be proved that if the amplification per stage is to be high and without wave form distortion the resistance load on any tube should be high. Ordinarily values of the order of 100,000 ohms are recommended for the plate resistors. But they are not high enough.

Load Defined

By increasing the values of the coupling resistors the amplification increases considerably and at the same time wave form distortion decreases. But if they are made too high a certain amount of frequency distortion enters. The high audio notes are suppressed. Hence good design demands that a compromise be effected.

The load on the tube is the effective resistance formed by the combination of the plate resistor in parallel with the grid leak, except for the very lowest frequencies. The lower the frequency, the less effect does the grid leak have on the load and for direct current or zero frequency the load is the resistance of the plate resistor alone. But for all practical frequencies the parallel combination must be considered.

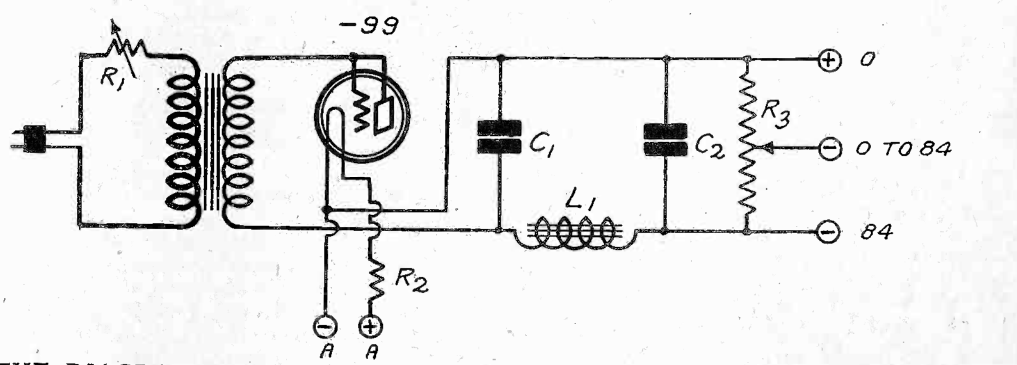
Now if the resistance of the plate resistor is 500,000 ohms and the grid leak is 2 megohms the effective load is 400,000 ohms. If the mu of the tube is 30 and the internal plate resistance is 150,000 ohms, as for a high mu tube of the —40 type, the amplification is about 22. For very low audio frequencies it drops a little and also for the highest audio frequencies. But over the essential range of audio frequencies it is constant. Thus a plate resistor of 500,000 ohms is suitable, although a 250,000 ohm resistor may be used for slightly lower volume and a little better frequency characteristic.

Effect of Grid Condenser and Leak

The magnitudes of the grid condensers and the grid leaks have a great influence on the faithfulness of the amplification, especially on the lower frequencies. The larger the stopping condensers are, the better will the low notes be amplified. Also the higher the resistance of the grid leaks, the better is the low note characteristic. Hence to get a good low note response large capacity condensers and high values of grid resistors must be used.

But there are practical limitations. Condensers with paper dielectric seem to be wholly unsuitable because of the leakage through them. If such condensers are used, low values of leaks must be used to prevent the grids from going positive. When that occurs the amplification becomes very uncertain and blocking is likely to occur. And there is no good reason why paper condensers should be used for they are bulky and more expensive than mica condensers, that is, they are more expensive than

(Continued on page 20)



THE DIAGRAM OF A SIMPLE C BATTERY ELIMINATOR WHICH WILL SUPPLY THE HIGH BIAS REQUIRED FOR A —50 TUBE. THIS MAY BE BUILT INTO THE RECEIVER.

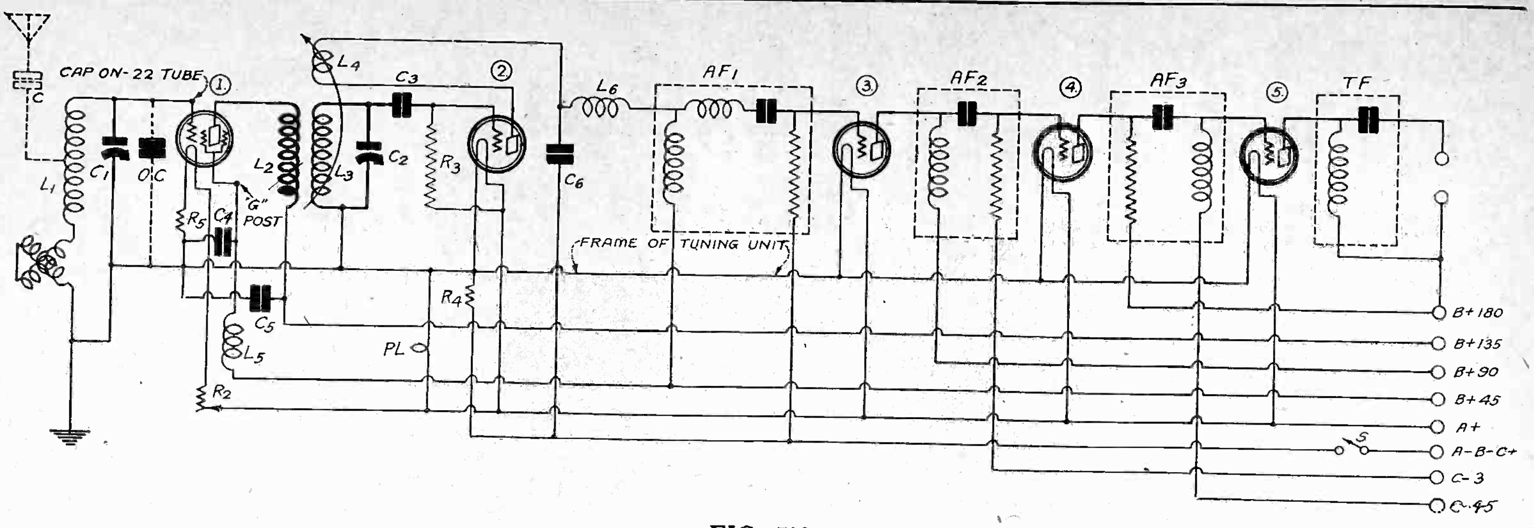


FIG. 709
THE CIRCUIT DIAGRAM OF THE NATIONAL SCREEN GRID FIVE RECEIVER, REQUESTED BY CHARLES OVERTON

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.

I WANT TO BUILD the National Screen Grid Five but have lost the circuit diagram. If possible will you kindly publish the circuit.

CHARLES OVERTON,
Cairo, Ill.

(1)—See Fig. 709 for a diagram of the National Screen Grid Five.

* * *

I HAVE a short wave receiver which is very critical to tune. Can you suggest a simple arrangement whereby I can change the tuning capacity by very small amounts?

PEDRO LOPEZ,
El Paso, Texas.

(1)—A very simple method of obtaining vernier control of the tuning is to connect a large variable condenser in series with the small tuning condenser, for example, a .0005 mfd. in series with a .00014 mfd. The total maximum capacity of this combination is approximately .00011 mfd. The vernier effect of the large condenser is greatest where it is most needed, that is when the smaller condenser is set near zero capacity. Suppose the smaller condenser is set so that its capacity is .00002 mfd. and the larger near its maximum. The change of one division of the larger condenser changes the capacity of the combination by 42 thousands of one micromicrofarad, or by 1/26 of one percent of the capacity in the circuit.

* * *

WHAT ADVANTAGE is there in using a variable grid leak in the detector?

(2)—Cannot fixed leaks be used with equal effectiveness?

(3)—I have been unable to get a satisfactory variable grid leak of the order of 10 megohms. Are any variable leaks satisfactory?

(4)—What is the best value of grid condenser?

(5)—Which is better, to connect the grid leak across the grid condenser or from the grid to the filament?

SAMUEL EDELSTEIN,
Bronx, New York.

(1)—When extremely weak stations are to be tuned in, the circuit may be brought to the highest detecting efficiency by adjusting the leak. Usually the higher the leak the more efficient is the detector on weak signals. This greater efficiency is partly due to the fact that the variable grid leak acts as a vernier control of the tuning.

(2)—A fixed leak cannot be used with equal efficiency unless the grid condenser is variable. Varying the value of the grid condenser produces about the same effect as varying the leak.

(3)—Yes.

(4)—There is no value of grid condenser which is the best under all conditions. For weak signals and for high frequencies a small condenser is better than a larger one. A condenser which is variable between .00025 and .00005 mfd. should prove satisfactory.

(5)—Usually it is better to connect the grid leak across the condenser.

* * *

I WISH to measure alternating currents of the order of 50 microamperes. How can this be done?

(2)—Are there any commercial meters which will measure currents of this magnitude? The most sensitive AC meters I have heard of do not measure currents lower than 100 milliamperes.

WILLIAM SWAN,
Council Bluffs, Ia.

(1)—It is difficult to measure alternating currents of such small magnitudes, but there are several methods capable of doing it. One is the Duddell thermo-galvanometer. This can be constructed to measure down to a few microamperes. Sensitive thermo-couples in conjunction with a microammeter or galvanometer can be used for measuring alternating currents of the order of 50 microamperes.

(2)—The Duddell thermo-galvanometer can be purchased. Look up the discussion on AC measurements in Circular 74, Bureau of Standards, which may be obtained by sending 60c to the Superintendent of Documents, Government Printing Office, Washington, D. C.

* * *

I HAVE NOTICED that manufacturers of photo-electric cells make both gaseous cells and high vacuum cells and that they claim the gaseous cells are super-sensitive. Why are those that contain gas more sensitive?

JAMES B. DAVIS,
Atlanta, Ga.

(1)—A cell containing a small amount of gas passes more current than a "hard" cell for a given applied voltage because the process of ionization by collision takes place in it. When an electron is released by light it gains speed. Finally it hits a gas molecule and knocks out one or more electrons. Then they all gain more speed in the same direction and finally each one strikes and produces more electrons. By this process for every electron that leaves the cathode 1,000 or more reach the anode. In a "hard" tube only the one that left the cathode would reach the anode. If there are too many collisions in the gas filled cell the gas begins to glow, just as a neon lamp strikes up a glow at a given voltage.

* * *

HOW COULD two broadcast stations be synchronized automatically? I have noticed that several methods have been proposed but all involve partial manual control.

BURTON E. SEMPLE
Kansas City, Mo.

The carrier wave of one station could be picked up by the other and amplified to such an amplitude that it could be used as carrier for the second station, just as now the frequency of a quartz crystal oscillator is now amplified and made to control a broadcast transmitter.

Wants Small Station in Each Town of 10,000

Washington

A comparatively large number of small broadcasting stations of 10 to 50 watts power represents "a very real need" and every community of 10,000 population and above should have "its voice" on the air for a time each day, Commissioner O. H. Caldwell, of the Federal Radio Commission, declared in a letter to William H. Ross, president of the Long Island City Chamber of Commerce, Long Island City, N. Y.

Replying to a telegram from Mr. Ross in support of the service rendered by small stations in Long Island towns, Commissioner Caldwell said that so far as radio requirements are concerned he believed that many hundreds of such little stations, sharing time, could be accommodated "so long as their powers and service ranges are restricted to the localities really interested in their outputs."

Full Text of Letter

The full text of the letter follows:

"My Dear Mr. Ross: In answer to your telegram in support of the service rendered by small local broadcasting stations in Long Island towns, I want to say that not only am I a hearty supporter of such small stations and the useful service which they can render, but I would like to add that from a radio standpoint I feel that there is plenty of room for a comparatively large number of such small local transmitters of 10 to 50 watts power, so that every community of 10,000 population and above can have its voice on the air for a time each day, without interfering with the important general service rendered by the larger stations.

"Indeed, to my mind, the usefulness of every home radio receiver will be expanded in a new dimension, if in addition to receiving the splendid general programs, which will always be the backbone of radio service to all listeners, there is also made available at one end of the dial, out of the way of present popular programs, a 'local band' where the listener can tune in in his town or county transmitter, and hear events and ceremonies of strictly local interest. Such features would be local basketball and baseball games, high-school events, town meetings and debates of local issues, and so on.

Would Have Local Interest

"Of course none of these events would have any interest more than a few miles away, and as program material they could hardly be accepted by the ordinary broadcaster. Yet, like the home-town weekly paper—or amateur theatricals among friends—they would have a local interest all their own, and any crudities of presentation or reproduction would be readily forgiven.

"Recently I spent some time in a town of 10,000 while local civic events of great community interest were taking place. "What an extension of the usefulness of my own radio receiver it would have been, had I been able to tune in on the 'village station' (10 watts would have been ample), and so obtained first-hand the hot debates in the several town meetings which were called to thrash out village problems. And during the same weeks, the village paper chronicled several other events, school exercises, lectures, and church affairs, which might similarly have been brought into the homes of the populace.

A Real Need

"From this experience, I feel that there is a very real need for this class of local broadcasting, providing it does not get in the way of the great program features which are now bringing entertainment, inspiration, and enlightenment to millions.

"So far as radio requirements are concerned, I believe that many hundreds of such little stations, sharing time, can be accommodated, so long as their powers and service ranges are restricted to the localities really interested in their output.

"In this respect, so deep-seated is my conviction regarding the usefulness of the small local station, that some weeks ago I put down as one of the four essentials in any reallocation plan promulgated by the Federal Radio Commission, the requirement that a large number of local stations of low power and restricted service range be provided for."

Set-Building Test to Be Held by Fair

A set-building contest will be conducted in connection with Radio World's Fair to be held in Madison Square Garden during the week Sept. 17th to 22nd inclusive. A silver cup emblematic of the championship will go to the winner. Eight cash prizes will also be awarded.

The judges of the sets will be Lloyd Hammarlund Jr., of Hammarlund Manufacturing Company, Inc., New York; Arthur Moss, treasurer of Electrad, Inc., New York; A. J. Carter, president of Carter Radio Corporation of Chicago; Leslie F. Muter, of Muter Company, Chicago, and H. B. Richmond, vice-president of General Radio Co., Cambridge, Mass.

There will be two divisions in the contest, one for boys and girls and one for adult contestants. There will be two subdivisions in each group, one for the best set of any number of tubes and another for the most novel good design.

There will be four cash prizes at $25 each and also four cash prizes of $15 each.

---

92 Stations Carried Speech by Hoover

The greatest chain of broadcasting stations ever tied together was used for broadcasting the acceptance speech of Herbert C. Hoover at Palo Alto, California, on Aug. 11. All the stations of the Red, Blue and Pacific Coast networks of the National Broadcasting Company and associated stations were tied together on one set of microphones, and the stations in the Columbia system were connected to another.

Besides the regular broadcast stations, the ceremonies were carried on the short wave of the Westinghouse Electric and Manufacturing Company, Pittsburgh, and on two of the short waves of the General Electric Co., Schenectady, N. Y. In all there were ninety-two stations radiating the speeches and incidental music of the ceremonies.

It is estimated that 60 million people listened in on the proceedings in this country alone, and in view of the fact that the waves carried far beyond the borders of this country many more listened in on the ceremonies. The three short wave stations carrying the speeches could be heard in distant countries.

Higher Power Urged As Rural Advantage

Washington.

The inhabitants of the small towns and cities in New England "do not know what good radio is," because of the inadequate local service, and because the larger stations do not have sufficient power to carry programs to them, Commissioner O. H. Caldwell, of the Federal Radio Commission said on his return to Washington from an inspection of the New England area.

"I am more convinced than ever that the way to solve the problem of rural listeners is more power to big stations rendering regular programs of high quality and more of the little local stations with small power operating intermittently and on shared channels," he declared.

"The way to reach the country as a whole is to assign more high power to the existing stations of public service and to have more high powered stations. These station should have 150 kilowatts of power or even 500 kilowatts, if need be. At the same time the little stations should be encouraged to serve their local communities, and should have low power and restricted service ranges."

Commissioner Caldwell said that he had visited small towns in Maine, Vermont, New Hampshire, and northern New York, and that "practically no radio reception" is being obtained because of the static and insufficiency of power to stations. He stated that he stopped at farm houses and listened in but was unable to get good reception. Inhabitants informed him, he said, that when WGY, of Schenectady last Summer broadcast experimentally with 100,000 watts of power (100 kilowatts) reception was fairly good.

Two Black Crows On Air Each Week

Moran and Mack, otherwise known as the "Two Black Crows," famous comedians, will be heard this winter in a series of broadcasts over the Columbia chain of stations. This feature began Sunday night, August 19th, and will continue once a week for several months. The comedians will be the featured artists in specially prepared productions of musical comedy proportions. The series of broadcasts featuring Moran and Mack will be sponsored by Grigsby-Grunow Company, manufacturers of Majestic receivers and B battery eliminators.

Broadcasting Hurts Czech Cafe Business

Washington

Radio broadcasting has caused a drop in the cafe business of Czechoslovakia but has not diminished the audiences at instructive lectures, the Department of Labor is advised by the International office at Geneva.

KSTP TRIES TELEVISION

KSTP, St. Paul, is equipped for television, and is preparing to present this feature as soon as it is developed to the point where reasonable reception can be assured.

LEKTOPHONE LICENSES JENSEN

Lektophone Corporation has licensed the Jensen Radio Manufacturing Company, Oakland, California, under the controlled edge patents.

TYRMAN DIES

Ernst Tyrman, designer of the Tyrman 70 and president of the Tyrman Electric Co., Chicago, died at the age of 34.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

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Time Constant Guides Low Note Response

(*Continued from page 15*)

the mica condensers which would be used in place of them.

Hence the choice of coupling condensers must fall on the largest available practically leakproof. Good mica condenser of .01 mfd. are everywhere available and they are suitable.

Small Condensers and High Resistance

Condensers of .01 mfd. are rather small when frequencies of the order of 30 cycles per second are to be amplified. But any tendency toward suppression of the low notes in the condensers can be offset by the use of high value resistors for grid leaks. The absence of leakage through the condensers permits high resistance leaks. As higher value grid leaks are less expensive than lower values there is a saving in cost both on the condensers and on the leaks, and without any loss in the low note effectiveness.

With stopping condensers of .01 mfd., grid leaks of 2 megohms, coupling resistors of 500,000 ohms and internal plate resistance of 150,000 ohms, the loss in amplification at 40 cycles per second per stage is only 1.32 percent., or about 2.3 percent. for the entire amplifier. This is entirely negligible.

There is other leakage than that through the stopping condenser which must be guarded against, and that is the leakage through the insulation of the grid, especially in the socket or through the insulation around the stopping condenser. Only the highest grade insulating material should be used. Many resistance coupled amplifiers have failed because the leakage from the plates to the grid exceeded that through the grid leak.

The product of the capacity of the stopping condenser and the resistance in series with it is called the "time constant" of the coupler. The resistance in series with the condenser is the sum of the grid leak resistance and the resistance formed by the parallel combination of plate coupling resistor and the internal plate resistance of the tube.

Thus if Ro is the internal plate resistance and R1 is the plate coupling resistance, the resistance of these two in parallel is RoR1/(Ro+R1). The value of this is added to the grid leak resistance and the sum is multiplied by the capacity in farads of the condenser to get the time constant. It is measured in seconds. A value of .02 seconds is suitable for a resistance coupled amplifier. The higher the time constant is, the better will the low notes be amplified.

It is not necessary to keep the time constants of all the couplers the same. Indeed, in some cases it may be advantageous to make them different. But it is necessary that the geometric mean of all of them be high, that is of the order of .02 seconds. The geometric mean of three is obtained by multiplying them together and extracting the cube root of the product. For example, if the three time constants are .01, .02 and .04 the geometric mean is the cube root of .01x.02x.04, or .02 seconds.

The time constant is a convenient guide in designing resistance coupled amplifiers, and for approximate work only the grid leak resistance need be considered when ordinary receiver tubes are used.

(*Concluded next week*)

Quick Action Classified Ads

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

No Alien Own

Con

Washington.

A question respecting the ownership of KMTR, Los Angeles, Calif., pending before the Federal Radio Commission for several weeks and involving the matter of illegal possession of the station by an alien, in violation of the provisions of the Radio Act, has been answered by the parties involved.

The original owner of the station, C. C. Julian, was a British subject and took up residence in Los Angeles from Canada, according to the Commission's files. Notified by the Commission that the law does not permit alien ownership of broadcasting stations, Mr. Julian declared he had sold his full interest in KMTR to Frank P. Doherty, his attorney, and thereby had complied with the Radio Act.

Questioned by Supervisor

A report subsequently received from Bernard H. Linden, supervisor of radio for the Pacific Coast district, based on an investigation, stated that it had not been proved to the satisfaction of the supervisor that the station was owned by Mr. Doherty, and suggested that the case "be placed in the hands of the Department of Justice or that the Federal Radio Commission should request Mr. Doherty, who is apparently in charge of all business transactions pertaining to the KMTR Radio Corporation, to make known the ownership of the station and show proof of such ownership."

Federal Radio Commissioner Lafount wrote to Mr. Doherty that there had been

KMTR, ...nission Is Told

submitted to the Commission "considerable data which appear to prove conclusively that your application for license to operate a broadcasting station was incorrect in that it did not state the facts as to ownership."

He requested a sworn statement as to the ownership of the station, which, he added, would be turned over to the Department of Justice to assist them in such investigation as they may deem necessary.

Division of Shares

Complying with this request, Mr. Doherty submitted an affidavit that the station was capitalized for $100,000, divided into 1,000 shares of stock, and that he owns 998 shares of the stock and that the remaining two shares are issued to two different individuals, neither of whom is Mr. Julian.

He stated that in February, 1928, he had entered into a written agreement with Frank P. Flint, former United States Senator from California, giving the Senator "the sole and exclusive option and right for a period of one year" in which to purchase all the stock of the station, that he was informed by Senator Flint that the option to purchase had been transferred to the "Los Angeles Evening Herald."

"I have no definite information concerning the interest of the Evening Herald in and to the option other than that given to me by Senator Flint," the affidavit said.

Commissioner Lafount said that the affidavit apparently ended the case in so far as the Commission is concerned, but the Department of Justice may determine to make a further investigation. The full Commission, he explained, has not yet had opportunity to consider Mr. Doherty's affidavit, but would probably consider the case closed.